EGUANA

Evolve ESS

Installation & Startup Manual

For use only with battery model

- LG Chem EM048126P3S7

DO 58160 Rev1

IMPORTANT SAFETY INSTRUCTIONS

SAVE THESE INSTRUCTIONS

This manual contains important instructions for the Eguana Evolve™ ESS – including the Power Control System (PCS) and base model battery cabinet installation and operation. The AC Battery is expandable with the addition of up to two more battery cabinets. Refer to the manual, "Eguana AC Battery Expansion Cabinet Installation Guide" for more details if your system contains additional battery capacity beyond the base model. The Eguana AC Battery™ components described by this manual are intended to be used as part of an Energy Storage system and installed per all local building codes and regulations in addition to the National Electrical Code, ANSI/NFPA 70 (for US) and Canadian Electrical Code (for Canada).

CAUTION: Hazardous Voltages! This inverter contains hazardous voltage and energy that may be lethal. It may only be installed by qualified personnel who have read this manual and are familiar with its operation and hazards. The following safety procedures should be followed:

Only connect the PCS cabinet to a compatible electrical service as defined in the model specifications. The PCS must be connected to a dedicated branch circuit in the main electrical panel.

An external disconnect switch shall be provided in the end installation by others for the AC Grid output circuit.

CAUTION! This equipment contains high energy lithium batteries. Qualified and trained personnel should wear protective clothing and equipment when working inside the battery cabinet and/or with battery modules.

The PCS is compatible with the LG Chem battery model EM048126P3S7 only.

CAUTION! The batteries provided with this system must be charged only by the PCS included as part of the energy storage system. Do not attempt to charge batteries with any other charger device or connect any devices directly to the DC battery bus.

Ensure proper electrical grounding in accordance with code requirements.

Ensure proper airflow path for active cooling.

Never operate system in a manner not described by this manual.

Only qualified personnel should service this product.

Ensure all covers are securely fastened after installation is complete.

This product must be stored indoors in an environmentally conditioned location prior to installation, protected from rain and exposure to any hazardous chemicals.

Do not attempt to operate this product if there is any physical evidence of damage to any of the cabinets or internal components.

CAUTION! This equipment is heavy. Mechanical lifts are recommended for safe installation.

Table of Contents

1 Safety

This manual contains important instructions for the Eguana Evolve ESS . The Eguana Evolve ESS components described by this manual are intended to be used as part of an energy storage system and installed per all local building codes and regulations in addition to the National Electrical Code, ANSI/NFPA 70 (for US) and Canadian Electrical Code (for Canada).

Throughout this manual, the following symbols will be used to highlight important information and procedures:

Symbol	Definition	Symbol	Definition
	***WARNING! A dangerous voltage or other condition exists. Use extreme caution when performing these tasks.***		Meter measurement required.
	***CAUTION!*** *This information is critical to the safe installation and or operation of the inverter. Follow these instructions closely.*		Torque rating critical to operation.
	***NOTE:*** *This statement is important. Follow instructions closely.*		Login to the remote monitoring system for operating status

1.1 In case of emergency

In all cases:

- If safe to do so, switch off the AC breakers (external to the system).
- Contact the fire department or other required emergency response team.
- Evacuate the area, and if applicable, follow your emergency evacuation plan if others are in proximity to the installed location.

In case of fire:

- When safe, use a fire extinguisher suitable for use; including A, B, and C dry chemical fire extinguishers or carbon dioxide extinguishers.

In case of flooding:

- Stay out of water if any part of the system or wiring is submerged.
- Do not attempt to operate batteries that have been submerged in water even after they have been dried.

In case of unusual noise, smell or smoke:

- If safe to do so, ventilate the area.

1.2 Battery module safety precautions

This product is integrated with LG Chem EM048126P3S7 series battery modules. Refer to the LG Chem product manual LG Chem P3S series 48V Standalone Battery Module Installation Manual, for complete safety instructions regarding handling of battery modules.

1.3 General safety precautions

Important! Installation, service, and operating personnel must read this document in its entirety, and observe all safety and installation procedures as described in this manual. Never operate system in a manner not described by this manual.

Only qualified personnel should service this product.

Ensure all covers are securely fastened after installation is complete.

Personal Protective Equipment (PPE) in compliance with local work place safety standards must be worn when working inside the cabinet.

Risks of Fire
Do not expose the system to temperatures exceeding 60 degrees Celsius.
Avoid installation in direct sunlight.
Do not store objects on top of the cabinet.
Do not obstruct the airflow paths of the cabinet air intake.
Do not obstruct the exhaust of cabinet exhaust.
Do not store combustible objects and corrosive chemicals directly adjacent to the system.
Risks of Shock
 **WARNING! Hazardous Voltages. The Inverter contains hazardous voltage and energy that may be lethal**. It may only be installed by qualified personnel who have read this manual and are familiar with its operation and hazards.
 Only connect the PCS cabinet to a compatible electrical service as defined in the model specifications. The PCS must be connected to a dedicated branch circuit in the main electrical panel.
Ensure proper electrical grounding in accordance with code requirements.
 **CAUTION! Both AC and DC voltage sources are terminated inside this equipment. Each circuit must be individually disconnected before servicing**
Risks of Damage
The PCS is compatible with the LG Chem battery model EM048126P3S7 only. Do not attempt to connect any other battery to the system.
Do not connect any other loads directly to the battery power bus.
Do not drop, tip, or puncture the cabinet during transport and installation. Visible damage to the cabinet and/or internal components should be reported to the manufacturer immediately.
Do not store this system for periods longer than six months without a battery maintenance charge. This may result in permanent damage to the batteries.

1.4 Disposal and Recycling

Do not dispose of the system or any of the components within the cabinet. Batteries, electronics, cables, and metal parts are recyclable. Consult your municipal waste management authority to determine required methods of component recycling.

2 Introduction

Throughout this manual, the following symbols will be used to highlight important information and procedures:

Symbol	Definition	Symbol	Definition
	***WARNING! A dangerous voltage or other condition exists. Use extreme caution when performing these tasks.***		Meter measurement required.
	**CAUTION!** *This information is critical to the safe installation and or operation of the inverter.* *Follow these instructions closely.*		Torque rating critical to operation.
	**NOTE:** *This statement is important. Follow instructions closely.*		Login to the remote monitoring system for operating status

2.1 About this Manual – Target Audience

This manual is intended to be used by qualified service and installation personnel for the purposes of product installation.

This manual contains instructions for the installation and start up sequence of the Eguana Evolve™ ESS; including the PCS and master battery cabinets. This product is permanently wired to the home electrical service, and must be installed by a licensed electrician only.

2.2 Installation Planning & Supporting Documents

Eguana offers different models of the energy management system (EMS) supplied with this product at the time of order. Please consult the Installation Guide of the EMS ordered with this product for full installation planning details, including conduit layout plans and sample line diagrams. The EMS manuals also describe in more detail the various operating modes and configurations for AC coupled PV solar plus storage systems.

The battery capacity of this system can be expanded by adding additional cabinets adjacent to the master battery cabinet. Battery expansion is not covered within this document.

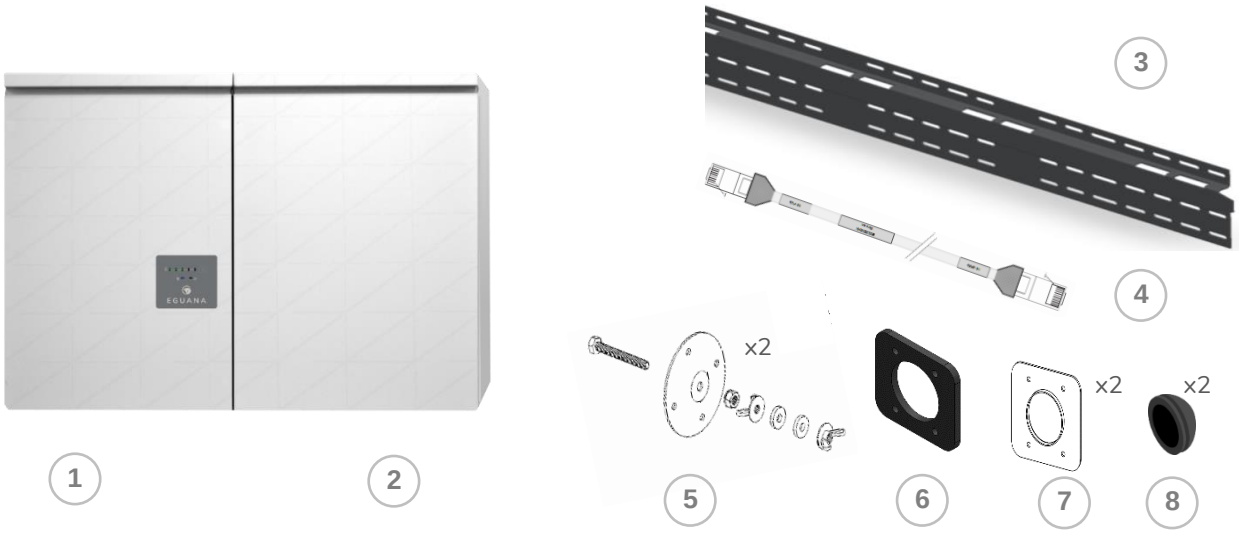
A complete list of Installer resources (Evolve 0513U North America) is available at www.eguanatech.com under the Evolve product banner.

2.3 Glossary

Term	Definition	Term	Definition
AC	Alternating Current	LED	Light Emitting Diode
ARC	Auto Recovery Circuit	NC	Normally Closed
CPU	Central Processing Unit	NO	Normally Open
DC	Direct Current	PCS	Power Control System (Inverter)
EMS	Energy Management System	PE	Protective Earth
ESD	Electrostatic Discharge	PV	Photo-Voltaic
ESS	Energy Storage System	RF	Radio Frequency
GND	Ground	SOC	State Of Charge (Battery)
		SOH	State of Health (Battery)

2.4 Initial Inspection of Material List

The system components supplied with your Eguana Evolve™ ESS are shown below. Each component should be inspected visually for any damage that may have been caused by shipment. If damage is present, please contact your local distributor.



2.5 Special tools & hardware

The following tools are required to complete the installation of the ESS:

- Torque wrench
- 17mm socket wrench (battery negative main power connection).
- 10mm socket wrench (battery +/- module power connections).
- 3/8” socket wrench (battery positive main power connection).
- RJ-45 crimp tool (EMS to PCS communication cable) and RJ-45 connectors.
- Mounting hardware for wall bracket (load bearing) – M8 (5/16”) hardware suitable for use with mounting structure.

Item	Description
1	ACB05-LP PCS cabinet
2	ACB05-LB Master battery cabinet
3	Wall bracket
4	BMS – PCS high level communication cable
5	PCS and battery cabinet levelling brackets
6	2 ea Cabinet coupler plates
7	Cabinet coupler gasket
8	2 ea levelling bracket hole grommet
	Cabinet coupler hardware (not shown) 4 ea M4 bolts, star washers, and locknutsM4 star washers

3 Installation Site Preparation

Before installing the Evolve ESS components, read all instructions and warnings in this manual.

CAUTION! *All electrical installation work should be performed in accordance with local building and electrical codes.*

WARNING! Isolate the PCS from all energy sources prior to electrical installation by means of disconnects, breakers or connectors. Failure to properly isolate either AC or DC sources may result in serious injury or death. This system will generate an AC voltage at the off-grid terminals when DC source is applied.

CAUTION! The PCS cabinet weighs up to 145 lbs (65 kg), and the battery cabinet weighs up to 223 lbs (102 kg). Handle with care. The wall to which the system is mounted must be load-bearing rated according to the local building code. Mechanical lifts are recommended to position cabinets on the wall bracket.

NOTE: All interconnecting cables are limited in length, and designed specifically for adjacent cabinet mounting using the manufactured wall brackets.

CAUTION! Do not install in direct sunlight. Battery performance is dependent upon operating ambient temperature. Radiant heat absorbed in direct sunlight will greatly reduce the performance of the battery, and will prematurely cause degradation of the display indicator panel on the PCS cabinet. The battery modules are rated for full power operation between -10C to +45C.

3.1 Overview of PCS and Battery components

1. The cabinets can be installed in an indoor and outdoor non-corrosive environment (not marine environment).
2. The forced air cooling of the PCS cabinet is designed to flow air from bottom to top.
3. The PCS and Battery cabinets are rated Type 3R.
4. Wall mounting hardware not included. The load-bearing wall bracket is provisioned for M8 hardware. Levelling brackets are provisioned for M5 hardware.

3.2 Installation Area Required to Wall Mount PCS and Battery:

The physical installation of the cabinets requires the layout planning and installation of the system components in the available installation space. The recommended installation height is driven by the viewing angle of the display panel on the PCS cabinet.

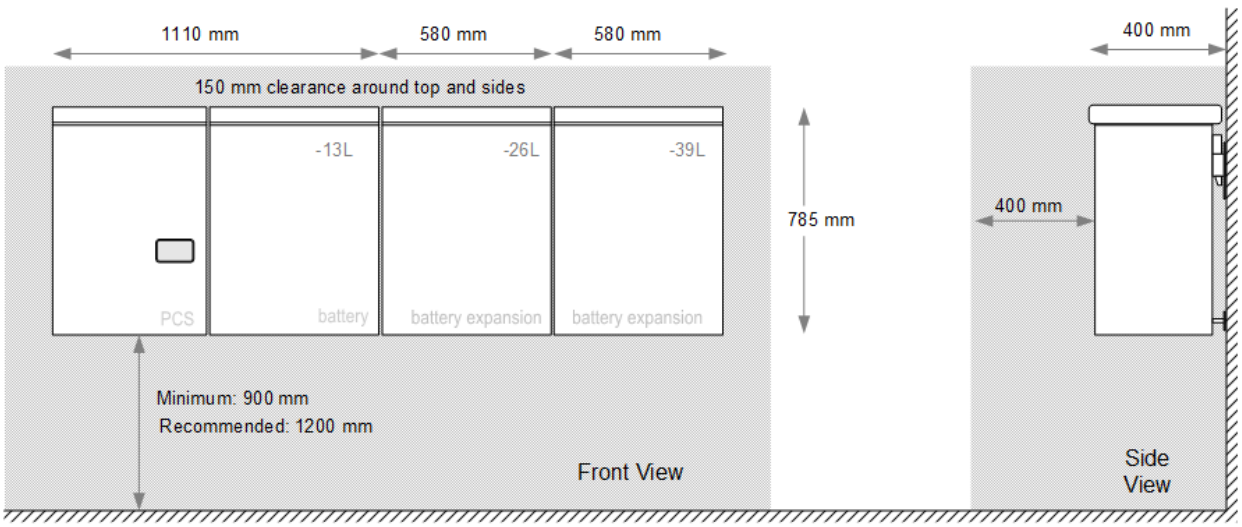
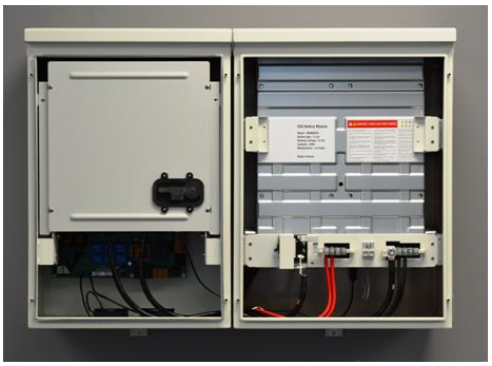
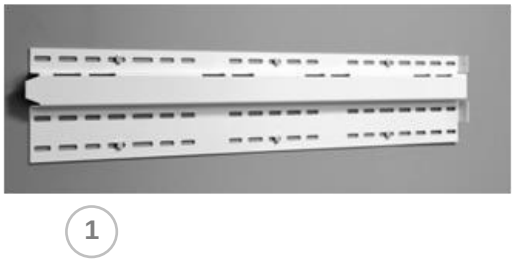
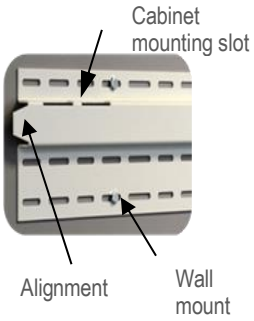


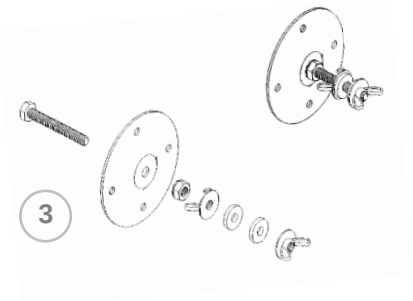
Figure 1: Installation clearances.

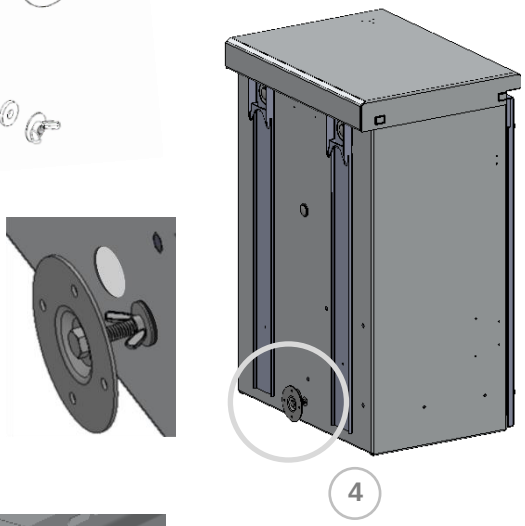
4 PCS and Battery Cabinet Wall-Mounting Instructions

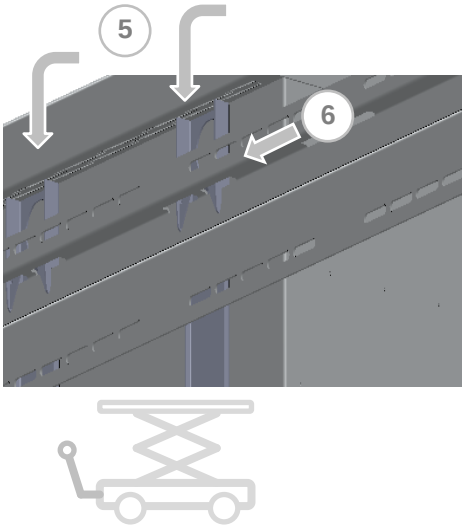


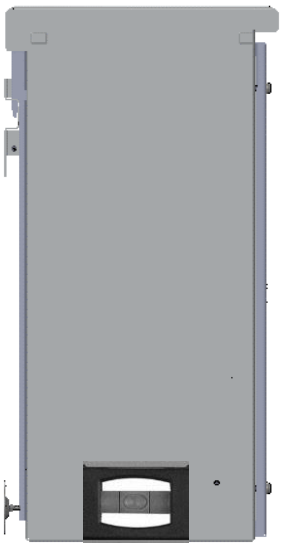


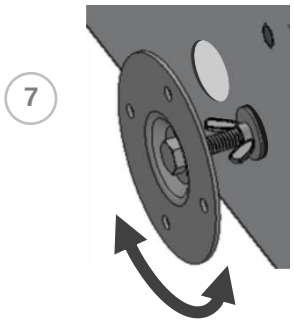












1. Mount the wall bracket to the wall. Use the available slot pattern to mount to a load-bearing structure rated for the weight of the final system. The slots accommodate a M8 bolt diameter.

IMPORTANT! Wall-stud mounting: A minimum of three wall studs spanned within the width of the mounting bracket are required. A minimum of two mounting bolts are required per stud (top/bottom).

2. Remove the master battery cabinet from the packaging, and stand the cabinet upright. (not shown). Remove the front cover.

3. Assemble the lower leveling bracket. (Fully assembled drawing shown – the last washer and wing nut are mounted from inside the cabinet).

4. Mount the leveling bracket to the cabinet. Each side of the cabinet must have a rubber washer in direct contact with the cabinet wall.

CAUTION! Battery cabinet is heavy. Mechanical lift recommended.

5. Lift the battery cabinet onto the wall mount bracket, aligning the wall hooks at the rear of the cabinet with the slots on the load-bearing face of the bracket.

6. Slide the battery cabinet towards the right end of the bracket to allow for clearance for the PCS cabinet.

7. From the rear side of the cabinet, spin the lower levelling bracket (in/out) until the cabinet is vertically plumb (level) to the wall.

Figure 2: Wall mount bracket and battery cabinet installation.

8. Remove the PCS cabinet from its packaging and stand upright. (not shown). Remove the front cover.

9. Assemble and mount the leveling bracket as shown in steps 3 and 4 above.

CAUTION! The PCS cabinet is heavy. Mechanical lift recommended.

10. Lift the PCS cabinet onto the wall mounting bracket.

11. Slide the PCS cabinet to the left such that it aligns with the alignment tab on the mounting bracket.

12. From the rear side of the cabinet, spin the lower levelling bracket (in/out) until the cabinet is vertically plumb (level) to the wall (as shown in step 7).

WARNING! *The mounting bolts of the flange assembly are required to be fully secured, as they provide the chassis grounding for the battery cabinet. Torque nuts as specified in the specification tables provided in this manual.*

13. Insert the PCS cabinet coupling gasket between the two cabinets (lower-front). Slide the battery cabinet towards the left until mating to the gasket.

14. Place the coupling plate inside the PCS cabinet and insert the four mounting bolts and washers through to the battery cabinet side.

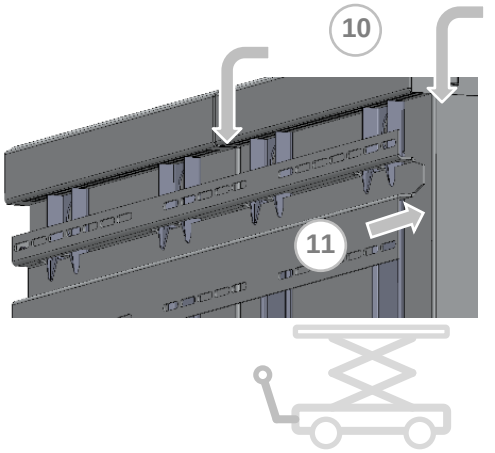
15. Place star washers on the bolts on the battery side of the cabinet.

16. Mount the battery cabinet side coupling plate, and fasten with the lock nuts. Torque to 10 – 15 in-lbs.

17. **Continuity test:** Check the continuity between the cabinets using an Ohm meter. The test reading must be zero Ohms at a bare metal point inside each of the PCS and battery cabinets.

18. Optional: (This is not a load bearing anchor – anchored conduit runs to the PCS are satisfactory). Install screws in leveling plates for PCS and battery cabinets by inserting a screwdriver through the hole on the backside of the cabinets.

19. Plug hole on back of cabinet using by inserting the hole plug from the front side.



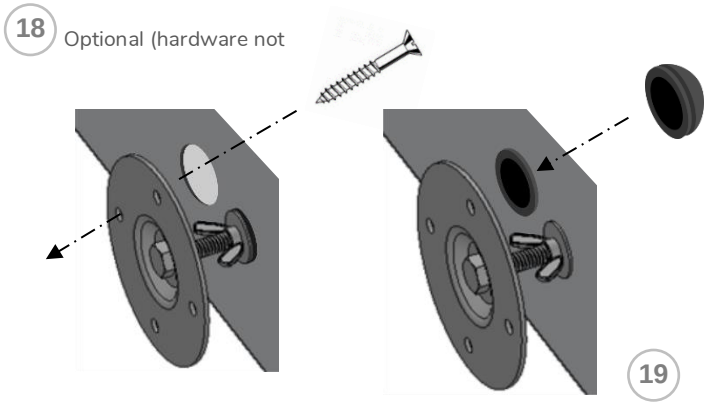
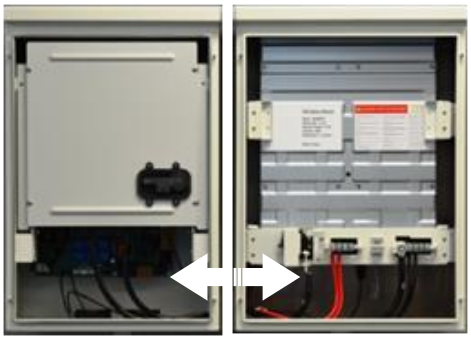


Figure 3: PCS cabinet and inter-cabinet coupler installation.

5 PCS / Battery Inter-Cabinet Wiring



The following instructions cover the interconnection wiring of the PCS and master battery cabinet. No cable preparation is required with battery modules pre-installed in the cabinet. Refer to appendix A for a complete inter-cabinet wiring diagram.

Note: *Overcurrent protection of the DC source is provided internally as part of the integrated battery system. No external DC disconnect is required.*

5.1 Battery power cable connections

CAUTION! A torque wrench is required to ensure the power cables are terminated to their specifications. Over-torque can damage the DC breaker and/or strip the threads on the copper bus bar posts. Under-torque can result in an arc fault hazard, and risk of fire. Damage as a result of improper termination is not covered by the manufacturer warranty.

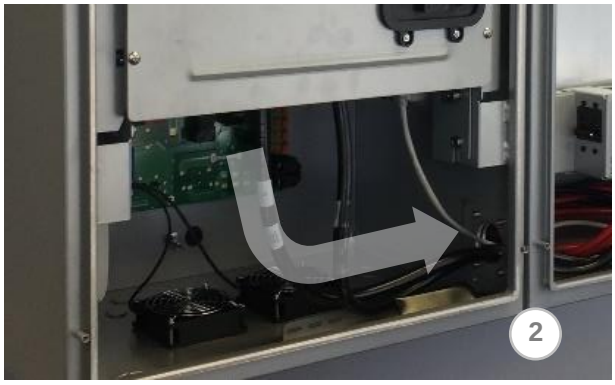
1. Remove the plastic safety barrier on the power panel assembly inside the master battery cabinet by removing the three white plastic lug nuts on the top of the safety barrier.

2. Route the battery cables from the PCS cabinet to the battery cabinet.

3. Loosen the PCS DC- terminal bolt using a 17mm socket wrench. Remove the ground cable.

4. Place the DC- cable and ground cable ring terminals back-to-back, and mount them to the PCS DC- bus bar. Tighten the bolt using the 17mm socket. Torque to 60 in-lbs.

5. Connect the Battery positive (+) cable to the PCS Batt+ bus bar terminal on the rear of the battery disconnect switch using a 3/8" socket wrench. Torque to 35 in-lbs.



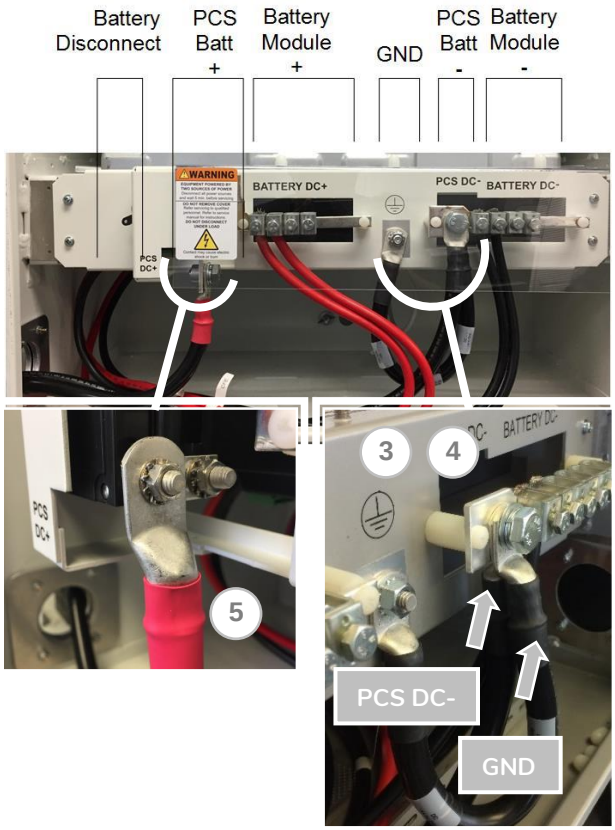


Figure 4: Battery power cable installation.

5.2 Battery BMS to PCS communication connection

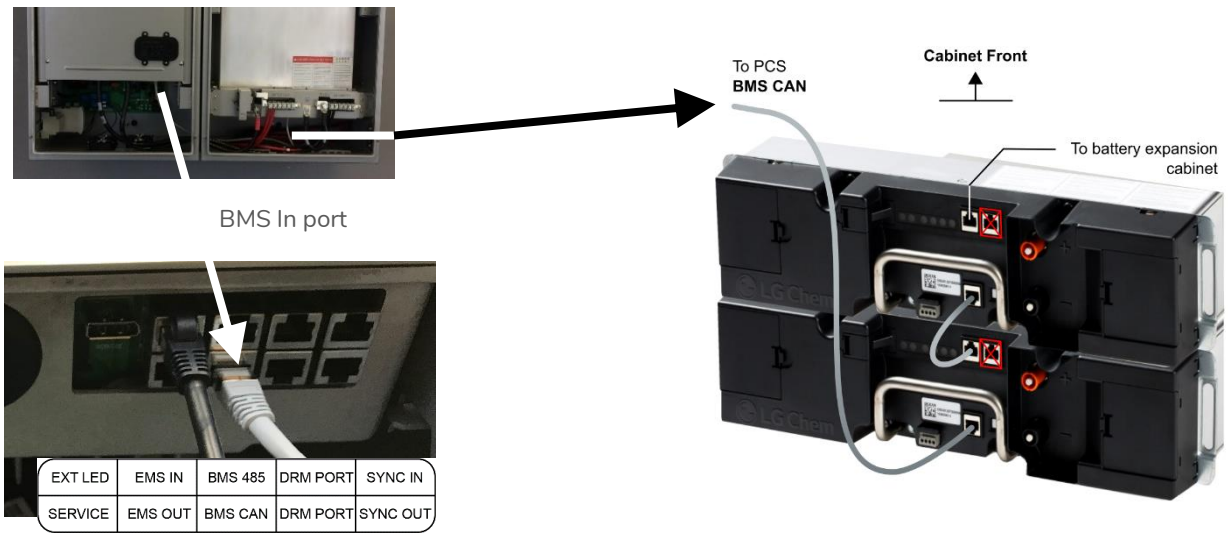


Figure 5: PCS - BMS high level communication wire installation. Left – PCS cabinet termination. Right – Battery cabinet termination.

The communication cable can be routed with DC power cables. Take care that the communication cable is routed through the inter-cabinet coupler so that there is no stress or tension on the terminations. This cable is terminated with RJ-50, 10-pin connectors.

1. PCS cabinet: Terminate the cable (p/n 801003338) at the **BMS CAN** port, as shown in figure 5, above-left.

2. Battery cabinet: Terminate the cable at the rear battery module BMS port as shown above-right.

6 System Electrical Wiring

Note: This product is capable of providing utility interactive and islanded back up power, and can be AC coupled to a utility interactive photovoltaic inverter. Wiring methods must be in accordance with local electrical codes. The installer is responsible for ensuring that over-current protection is installed and sized appropriately for the AC grid and off-grid output circuits, in accordance with the National Electrical Code, ANSI/NFPA 70, Canadian Electrical Code and local codes.

All field wiring connections to the battery system are at the PCS cabinet only. The diagram (left) indicates the knockout locations for conduit entry into the PCS; categorized as AC power and signal level circuits.

IMPORTANT! Drilling holes anywhere in the battery or PCS cabinet renders the warranty null and void. Use the knockouts provided at the bottom face of the PCS cabinet only! Do not drill holes anywhere in the battery system. Use conduit fitting reducers, if applicable.

PCS cabinet – bottom view

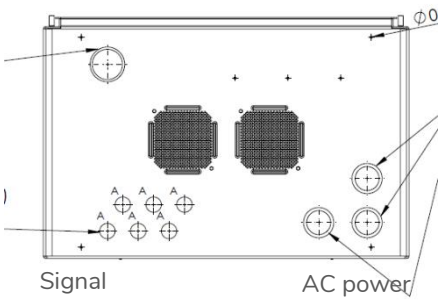


Figure 6: PCS cabinet knockout detail.

6.1 AC power connections

This battery system contains two independent AC power connection ports; one port dedicated for an electrical utility connection, marked “AC Grid”, the other port dedicated for backup operation, marked “AC Load”. This product’s primary application is intended for utility interconnection, and must be connected to a utility electrical service supplying split phase 240/120 Vac, 60 Hz. The backup operation of this product is a secondary application, and is intended to supply emergency backup operation only.

Note: The PCS provides galvanic separation between AC and DC Sources.

CAUTION! *To reduce the risk of fire, connect only to a dedicated circuit provided with appropriate branch circuit over-current protection in accordance with local electrical codes.*

WARNING! *Improper connection of the wiring panel may result in equipment damage and cause personal injury. Disconnect all AC and DC Sources prior to installation.*

CAUTION! *The AC grid and load ports are independent circuits, controlled internally by an automatic bypass and transfer switch. Each port must be connected to electrically isolated panels. Tapping line or neutral wires from the main electrical panel to the backup panel may result in permanent damage to the product.*

AC Grid Port:

1. Open the spring clamp terminals on the AC circuit board at the port marked “AC Grid”.
2. Terminate the AC grid connection wires as follows: “L_Grid” = Line, “N_Grid” = Neutral, and “PE” = Ground.
3. Close the spring clamp terminals, ensuring levers are fully engaged.

AC Load Port:

1. Open the spring clamp terminals on the AC circuit board at the port marked “AC Load”.
2. Terminate the wires at “L_AC load” (Line), “N_AC load” (neutral), and “PE_AC load” (protective earth).
3. Close the spring clamp terminals, ensuring levers are fully engaged.

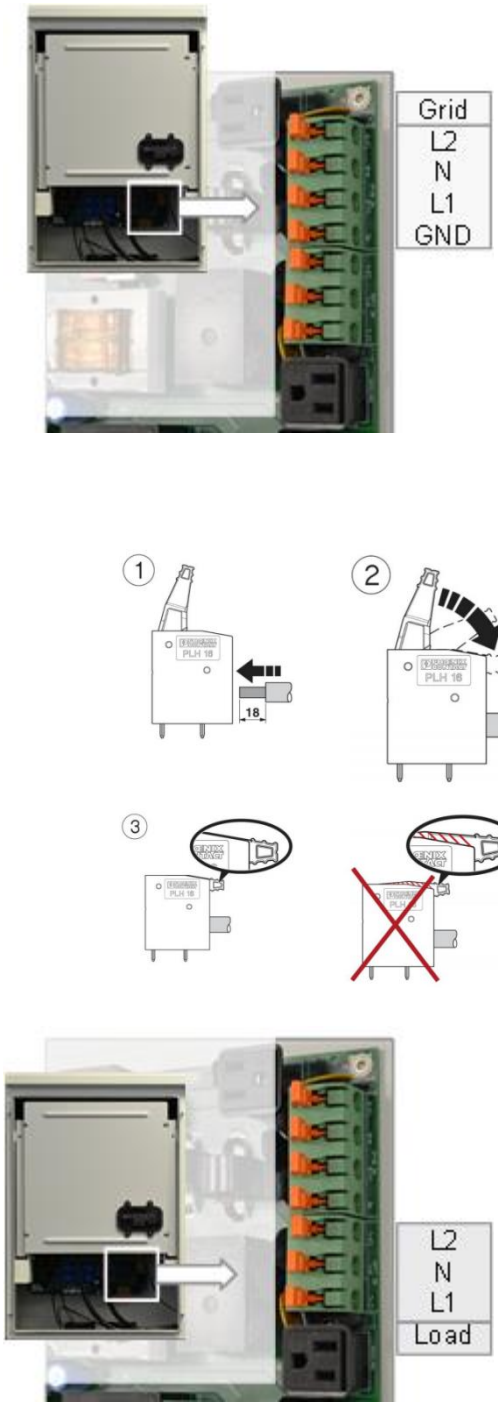


Figure 7: AC wiring.

6.2 Chassis Grounding

In this section, “Chassis Ground” is referred to as “ground” or “grounding” unless otherwise mentioned.
The AC and DC grounding are intended to provide a low impedance signal path at all frequencies.

DC Ground Wiring Installation: The PCS cabinet is shipped with ungrounded DC power terminals within the inverter. However the default setting for DC grounding is set for DC negative to ground. This is to indicate that the DC negative terminal of the inverter is grounded within the PCS system. The DC negative ground is completed once terminated in the master battery cabinet, as the battery module DC bus is pre-wired with negative grounded battery modules. .

AC Ground Wiring Installation: The AC power grounding is achieved through the PE terminals of the AC grid connectors on the AC Filter Board, as shown in section 6.1.

Note: The field ground wire rating applies to the AC circuit only. The DC source loop is internal to the battery cabinet, and is rated accordingly.

Lightning Grounding: The inverter has built-in lightning protection. In order for the lightning protection to be effective, the grounding for lightning currents must be provided via low impedance path from AC Filter Board to System Ground and further to the building Ground/Earthing point.

6.3 Communication Wiring to the Energy Management System – RJ45 Pin-out

The Evolve ESS communicates with the energy management system using the Modbus protocol over an RS-485 network. Shielded twisted pair cable is required.

Note: The EMS panel supplied with the ESS includes a 10 ft factory prepared cable. Should the installation require further separation between the EMS panel and the Evolve PCS cabinet (ACB05U-LP), a cable can be prepared using CAT 5 shielded wire, with an RJ-45 connector terminated at the PCS end only. Connect the shield to the EMS end only.

Terminate the cable as shown:

EMS	PCS	PCS: RJ-45 Pin
G+shield	G	3
A	A	4
B	B	5

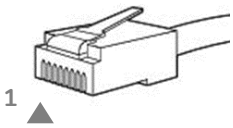


Figure 8: RJ-45 pinout for EMS to PCS communication cable.

7 Start-up Sequence

CAUTION! Powering the Evolve ESS requires a specific start-up procedure. Please follow the steps below.

CAUTION! If the battery disconnect has been placed in the OFF position at any time during operation, wait one minute before returning to the ON position. Rapid cycling (less than one minute) of the battery disconnect can cause damage to the pre-charge circuit.

CAUTION! During the first start-up sequence after installation, the battery modules may require a battery maintenance cycle to balance the SOC. This maintenance cycle requires a grid connection so that the PCS can be commanded to charge the batteries. The PCS battery SOC alarm light will flash yellow if maintenance and/or other battery faults are present. This procedure may take from a few minutes to a few hours, depending on the difference in battery module SOC. Please refer to the PCS Service Manual for more information.

1. Fan
2. Status indicators
3. RJ48 port for intra-rack communication cable
4. RJ48 port for higher-level communication cable
5. Positive connector (+)
6. Power terminal compartment
7. Negative connector (–)
8. On/Off button
9. Dry contact
10. Handle

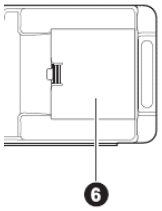


Figure 9: Battery BMS interface.

1. Remove the front cover from the battery cabinet adjacent to the PCS cabinet.
2. Press the [Power] button (see above, label #8) on the master battery module. The master battery module has communication wired from the battery BMS port (label #4) to the PCS [BMS in] port.

WARNING! When the batteries are turned ON, the battery voltage will be present at the power panel assembly bus bar where the battery modules are terminated.

<u>*This step may take up to one minute.*</u>

3. Verify that the indicators are as shown in "Normal Operation" as shown below.

Battery Power Button Operation

Turn Batteries ON: Press and Release the power button on the module designated as the Master module (PCS connected com cable).

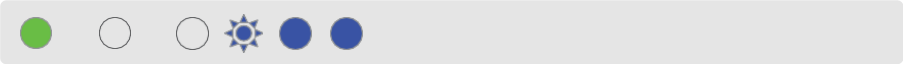
Turn Batteries OFF: Press and hold 5 seconds the power button of any module designated as a Slave Module. If all modules do not shut off, repeat individually for each module.

Normal	
SOC ≥ 75%	
SOC ≥ 50%	
SOC ≥ 25%	
SOC < 25%	
Voltage imbalance	
Warning	
Fault 1	
Fault 2	

Green indicator: The left indicator indicates normal operation when solid green.

Blue indicators (SOC): In normal operation, the four indicators on the right show the module's state of charge (SOC). Each indicator represents 25% of a full charge. If the SOC value is 50%, the three rightmost indicators are on solid ***BLUE***. The blue indicators of the slave modules look as below.

Whereas, the leftmost blue indicator on the master module flashes.



Also, verify that the module with the left-most flashing blue SOC indicator corresponds to the module which has communication wired from the BMS to the PCS [BMS in] port.

Caution! If the battery module other than the module designated as a master has a flashing SOC light at startup, shut down all battery modules by holding the [Power] button for 5 seconds. In this state, it may be necessary to shut down battery modules individually. After all modules are OFF. Repeat steps 2 and 3.

4. Turn ON the Battery disconnect switch inside the battery cabinet.
5. The PCS module will initialize, indicated by a brief flash of all LEDs on the display panel, followed by a status of the battery and PCS. Refer to section 9.2 for indicator status of the PCS.
6. Turn ON the AC breaker at the main electrical panel to the PCS.

Figure 10: Battery breaker disconnect turn ON.

8 Operation

The Evolve ESS is fully automated. The EMS will be programmed to connect the system to the grid after AC and DC sources are applied. The operating states can also be viewed on the PCS display panel. For more details on system operation, refer to the Evolve ESS Owner's Manual.

9 PCS Display Panel

9.1 LED Display Indicators

The PCS cabinet is equipped with a display panel that provides indication of the following:

- Battery Operating State
- PCS Operating State
- (out of) Service Indicator

Refer to section 9.2 for a complete definition of indicator states.

To conserve energy, the LEDs will turn off after 5 minutes from being activated. They can be re-activated by pressing the service button.

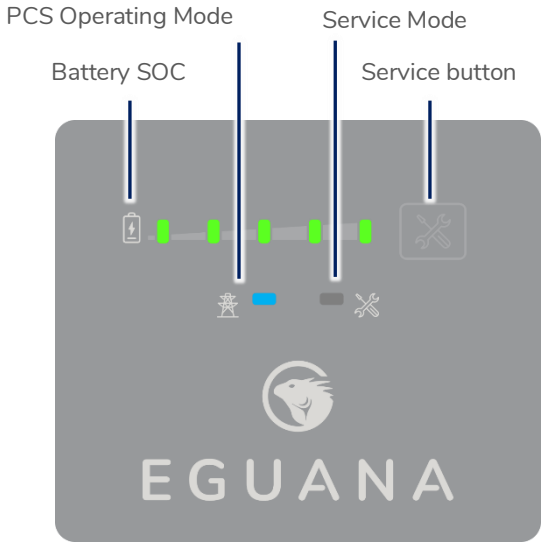
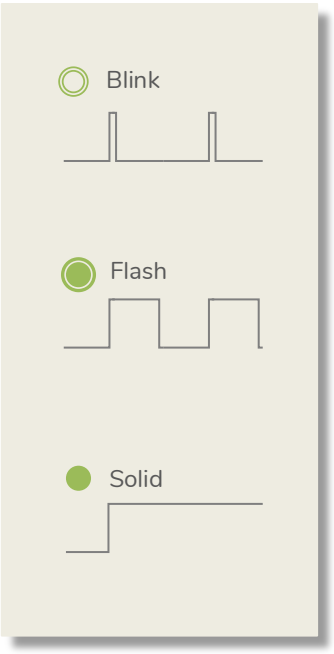


Figure 11: PCS display panel.

9.2 PCS display panel indicator summary

LED	Mode	Definition
		State of charge. Each LED represents 20% SOC. Solid = battery idle.
		Charge = flash right. Discharge = flash left.
		Low battery.
		Sleep / Standby mode.
		Grid timing mode.
		Grid synchronization mode. Ten second test before grid connect mode.
		Grid connected mode.
		System OK.
		System out of service.
		User initiated service mode.



9.3 Service Button

The service button can be used to wake the LED display, and either place the system into or out of service mode, as well as cycle through various operating modes. If the system has gone into service mode, the user can attempt to bring the system back into normal operation using the service button.

Note: It is recommended to login to the EMS via web browser and retrieve the service code from the system prior to attempting to clear the service mode.

Observed state	Action	Service button command
All panel lights off	Wake panel display	Press and release
Service light on	Exit service mode	Press and hold 5 seconds

Refer to *section 11 – Troubleshooting* if the service button does not perform the action requested.

9.4 Backup Power Operation

This system will provide backup power to dedicated electrical circuits within the home via a permanently wired electrical sub-panel, referred to as the backup panel. Backup power is limited in rating and duration, both of which are dependent on the nature of the loads connected to the system, and the availability of the solar PV supply. This system is designed to reliably provide power to a refrigerator, home lighting, home electronics, and small appliances.

NOTE: This product is not an uninterrupted power source (UPS). Following a utility outage, a four second power interruption will occur before the backup power source commences. As a result of this interruption, a desktop or portable UPS is recommended if continuous operation is desired for any electronic devices.

IMPORTANT! Surge rated loads, ie) power tools, portable air conditioners, may cause an overload shutdown. Equipment of this type that is connected to the backup panel should be inspected and tested regularly as per manufacturer suggested schedules. Permanent damage to the battery system and/or your equipment may occur if exposed to chronic overloading cycles.

IMPORTANT! Portable extension cords connected to a backup circuit should be limited to 10 meters.

IMPORTANT! This product does not support automatic gas generator integration. Do not attempt to connect a gas generator to the battery system. If generator support is required, consult your installer regarding a separate manual transfer to your backup electrical panel.

NOTE: The power output / surge rating will be further limited when the battery is below 10% SOC.

9.4.1 Backup Power Display Modes

Display	Definition
	Battery status LEDs indicate the following: • Charge = flash right. Discharge = flash left. • PCS and service lights off.
	Low SOC shutdown in backup mode. See section 5.2 to restart the system.
	Low SOC shutdown initiated while out of service. See troubleshooting – section 7, *"service light on in backup mode"*.

9.5 Restarting the battery system after low battery shutdown

The system will shutdown when the battery reaches a critically low level during backup operation.

To restart the system:

IMPORTANT! Ensure there is adequate sunlight for the solar PV system to charge the battery before restarting the system. If the battery system is installed without a PV system connected to the backup panel, do not attempt to restart the system. Wait for the utility power to return.

1. Press and hold the service button for 5 seconds. 

The backup power will restart, allowing the PV system to reconnect* and begin charging the battery. The system will continue to operate if the battery charges to its minimal normal operating range. If the battery does not charge within 15 minutes of restart, the system will shut down to preserve the battery.

*PV system reconnect time is approximately 5 minutes.

Note: If necessary, the load circuits can be shut off inside the backup panel to increase the battery charge rate. Do not shut off the PV circuit.

10 Maintenance

The Evolve ESS is a maintenance free product. Regularly scheduled inspection of the airflow path for the active cooling fans on the bottom side of the PCS cabinet is all that is required. This inspection should occur on an annual basis, or coincide with PV inspection.

If the fan ventilation holes are obstructed with dust / debris, a soft-bristled brush can be used to wipe them clean. For heavy soiling use a soft, dry brush. Do not use any solvents, scouring, or corrosive materials to clean the unit. Never remove or unplug connections or plugs during cleaning.

11 Troubleshooting

System faults are reported and logged in the monitoring system. All fault logs are also accessible remotely by your installer.

IMPORTANT! Contact an Eguana service representative as recommended below only after any of the following conditions are present on the front display of the inverter panel, and the recommended actions do not resolve the issue.

Condition	Definition
Service light ON in grid mode	System is prevented from normal operation due to internal fault. Notify service personnel.
Service light ON in backup mode	If the system faults into service in backup operating mode, there may be an overload condition which prevents the system from operating safely. If the battery charge level is greater than 20% (one or more Green LEDs), reduce the load by shutting off circuits in the backup electrical panel, then press and hold the service button 5 seconds to resume backup power operation. If the battery low SOC shutdown mode is displayed, shut off all load circuits (keep PV ON) in the backup panel, and do not attempt to resume backup operation until adequate sunlight is present to provide a solar charge of the battery.
All panel lights flashing	System is attempting to communicate with the battery modules. Notify service personnel if this condition persists more than 30 minutes.
All panel lights OFF after service button wake command	This indicates loss of both AC And DC power sources to the PCS. Check the circuit breaker in the main electrical panel for the energy storage system.
Online monitoring system not accessible	Check the internet connection. If connection is via wi-fi, reboot the wireless router, and make sure the login user and password have not been changed since time of original installation. Check power to the energy management system via the orange indicator light on the right side of the panel. Note: the energy management system may lose power after an extended utility outage where there is not enough solar generation to maintain battery system power. Note: monitoring system servers may occasionally be down for service. If first attempts are not successfully, try again the following day before contacting your installer.

12 Serviceable Parts – Battery module removal/replacement

The battery modules within the battery cabinet are removable and/or replaceable. To replace or remove the battery modules:

1. Follow section 5 in this manual to disconnect the inter-cabinet cabling.
2. Refer to the 68006 Battery Module Field Assembly Guide for instructions on removing the battery modules. Assembly and disassembly are the reverse order.

13 Specifications

Table 1: PCS Electrical / Mechanical Ratings

Model		ACB05U-LP (contained in Evolve 0513U)		
		Grid : Charging	Grid : Discharging	Off Grid
Maximum DC Voltage		80 V DC		
Operating DC Voltage Range		40 to 80 V DC		
Operating DC Voltage Range at 100% Output Power		40 to 80 V DC		
Maximum DC Current		100 A	125 A	125 A
AC Power Factor*		0.8 lagging to 0.8 leading, adjustable		N/A
Operating Voltage Range (default)		105.6 to 132 V AC for L_1-N and L_2-N		N/A
Operating Voltage Range (with ride-through)		60.0 to 132 V AC for L_1-N and L_2-N		
Operating Frequency Range (default)		59.3 – 60.5 Hz		N/A
Operating Frequency Range (with ride-through)		50.0 – 66.0 Hz		N/A
Number of Phases		Split Phase		
Nominal Output Voltage*		120 V AC for L_1-N and L_2-N or 240 V AC L_1-L_2		
Normal Output Frequency*		60 Hz		
Maximum Continuous Output Current		20.8 A for L_1 and L_2		
Maximum Continuous Output Power (total)		5000 W		
Maximum Allowed Overload Condition (as percentage of maximum continuous current)		100%	100%	100-120 % - 30 minutes 120-170 % - 5 seconds
Maximum Output Overcurrent Protection		60 A for AC Grid, 60 A for AC Load		
Maximum AC Short-circuit Current		404 Apk-pk (< 5 ms), 8.0 Arms		
Maximum Synchronization In-rush Current		1.7 Arms		
Protective Class (I, II, or III)		Class I		
Over-Voltage Category (OVC I, II, III, or IV)		OVC III		
Pollution Degree		3		
Lightning protection		IEEE 62.41.2, location category B, low exposure		
Normal Operation Temperature Range / Humidity		-40 to +50 °C (limited by battery, see below)		
Normal Operation Humidity		Max 95% (non-condensing)		
Maximum Full Power Operating Ambient		40 °C		50 °C
Enclosure Rating		Type 3R		
Dimensions		20.8"W x 30.8"H x 15.6"D (529 x 783 x 397 mm)		
Weight		145 lbs (65 kg)		
Default Trip Limits: UL1741 (IEEE 1547.1)				
Low Volt Trip (adj.), Volts	Default	110 V AC (L_1-N or L_2-N)		N/A
	Min/Max	105 - 115 V AC (L_1-N or L_2-N)		N/A
Low Volt Trip (adj.), time	Default	117 cycles (1.95 Sec.)		N/A
	Min/Max	14 - 117 cycles (1.95 Sec.)		N/A
High Volt Trip (adj.), Volts	Default	132 V AC (L_1-N or L_2-N)		N/A
	Min/Max	125 - 132 V AC (L_1-N or L_2-N)		N/A
High Volt Trip (adj.) time	Default	57 cycles (0.95 Sec.)		N/A
	Min/Max	14 - 57 cycles (0.95 Sec.)		N/A
Undervoltage: (Very Low) Trip Limit		< 60 V AC (L_1-N or L_2-N)		N/A
Undervoltage: (Very Low) Trip Time		≤ 10 cycles (0.16 Sec)		N/A
Overvoltage: (Very High) Trip Limit		> 144 V AC (L_1-N or L_2-N)		N/A
Overvoltage: (Very High) Trip Time		≤ 10 cycles (0.16 Sec)		N/A
Under Frequency Trip Limits (Adjustable)	Min	59.3 Hz		N/A
	Default	59.3 Hz		N/A
	Max	59.8 Hz		N/A
Over Frequency Trip Limits (Adjustable)	Min	60.2 Hz		N/A
	Default	60.5 Hz		N/A
	Max	60.5 Hz		N/A
Frequency Trip Limit Accuracy		0.1 Hz		N/A
Frequency Trip Time Accuracy		0.1 Sec		N/A
Voltage Trip Limit Accuracy		2%		N/A
Voltage Trip Time Accuracy		0.043 Sec		N/A
Compliance				
Safety		UL 1741SA, UL 1998, UL 9540		

Refer to section 13.1 for operating characteristics in compliance with the UL 1741 SA standard.

Table 2: PCS Field Wiring Ratings – AWG / Torque

Field Wiring	**Use Copper Wire Only, 90°C or higher rated**		
Terminal	**Minimum Wire Size mm² (AWG)**	**Maximum Wire Size mm² (AWG)**	**Tightening Torque, Nm (in. lbs)**
Ground Lug	16 mm² (6 AWG)	16 mm² (6 AWG)	5.0 (45)
AC Grid Terminals	10 mm² (8 AWG)	16 mm² (6 AWG)	Push-lock spring cage
AC Load Terminals	10 mm² (8 AWG)	16 mm² (6 AWG)	Push-lock spring cage
PV Feed Through	10 mm² (8 AWG)	16 mm² (6 AWG)	Push-lock spring cage

Table 3: Battery Cabinet Electrical / Mechanical Ratings

Model		**Battery Cabinet**
		ACB05U-LB (contained in Evolve 0013U, 0007U)
Maximum DC Voltage (Cabinet)		80 V DC
Operating DC Voltage Range (Cabinet)		0 to 80 V DC
Operating DC Voltage Range at 100% Output Power (LG Chem EM048126P3S8 module)		42 to 58.8 V DC
DC Breaker Panel (if applicable)	Main DC current rating	125 A
	Max wire size of main DC	70 mm² (AWG 2/0)
	Circuit Breaker, Positive Pole	180A or 175A, UL 489
	Max # of branch circuits	6
	Max wire gauge of branch circuit	50 mm² (AWG1/0)
	Grounding terminal, DC negative grounded	70 mm² (AWG 2/0)
Maximum Number of Battery Modules supported		6
Battery Pack capacity (EM048126P3S7)		6.5 kWh
Maximum Continuous Output Power (total)		5000 W
Normal Operation Temperature Range		-10 to +45 °C
Maximum Full Power Operating Ambient		45 °C
Storage Temperature Range (EM048126P3S7)		-30 to +60 °C
Enclosure Rating		Type 3R
Dimensions		22.5”W x 30.8”H x 15.6”D (572 x 783 x 397 mm)
Weight (including 2 battery modules)		223 lbs (101 kg)
Compliance		
Safety		UL 9540, UL 1973

Table 4: Battery Cabinet Field Wiring Ratings – AWG / Torque

Field Wiring	**Use Copper Wire Only, 90°C or higher rated**		
Terminal	**Minimum Wire Size mm² (AWG)**	**Maximum Wire Size mm² (AWG)**	**Tightening Torque, Nm (in-lbs)**
Ground Lug (field connection)	**16 mm² (6 AWG)**	**70 mm² (2/0)**	**5.7 (50)**
Ground Lug (internal)	-	70 mm² (2/0) included	6.8 (60)
PCS DC+ Lug	-	70 mm² (2/0) included	4.0 (35)
PCS DC- Lug	-	70 mm² (2/0) included	6.8 (60)
Battery Module terminals (+/-)	-	50 mm² (1/0) included	4.5 (40)

13.1 UL 1741 SA Grid Support Utility Interactive Inverter Specifications

The PCS within this integrated storage product complies with the UL 1741 SA standard for grid support utility interactive inverters. These functions are intended to be either enabled or disabled in accordance with local utility interconnection requirements.

Table 5: UL1741 SA grid support functions.

Grid Support Function Tested	Test Standard
Anti-Islanding protection – unintentional islanding with grid support functions enabled	UL 1741 SA 8
Low/high voltage ride through	UL 1741 SA 9
Low/high frequency ride through	UL 1741 SA 10
Ramp rates	UL 1741 SA 11
Reconnect by "Soft Start"	UL 1741 SA 11
Specified power factor	UL 1741 SA 12
Dynamic Volt/VAR operations	UL 1741 SA 13
Frequency-Watt	UL 1741 SA 14
Volt-Watt	UL 1741 SA 15

Table 7: SA9 Low and high voltage ride through settings.

SA9 Low and High Voltage Ride Through - Rule 21				
Region	**Voltage Range [%Vnom]**	**RideThrough Duration [s]**	**Maximum Trip Time [s]**	**Operating Mode During Ride Through**
High Voltage 2 (HV2)	V > 120%	N/A	0.16	N/A
High Voltage 1 (HV1)	110% < V ≤ 120%	12	13	Momentary Cessation (zero power)
Near Nominal (NN)	88% ≤ V ≤ 110%	Indefinite	N/A	Continuous Operation
Low Voltage 1 (LV1)	70% ≤ V < 88%	20	21	Mandatory Operation
Low Voltage 2 (LV2)	50% ≤ V < 70%	10	11	Mandatory Operation
Low Voltage 3 (LV3)	V < 50%	1	1.5	Momentary Cessation (zero power)
SA9 Low and High Voltage Ride Through - Rule 14H				
Region	**Voltage Range [%Vnom]**	**RideThrough Duration [s]**	**Maximum Trip Time [s]**	**Operating Mode During Ride Through**
Over Voltage 2 (OV2)	V > 120%	N/A	0.16	Cease to Energize
Over Voltage 1 (OV1)	110% < V ≤ 120%	0.92	1	Mandatory Operation (VW)
Continuous Operation (CO)	88% ≤ V ≤ 110%	N/A	N/A	Continuous Operation (VW)
Under Voltage 1 (UV1)	70% ≤ V < 88%	20	21	Mandatory Operation
Under Voltage 2 (UV2)	50% ≤ V < 70%	10	11	Mandatory Operation
Under Voltage 3 (UV3)	V < 50%	1	1.5	Momentary Cessation (zero power)

Parameter	**Value for Rule 21**	**Value for Rule 14H**
Nominal AC voltage [V]	120	
AC voltage accuracy [%Vnom or V]	1%, 1.2V	
Voltage trip time accuracy [s]	0.043	
Minimum under-voltage [%Vnom]	50.0%	
Maximum over-voltage [%Vnom]	120.0%	
Default function status	Enabled	Enabled

Table 8: SA10 Low and high frequency ride through settings.

SA10 Low and High Frequency Ride Through - Rule 21				
Region	**Frequency Range [Hz]**	**RideThrough Duration [s]**	**Maximum Trip Time [s]**	**Operating Mode During Ride Through**
High Frequency 2 (HF2)	f > 62.0	N/A	0.16	N/A
High Frequency 1 (HF1)	60.5 < f ≤ 62.0	299	300	Mandatory Operation (FW)
Near Nominal (NN)	58.5 ≤ f ≤ 60.5	Indefinite	Indefinite	Continuous Operation
Low Frequency 1 (LF1)	57.0 ≤ f < 58.5	299	300	Mandatory Operation
Low Frequency 2 (LF2)	f < 57.0	N/A	0.16	N/A
SA10 Low and High Frequency Ride Through - Rule 14H: Oaho, Maui, Hawaii				
Region	**Frequency Range [Hz]**	**RideThrough Duration [s]**	**Maximum Trip Time [s]**	**Operating Mode During Ride Through**
Over Frequency 2 (OF2)	f > 64.0	N/A	0.16	N/A
Over Frequency 1 (OF1)	63.0 < f ≤ 64.0	20	21	Mandatory Operation (FW)
Continuous Operation (CO)	57.0 ≤ f ≤ 63.0	Indefinite	Indefinite	Continuous Operation (FW)
Under Frequency 1 (UF1)	56.0 ≤ f < 57.0	20	21	Mandatory Operation
Under Frequency 2 (UF2)	f < 56.0	N/A	0.16	N/A
SA10 Low and High Frequency Ride Through - Rule 14H: Lanai, Molokai				
Region	**Frequency Range [Hz]**	**RideThrough Duration [s]**	**Maximum Trip Time [s]**	**Operating Mode During Ride Through**
Over Frequency 2 (OF2)	f > 65.0	N/A	0.16	N/A
Over Frequency 1 (OF1)	63.0 < f ≤ 65.0	20	21	Mandatory Operation (FW)
Continuous Operation (CO)	57.0 ≤ f ≤ 63.0	Indefinite	Indefinite	Continuous Operation (FW)
Under Frequency 1 (UF1)	50.0 ≤ f < 57.0	20	21	Mandatory Operation
Under Frequency 2 (UF2)	f < 50.0	N/A	0.16	N/A

Parameter	**Value for Rule 21**	**Value for Rule 14H**
Nominal frequency [V]	60	
AC frequency measurement accuracy [Hz]	0.02	
Frequency trip time accuracy [s]	0.1	
Minimum under-frequency [Hz]	50.0	
Maximum over-frequency [Hz]	66.0	
Maximum trip time [s]	1000.0	
Default function status	Enabled	Enabled

Table 9: SA11 ramp rate settings.

SA11 Ramp Rates		
Parameter	**Value for Rule 21**	**Value for Rule 14H**
Output current rating for function [A]	20.8	
Minimum normal ramp up rate [%Irated/sec]	1.0%	
Maximum normal ramp up rate [%Irated/sec]	100.0%	
Minimum output current [A]	0	
Ramp rate accuracy [%Irated/sec]	N/A	
Minimum soft start ramp up rate [%Irated/sec]	0.1%	
Maximum soft start ramp up rate [%Irated/sec]	100.0%	
Default normal ramp up rate [%Irated/sec]	100.0%	100.0%
Default soft start ramp function status	Enabled	Enabled
Default soft start ramp up rate [%Irated/sec]	2.0%	0.33%

Table 10: SA12 specified power factor settings.

SA12 Specified Power Factor		
Parameter	**Value for Rule 21**	**Value for Rule 14H**
Apparent power rating for function [VA]	5000	
Output power rating for function [W]	5000	
DC input voltage range with function enabled [V]	40.0 - 80.0	
Nominal AC voltage [V]	120	
AC voltage range with function enabled [V]	105.6 - 132.0	
AC voltage accuracy [%Vnom or V]	1%, 1.2V	
DC voltage measurement accuracy [V]	0.05	
Active power range of function [W]	1000 - 5000	250 - 5000
Power Factor Accuracy	0.01	
Power Factor settling time [sec]	5	
Minimum inductive power factor	-0.8	
Minimum capacitive power factor	0.8	
Mid inductive power factor	-0.9	
Mid capacitive power factor	0.9	
Default function status	Disabled	Disabled
Power factor default	-0.95	-0.95

Table 11: SA13 Volt VAR Mode

SA13 Volt-VAr Mode		
Parameter	Value for Rule 21	Value for Rule 14H
Apparent power rating for function [VA]	5000	
Output power rating for function [W]	5000	
EUT input voltage range with function enabled [V]	40.0 - 80.0	
Nominal AC EPS voltage [V]	120	
AC EPS voltage range with function enabled [V]	96.0 - 144.0	
Reactive power accuracy [%Srated, VAr]	5%, 250VAr	
Maximum ramp rate [VAr/s]	500	
Maximum rated reactive power production (capacitive, overexcited) [VAr]	2200	
Maximum rated reactive power production (inducitive. underexcited) [VAr]	-2200	
Minimum rated reactive power production (capacitive, overexcited) [VAr]	250	
Minimum rated reactive power production (inducitive. underexcited) [VAr]	-250	
Maximum slope [VAr/V]	611	
Deadband range [V]	4.8 - 18.0	
Time accuracy [s], related Tr-vv	2	
Settling time [s]	3	
Default function status	Enabled	Enabled
Default response time, ramp to Qmax,ind [s]	10	10
Default power prioritization	Q	Q
Default Voltage at Q1 [V]	110.4	112.8
Default max reactive power production setting [VAr], Q1	1500	2200
Default voltage at Q2 [V]	116.04	116.4
Default reactive power setting at lower voltage deadband limit [VAr], Q2	0	0
Default voltage at Q3 [V]	123.96	123.6
Default reactive power setting at upper voltage deadband limit [VAr], Q3	0	0
Default voltage at Q4 [V]	128.4	127.2
Default max reactive power absorption setting [VAr], Q4	-1500	-2200

* Volt-VAr mode can function with active or reactive power priority. When an inverter is set in Volt-VAr mode with reactive power priority and the inverter's apparent power kVA limit is reached, active power is reduced to maintain reactive power production. When an inverter is set in Volt-VAr mode with active power priority and the inverter's apparent power kVA limit is reached, the reactive power is reduced to maximize active power production.

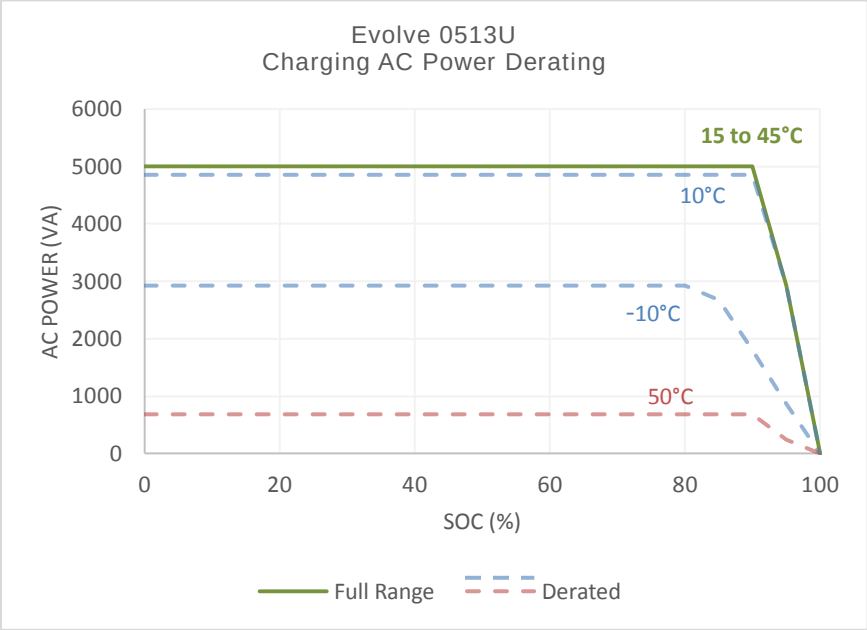
Table 12: SA14 Frequency-Watt settings.

SA14 Frequency Watt		
Parameter	**Value for Rule 21**	**Value for Rule 14H**
Output power rating for function [W]	5000	
AC frequency range with function enabled [Hz]	50.0 - 65.0	
AC frequency measurement accuracy [Hz]	0.02	
P(f) accuracy [%Prated or W]	2%, 100W	
Settling time [sec]	3	
Adjustment range of response time [s]	0.5 - 5.0	
Adjustment range of the start of frequency droop [Hz]	60.016 - 63.0	
Maximum slope of frequency droop [%Prated/Hz]	100.0%	
Minimum slope of frequency droop [%Prated/Hz]	23.8%	
Default function status	Enabled	Enabled
Default response time, ramp to 10% Prated [s]	0.5	0.5
Default start frequency [Hz]	60.1	60.036
Default slope of frequency droop [%Prated/Hz]	50.0%	41.7%
Default use of hysteresis (symmetric recovery)	Enabled	Enabled
Under-frequency response function status	Enabled	Disabled
Default under-frequency start [Hz]	59.964	N/A
Default slope of under-frequency droop [%Prated/Hz]	50.0%	N/A

Table 13: SA15 Volt-Watt Settings.

SA15 Voltage Watt		
Parameter	**Value for Rule 21**	**Value for Rule 14H**
Output power rating for function [W]	5000	
AC voltage range with function enabled [V]	120.0 - 132.0	
Nominal AC voltage [V]	120	
AC voltage accuracy [%Vnom or V]	1%, 1.2V	
Output power accuracy [%Prated or W]	2%, 100W	
Time accuracy [s]	2	
Setting time [sec]	3	
Adjustment range of the start of active power reduction [V]	122.4 - 127.2	
Adjustment range of the stop of the curtailment function [V]	121.2 - 127.2	
Maximum Slope of active power reduction [%Prated/V]	33.3%	
Minimum slope of active power reduction [%Prated/V]	10.4%	
Range of adjustment of a delay before return to normal operation [sec]	1.0 – 60.0	
Adjustment range of the rate of return to normal operation [%Prated/sec]	10.0 - 100.0%	
Default function status	Disabled	Disabled
Power duration reference	Pre-disturbance	Rated
Default response time, ramp to 10% Prated [s]	1	10
Default start voltage [V]	127.2	127.2
Default stop voltage [V]	126.0	127.2
Default active power slope [%Prated/V]	20.8%	20.8%
Default use of hysteresis (symmetric recovery)	Disabled	Enabled
Default delay before return to normal operation [s]	1	N/A
Default active power rate of return to normal operation [%Prated/s]	100	N/A

13.2 Thermal performance: Charge / Discharge Curves



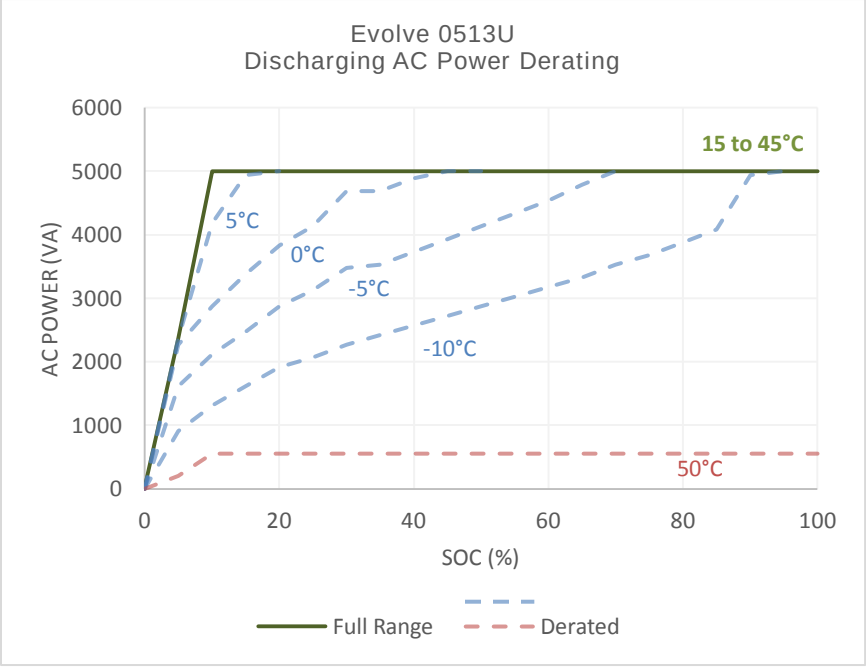


Figure 12: Energy storage system thermal derated charge and discharge curves with base (13 kWh) battery cabinet.

Appendix A: Electrical Block Diagram of Inter-Cabinet Wiring

The following reference diagram outlines the DC and communication interconnections between PCS, master battery, and expansion battery cabinets.

Reference	P/N	Title	Notes
A1	801003**338**	PCS-BMS cable	Connects master battery to PCS [BMS CAN] port.
A2	801003**533**	BMS cable – short	Interconnects modules within same cabinet.
A3	801003**247**	BMS cable – long	Interconnects modules between cabinets.
A4	-	Battery power cables	Positive / negative pair

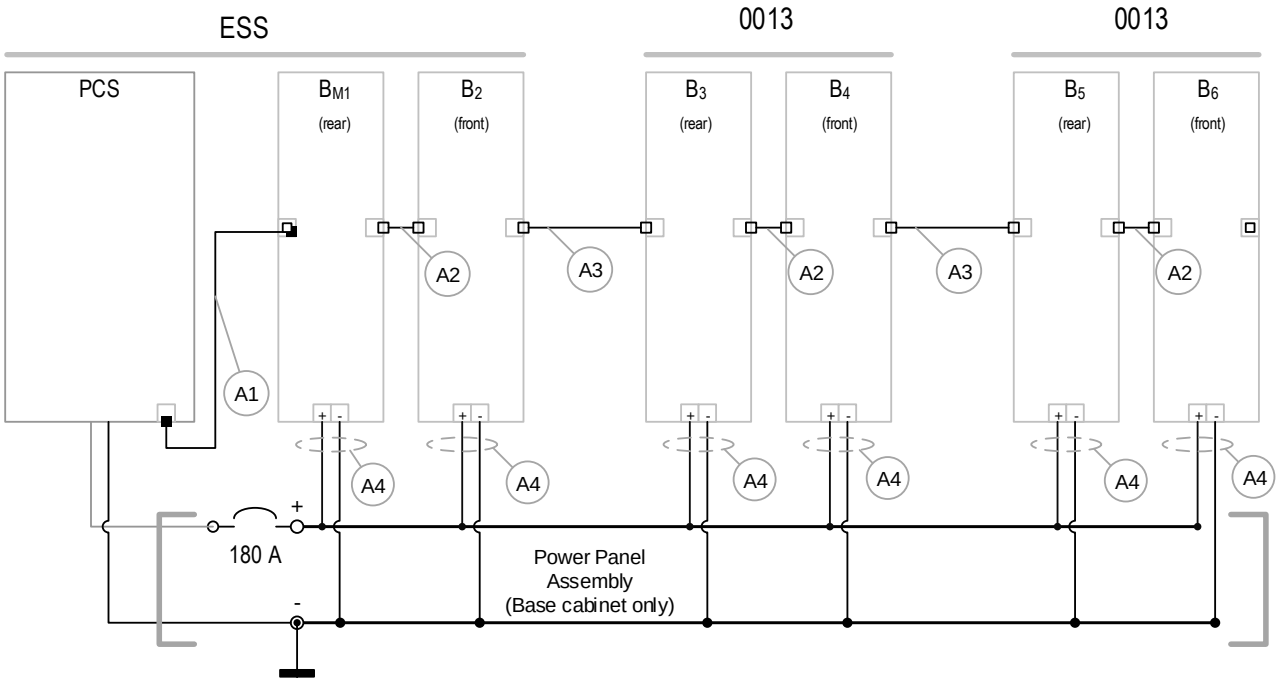


Figure 13: Electrical block diagram of the Evolve ESS, including the base system and expansion battery cabinets with inter-cabinet wiring references.

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