AMPS HP2 Power System

Technical Guide: 0260080-J0

Effective: 09/2019

Alpha Technologies Ltd.

an EnerSys company

AMPS HP2 Power Systems

NOTE:

Photographs contained in this manual are for illustrative purposes only. These photographs may not match your installation.

NOTE:

Operator is cautioned to review the drawings and illustrations contained in this manual before proceeding. If there are questions regarding the safe operation of this powering system, contact Alpha Technologies or your nearest Alpha representative.

NOTE:

Alpha shall not be held liable for any damage or injury involving its enclosures, power supplies, generators, batteries, or other hardware if used or operated in any manner or subject to any condition not consistent with its intended purpose, or is installed or operated in an unapproved manner, or improperly maintained.

For technical support, contact Alpha Technologies:
Canada and USA: **1-888-462-7487**

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1. Safety

SAVE THESE INSTRUCTIONS: This manual contains important safety instructions that must be followed during the installation, servicing, and maintenance of the product. Keep it in a safe place. Review the drawings and illustrations contained in this manual before proceeding. If there are any questions regarding the safe installation or operation of this product, contact Alpha Technologies or the nearest Alpha representative.

1.1 Safety Symbols

To reduce the risk of injury or death, and to ensure the continued safe operation of this product, the following symbols have been placed throughout this manual. Where these symbols appear, use extra care and attention.

The use of ATTENTION indicates specific regulatory/code requirements that may affect the placement of equipment and /or installation procedures.

NOTE:

A NOTE provides additional information to help complete a specific task or procedure. Notes are designated with a checkmark, the word NOTE, and a rule beneath which the information appears

CAUTION!

CAUTION indicates safety information intended to PREVENT DAMAGE to material or equipment. Cautions are designated with a yellow warning triangle, the word CAUTION, and a rule beneath which the information appears.

WARNING!

WARNING presents safety information to PREVENT INJURY OR DEATH to personnel. Warnings are indicated by a shock hazard icon, the word WARNING, and a rule beneath which the information appears.

HOT!

The use of the BURN HAZARD symbol (1508005) on the product indicated a potential hazard to the technical or user. The AMPS HP2 rear panel surface may exceed 70°C.

1.2 General Warning and Cautions

WARNING!

You must read and understand the following warnings before installing the enclosure and its component. Failure to do so could result in personal injury or death.

- Read and follow all instructions included in this manual.
- Only trained personnel are qualified to install or replace this equipment and its components.
- Use proper lifting techniques whenever handling equipment, parts, or batteries.

1.3 General Safety

- Only qualified personnel shall install, operate, and service the power system and components.
- Installation instructions provided with each unit.
- Observe all applicable national and local electrical and building codes during installation.
- Maintain the security of all SELV circuits in the system when connecting to other equipment like signaling/alarm circuits, emergency power off (EPO) circuits, relay contacts, Ethernet or CANbus. The other equipment must be the same circuit type.
- Bolt the AMPS HP2 system securely to the floor.
- Always assume electrical connections and/or conductors are live.
- Turn off all circuit breakers and double-check potentially charged components with a voltmeter before performing installation or maintenance.
- Before installation, verify that the input voltage and current requirements of the load are within the specifications of the power system. Refer to the product nameplate label.
- Keep tools away from walk areas to prevent personnel from tripping over the tools.
- Wear safety glasses when working under any conditions that may be hazardous to your eyes.
- Do not work on the power system, or connect or disconnect cables, during atmospheric lightning activity.
- Do not let water enter the enclosure as this can cause electrical shorts, shocks, or electrocutions.
- Do not remove the covers of electrical components as this can cause electrical shorts, shocks or electrocutions. There are no user serviceable parts inside.
- The power system is certified for use in restricted access locations only.
- All operators must be trained to perform the emergency shutdown procedure.
- The power system must be connected only to a dedicated branch circuit.
- Equip the utility service panel with a circuit breaker of appropriate rating.
- Do not exceed the output rating of the system when connecting the load.
- External metal surface temperatures on the rear of the AMPS HP2 system can exceed 70°C, do not touch. Use caution when working around the equipment while it is in operation.
- Always use proper lifting techniques when handling units, modules, or batteries.
- The power system contains more than one live circuit. Voltage may still be present at the output even when the input voltage is disconnected.
- Minimize the risk of sparks and wear on the connectors. Always switch off the inverter's battery circuit breaker before connecting or disconnecting the batteries.
- In the event of a short-circuit, batteries present a risk of electrical shock and burns from high currents. Observe proper safety precautions.
- Always wear protective clothing, such as insulated gloves, and safety glasses or a face shield when working with batteries.
- Carry a supply of water, such as a water jug, to wash eyes or skin in case of exposure to battery electrolyte.
- Do not allow live battery wires to contact the enclosure chassis. Shorting battery wires can result in a fire or possible explosion.
- Replace batteries with those of an identical type and rating. Never install old or untested batteries.
- Only use insulated tools when handling batteries or working inside the enclosure.

- Remove all rings, watches and other jewelry before servicing batteries.
- Recycle used batteries. Spent or damaged batteries are environmentally unsafe. Refer to local codes for the proper disposal of batteries.
- A disconnect switch shall be provided by others for the AC input and AC output circuits.
- Risk of Electric Shock and Fire Hazard: replace fuse with the same type and rating.

CAUTION!

Risk of electric shock, do not remove panels or covers. There are no user serviceable parts inside. Refer to qualified personnel.

1.4 External Battery Safety

- The power system requires an over-current protection device for the external batteries. Follow the local electrical codes.
- Ensure that the external battery connection is equipped with a disconnect.

WARNING!

The battery polarity must be correct or damage will result.

- If the batteries are stored for extended periods before the installation, charge the batteries at least once every three months to ensure optimum performance and maximum battery service life.
- Refer to the battery manufacturer's recommendation to select the correct float and equalize charge voltage settings. Failure to do so can damage the batteries. Verify that the battery charger's float and equalize settings are correct.
- The batteries are temperature sensitive. During extremely cold conditions, a battery's charge acceptance is reduced and requires a higher charge voltage. During extremely hot conditions, a battery's charge acceptance is increased and requires a lower charge voltage. To allow for changes in temperature, the battery charger must be equipped with a temperature compensating system. For UPS configurations with rectifier, refer to the rectifier manual for information about temperature compensation.
- If the batteries appear to be overcharged or undercharged, first check for defective batteries and then verify that the charger voltage settings are correct.
- To ensure optimal performance, inspect the batteries according to the battery manufacturers recommendations. Check for signs of cracking, leaking, or unusual swelling. Some swelling is normal.
- Check the battery terminals and connecting wires. Periodically clean the battery terminal connectors and retighten them to the battery manufacturer's torque specifications. Coat the terminals with an approved battery terminal coating such as NCP-2 or No-Ox.
- Verify that the polarity of the cables are correct before connecting the batteries to the power module. The polarity is clearly marked on the batteries. The battery breaker will trip and the rectifiers may be damaged if the cables are connected with the wrong polarity.
- Batteries are not provided and external battery cabinets are not part of this certification.

1.5 Utility Power Connection

Connecting to the utility must be performed by qualified service personnel only and must comply with local electrical codes. The utility power connection must be approved by the local utility before the installation.

WARNING!

Multiple power inputs: disconnect all inputs before servicing to avoid electric shock.

- AMPS-3-75 and AMPS-2-40 UPS are rated for use on a circuit capable of delivering no more than 10KA rms symmetrical amperes, 120V maximum.
- AMPS-3-30, AMPS2-20 and AMPS-1-10 UPS are rated for use on a circuit capable of delivering nor more than 5 KA rms symmetrical amperes, 120V maximum.

1.6 Equipment Grounding

To provide a ready, reliable source of backup power, the power system must be connected to an effective grounding and earthing system. The grounding system must be designed to protect both personnel and equipment.

WARNING!

High leakage current. Earth connections essential before connecting power supply. Low impedance grounding is mandatory for personnel safety, critical for the proper operation of the system, and must be in place and connected to the system before the supply cables are connected.

1.6.1 Safety Ground

The safety ground is a two-part system – the utility service ground and the power system ground.

Utility Service Ground

WARNING!

Risk of electric shock. The UPS equipment powered by this service panel requires the neutral to be bonded to ground. Disconnect the UPS DC batteries before servicing the panel.

As a minimum requirement for the protection of equipment, the local utility service must provide a low-impedance path for fault current return to Earth. This must meet or exceed the requirements of the US National Electrical Code or the Canadian Electrical Code.

Power System Ground

The power system ground consists of a low-impedance connection between the enclosure and an Earth Ground, which must be located at least six feet away from the utility earth connection.

1.6.2 Lightning Strike Ground

Lightning strikes, grid switching, or other power surges on the power line and/or communications cable can cause high-energy transients that can damage the power or communications systems. Without a low-impedance path to the ground, the current will travel through wires of varying impedance, which can produce damaging high voltages. The best method to protect the system from damage is to divert unwanted high-energy transients along a low-impedance path to the ground. See 8.6 for information on the surge suppression modules installed in the AMPS HP2.

2. Product Description

The Alpha Modular Power System (AMPS HP2) is a unique, high performance AC and hybrid AC/DC power system that is ideally suited to provide highly reliable back-up power to cable headend, telecom or server room facilities.

The AMPS HP2 features hot swappable 2.5kVA / 2.0kW inverter modules and optional 2.4kW rectifier modules that are the building blocks of a highly reliable power system. A smart, unified controller with an integrated Ethernet/ SNMP monitors and manages both inverter and rectifier modules through a web based interface and a local LCD touch screen. The AMPS HP2 is designed to be installed in a climate-controlled environment where ambient temperatures are between -20°C to 40°C.

2.1 Power System Configuration Terminology

This section lists the power configurations available with the system and defines the terminology used throughout this manual.

120Vac Single Phase

A single phase system is 120Vac from L1 to N (neutral).

120/240Vac Split Phase

The term 120/240Vac SPLIT PHASE is used throughout this manual to identify the “3-wire/ 2 legs from a single phase supply” configuration shown in Figure 1.

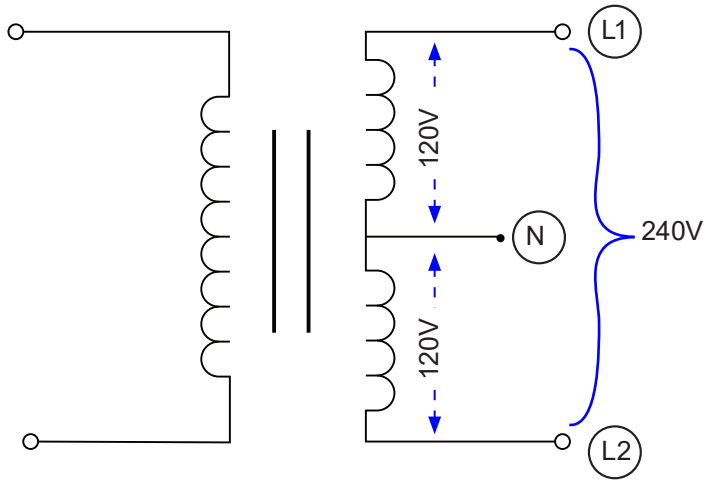


Figure 1 — Split Phase from a Single Phase Supply

120/208Vac 2-Pole

The term 120/208 2-POLE is used throughout this manual to identify the “2-pole from a 3-phase supply” configuration such as L2 to L3 shown in Figure 2

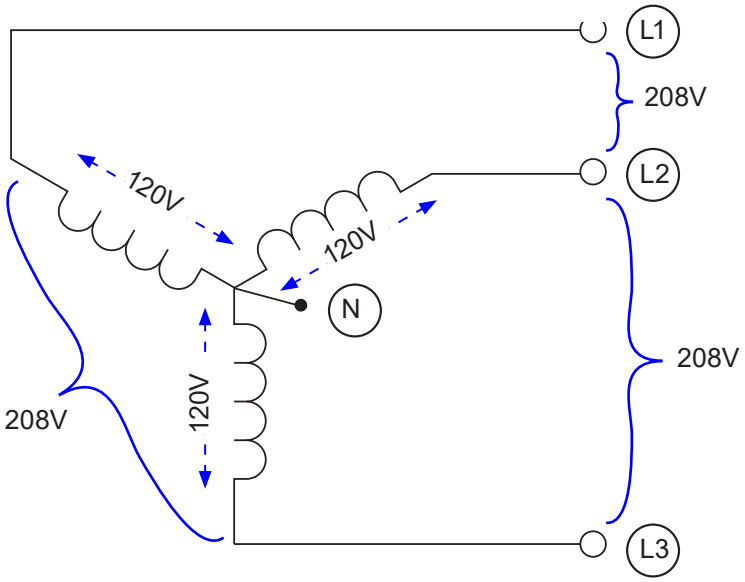


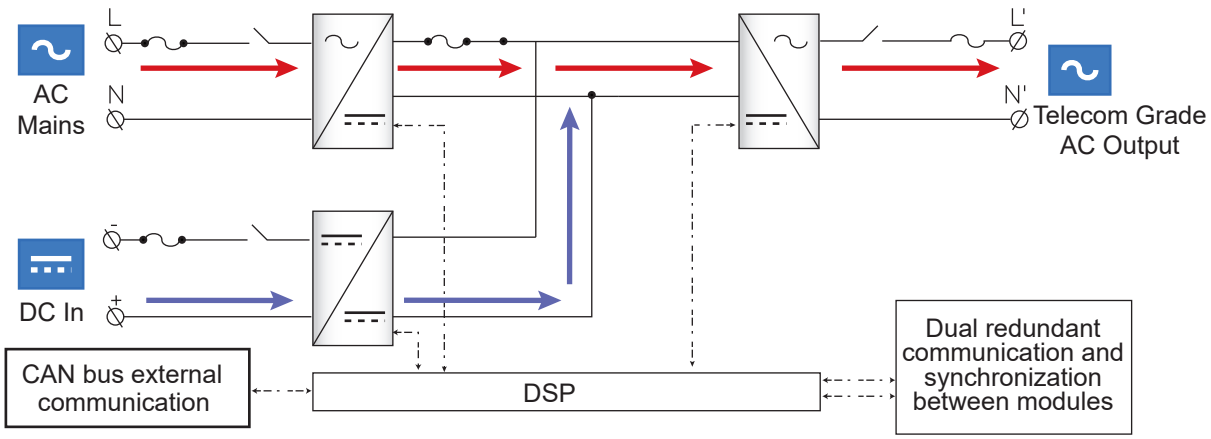
Figure 2 — 2-Pole from a 3-Phase Supply

120/208Vac 3-Phase

Each phase conductor is 120 degrees out of phase with the other, as shown in Figure 2. All three phases (3-pole) plus the neutral are in use.

2.2 Theory of Operation

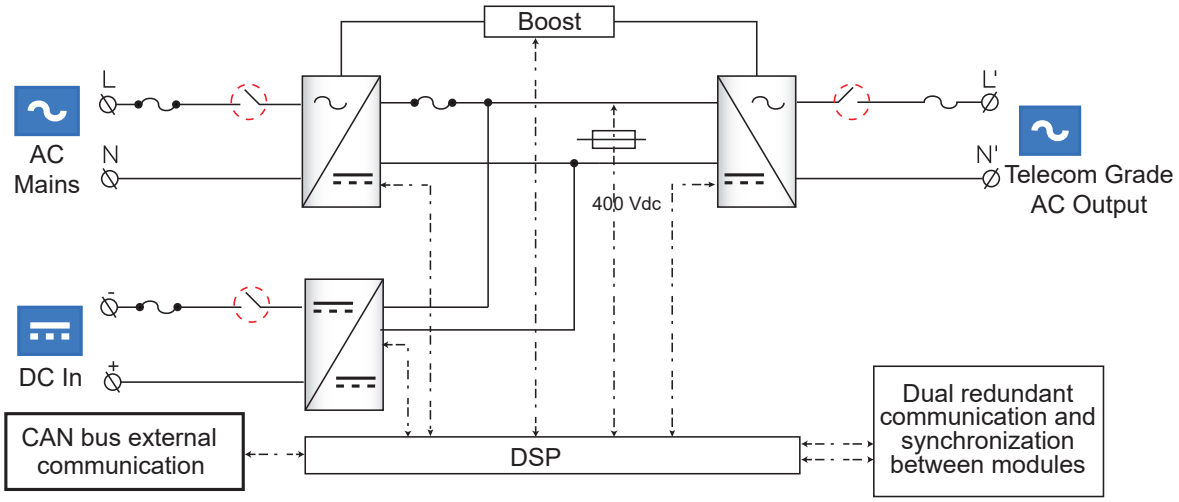
Each AMPS module includes a reliable 48Vdc to 120Vac inverter as well as an AC-to-DC converter. When AC Mains is available, AC power is converted to a high voltage DC bus, which is then converted back to AC. In this high performance (HP) mode, AMPS delivers fully conditioned, line-regulated telecom-grade AC power with 94% system efficiency.



When AC Mains is unavailable, DC battery power is converted to AC with zero transfer time. An intelligent high voltage DC bus decides when to draw power, and how much power to draw, from AC or DC source. During AC input brownout condition, output power is supplemented by battery power.

AC to DC input transfer can also be automatically triggered via the system controller to enable advanced operation such as utility peak shaving.

In case of a fault, advanced DSP controls allow the AMPS module to isolate itself, while the rest of the system continues to power the load (with reduced output).



AMPS modules also have a 'Boost' over-current feature with 10 times the rated current capacity for 20ms, allowing it to trip breakers downstream, thus protecting the load.

2.2.1 AC or DC input priority

The user can choose either AC or DC input priority. If AC priority is chosen, the AMPS HP2 acts more like an on-line, double conversion UPS. If AC commercial power is available, this power is filtered twice and passed to the AC output. If the AC commercial power fails, the DC converter simply takes over and supplies the power from the batteries.

If DC priority is chosen, the AMPS HP acts more like an Inverter with AC bypass function. Normally, power is drawn from the batteries. If DC power fails, the AC-DC converter takes over, still providing regulated and filtered power to the load.

2.2.2 AMPS HP External Maintenance Bypass Switch

This diagrams show the logical internal connections. They are not a detailed representation of the actual internal system wiring.

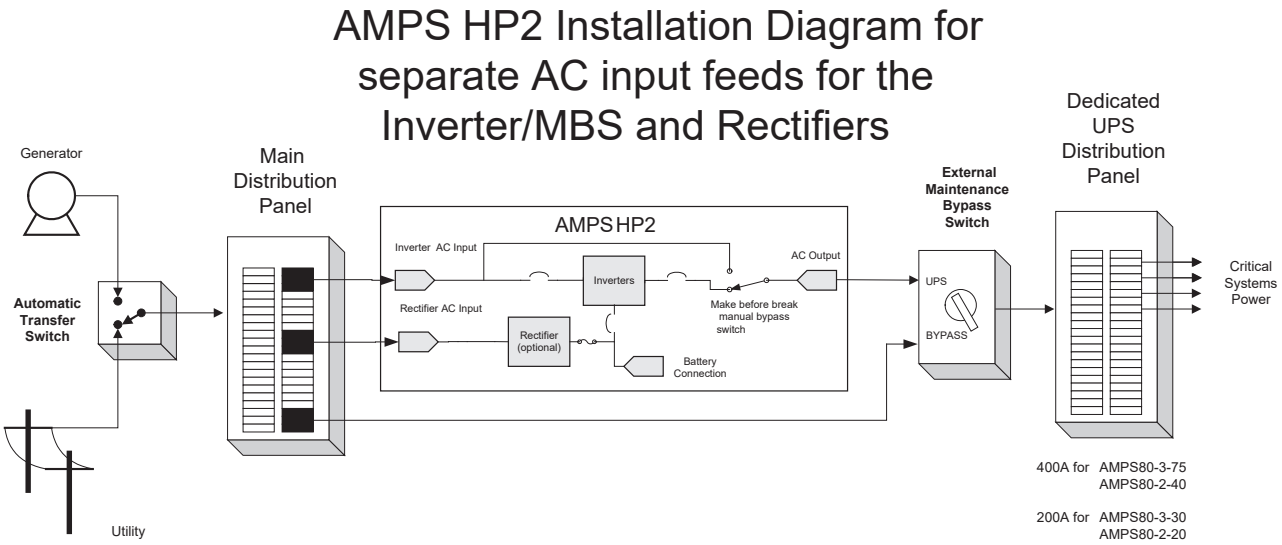


Figure 3 — Example wiring for AMPS inverter system w/ independent AC input feed for MBS

2.2.3 Wiring for Generator and/or External MBS

Refer to Figure 4 for schematic of a system with a generator and/or external MBS.

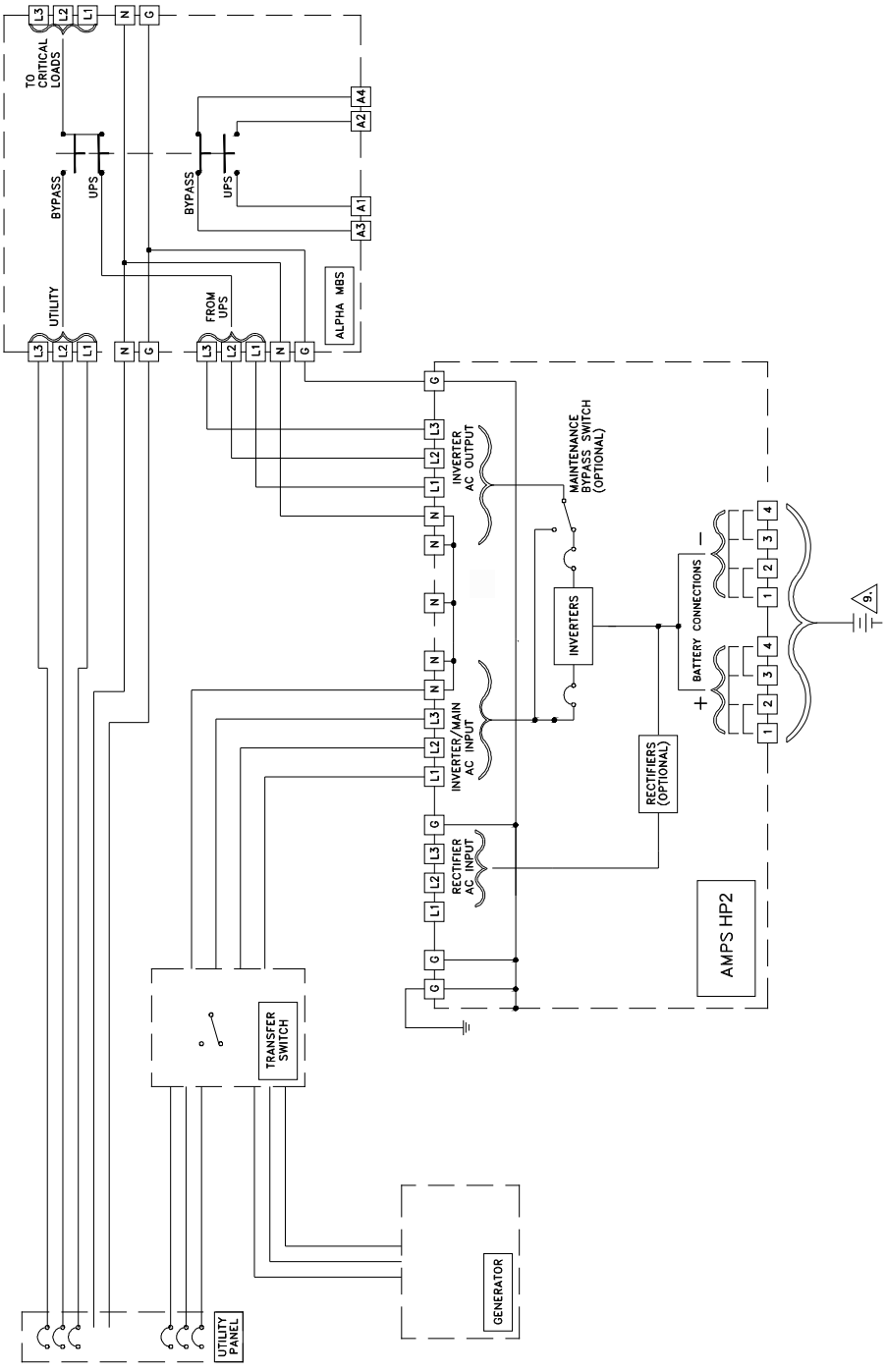


Figure 4 — System Schematic with Generator and MBS

2.2.4 AMPS HP2 Models

The versatile AMPS HP2 can be configured for use as an Inverter or a UPS in either single, split, or three-phase arrangements. 19-inch and 23-inch rack-mount versions are available in 10-30kVA inverter configurations. The seven-foot Box Bay, 40kVA & 75kVA are available as an Inverter or a UPS. All AMPS HP2 products use the same core modular inverter modules and are controlled by Alpha's CXC HP controller. See section 4 for details on the Box Bay systems, and section 5 for details on the Rack Mount systems.

Box Bay System configurations are:

- 2-40: 120/240Vac Split Phase or 120/208VAC 2 Pole; 40kVA Capacity
- 3-75: Three Phase 120/208VAC; 75kVA Capacity 68kVA/54kW N+1 rating

Both Box Bay systems are available as a UPS configuration using Cordex 2.4kW high efficiency rectifiers. System are available with Top Feed AC and DC or Top Feed AC and Bottom Feed DC from the factory.

Rack Mount System Configurations are:

- 1-10: Single Phase 120V; 10kVA Capacity
- 2-20: 120/240V Split Phase or 120/208V 2-Pole; 20kVA Capacity
- 3-30: Three Phase 208V; 30kVA Capacity

Figure 5 — AMPS HP2 Box Bay System

Figure 6 — AMPS HP2 Rack Mount System

3. Specifications

Table A — Specifications for 48-120 Inverter Module	
Compliance	
EMC (immunity):	EN 61000-4
EMC (emission):	EN55022 (Class A), FCC 47 VFR Part 15, class A
Safety:	IEC 60950, UL 1778 Issue 4
Cooling:	Forced Air
MTBF:	240,000hrs
Efficiency (typical):	
Enhanced Power Conversion:	94%
On Line:	89%
AC Output Power	
Nominal:	2500VA
Resistive Load:	2000W
Overload Capacity (short):	150% @ 5s
Overload Capacity (permanent):	110%
DC Input	
Nominal:	48V
Range (Vdc):	40 to 60V
Nominal Current (@ 40Vdc):	56A
Max input current (5s):	84A
Voltage Ripple:	2mV
AC Input Specifications	
Nominal Voltage (AC):	120Vac
Voltage Range (AC):	90 to 140Vac (adjustable)
Power Factor:	> 99%
Frequency Range (selectable):	60Hz
Frequency Tolerance:	± 3Hz (adjustable)
AC Output	
Nominal (AC)*:	120Vac Accuracy 2%
Frequency:	60Hz (Same as input frequency in EPC mode)
Frequency Accuracy:	0.03%
Transient Load Recovery Time:	0.4ms
Transfer Performance	
Maximum Voltage Interruption:	0s
Total Transient Voltage Duration:	0s
Environmental	
Operating Temperature:	-20 to +40°C
Storage Temperature:	-40 to +70°C
Humidity:	Up to 95% non-condensing
Elevation:	<1500M
Mechanical	
Dimensions:	2 RU H x 102mm W x 435mm D
Weight:	5kg (11lb.)

3.1 Specifications for 48-2.4kW Rectifier Module

Electrical	
Input Voltage:	
Nominal:	208 to 277Vac
Operating:	187 to 310Vac
Extended:	90 to 187Vac (de-rated power)
Input Frequency:	44 to 66Hz
Power:	2400W continuous
	(1200W output @ 120Vac Input)
Power Factor:	>0.99 (50 to 100% load)
THD:	<5%
Efficiency:	96.2% peak
Output Voltage:	42 to 58Vdc (No load 46.5 to 58Vdc)
Output Current:	44.5A @ 54Vdc (50A max.@ 48Vdc)
	(~25A @ 48Vdc at 120Vac Input)
Load Regulation:	<±0.7% (static)
Line Regulation:	<±0.1% (static)
Transient Response:	±3% for 40 to 90% load step
Noise:	
Voice Band:	<38dBrnC
Wide Band:	<20mV RMS (10kHz to 10MHz)
	<150mV peak to peak (10kHz to 100MHz)
Psophometric Noise:	<2mV RMS
Acoustic:	<60dBa @ 1m (3ft), 30°C
MTBF:	627,000 hours (71 years) per Telcodia SR332 - Issue 3 (2011)
Ambient:	30° C - ground benign, controlled
Mechanical	
Dimensions H x W x D:	41mm x 104mm x 333mm (1.6in x 4.1in x 13.1in)
Weight:	1.76kg (3.9lb)
Environmental	
Temperature:	
Operation:	-40 to 75°C (-40 to 149°F)
Full Nominal Output Power:	-40 to 55°C (-40 to 131°F); >2000W @ 65°C (167°F)
Storage:	-40 to 85°C (-40 to 185°F)
Humidity:	0 to 95% RH non-condensing
Heat Dissipation:	<350BTU per hour (typical)
	<500BTU per hour (worst case: 100% load at 187Vac)

4. AMPS HP2: Box Bay Systems

The AMPS HP2 consists of a number of individual subsystems designed to work together to provide highly reliable, filtered power in support of the load. A typical AMPS HP2 box bay system contains the following:

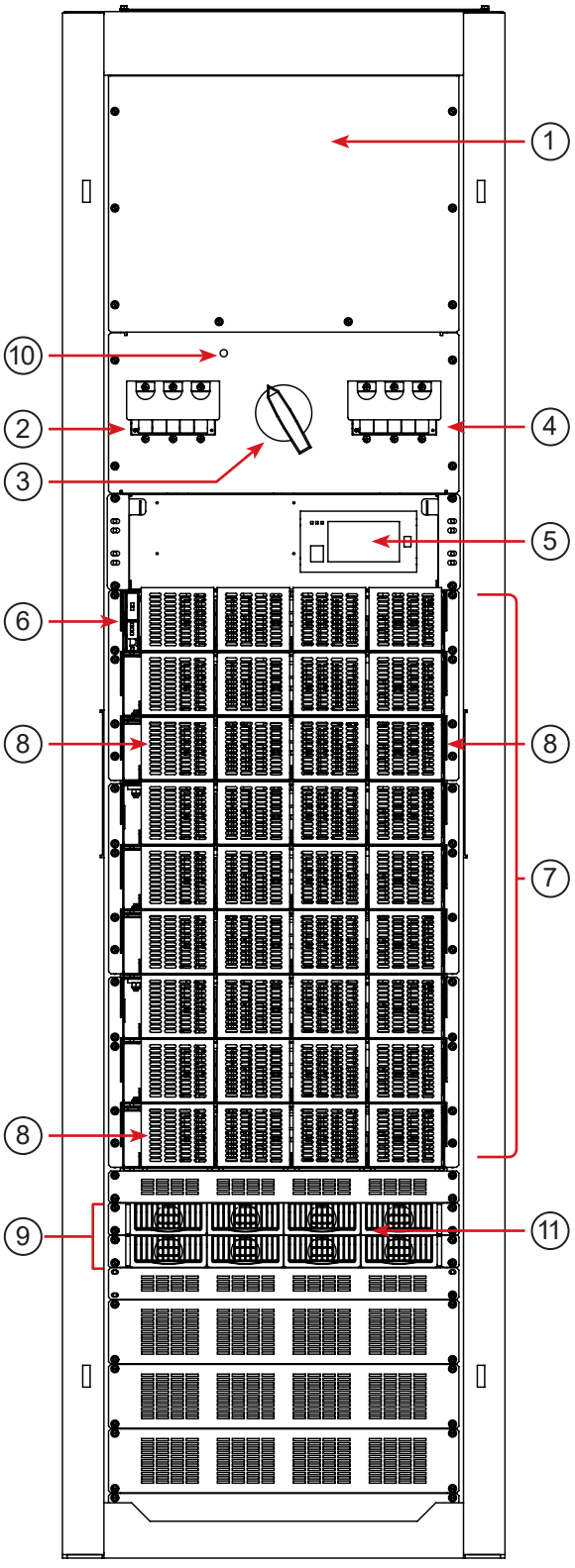


Figure 7 — AMPS HP2, 3-75

1. **Main Wiring Access Panel:** AC input and output as well as Safety Extra-Low Voltage (SELV) DC battery connections are accessed through the front panel and fed through the knockouts at the top of the rack.
2. **Inverter AC Input Breaker:** Serves as the main disconnect for the inverter AC input.
3. **Maintenance Bypass Switch (MBS):** Can be used to route power directly from the AC input to the AC output, bypassing the inverter modules.
4. **Inverter AC Output Breaker:** Serves as the main disconnect for the inverter AC outputs.
5. **CXC Unified System Controller with integrated Ethernet/ SNMP:** Monitors and manages both inverter and rectifier modules through a web-based GUI and local LCD touch screen. This is a SELV controller.
6. **T2S Inverter Control Card:** Communicates with the CXC Unified controller. This is a SELV Controller.
7. **Inverter Modules and shelves:** Up to 9 shelves containing 4 hot-swappable 2500 VA / 2000 W inverter modules on each shelf.
8. **Inverter Blank Modules**
9. **Rectifier Modules and shelves (optional):** Two shelves contain up to six hot-swappable 2400W rectifier modules three per shelf. The rectifiers are used as the SELV DC battery charging component of a hybrid system.

   Each rectifier shelf is only connected to one of the DC-battery feeds: the top shelf to DC1, and the bottom rectifier shelf is connected to DC4. In a system with four independent battery feeds, two of these battery banks will not be charged from the rectifiers.
10. **AC Input LED:** This LED is normally lit if AC input power is available at the bypass switch. If the LED is not lit, check the AC input.
11. **Rectifier Blank Module:** Slot 4 in both shelves is not wired. Do not place any module in these slots.

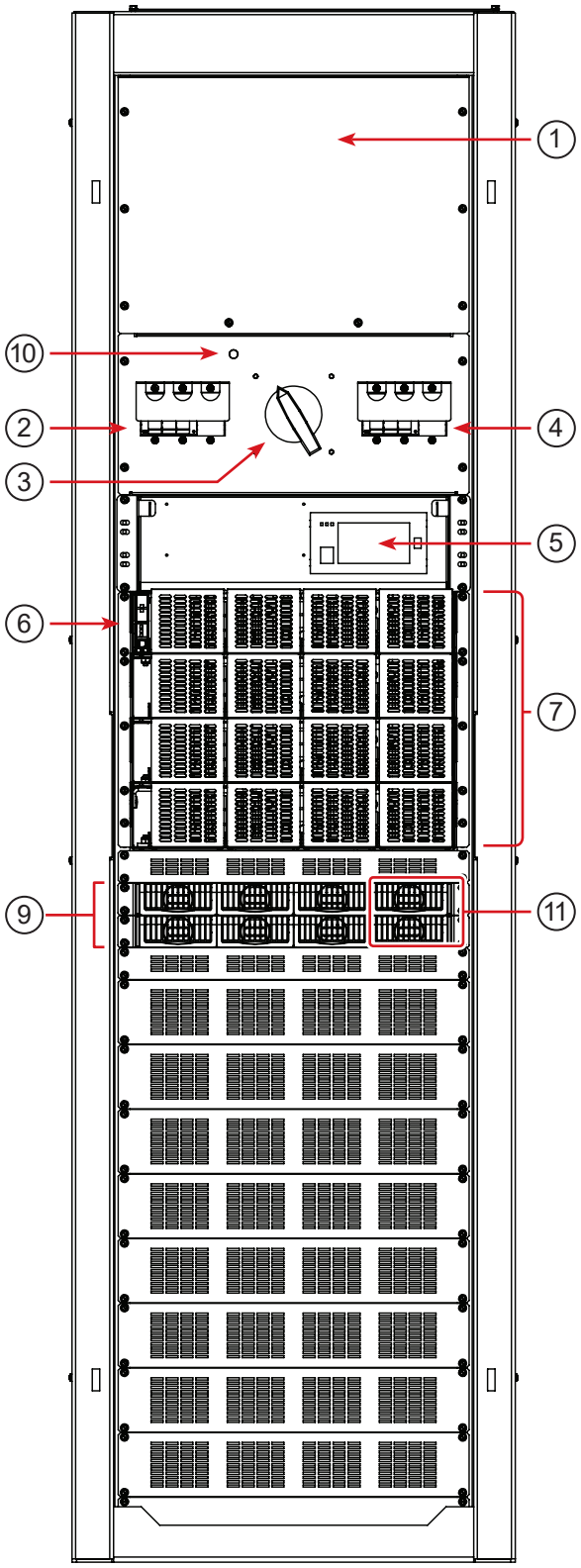


Figure 8 — AMPS HP2, 40KVA

1. **Main Wiring Access Panel:** AC input and output as well as Safety Extra-Low Voltage (SELV) DC battery connections are accessed through the front panel and fed through the knockouts at the top of the rack.
2. **Inverter AC Input Breaker:** Serves as the main disconnect for the inverter AC input.
3. **Maintenance Bypass Switch (MBS):** Can be used to route power directly from the AC input to the AC output, bypassing the inverter modules.
4. **Inverter AC Output Breaker:** Serves as the main disconnect for the inverter AC outputs.
5. **CXC Unified System Controller with integrated Ethernet/ SNMP:** Monitors and manages both inverter and rectifier modules through a web-based GUI and local LCD touch screen. This is a SELV controller.
6. **T2S Inverter Control Card:** Communicates with the CXC Unified controller. This is a SELV Controller.
7. **Inverter Modules and shelves:** 4 shelves containing 4 hot-swappable 2500 VA / 2000 W inverter modules on each shelf.
8. **Inverter Blank Modules:** not applicable in this model.
9. **Rectifier Modules and shelves (optional):** Two shelves contain up to six hot-swappable 2400W rectifier modules three per shelf. The rectifiers are used as the SELV DC battery charging component of a hybrid system.

   Each rectifier shelf is only connected to one of the DC-battery feeds: the top shelf to DC1, and the bottom rectifier shelf is connected to DC4. In a system with four independent battery feeds, two of these battery banks will not be charged from the rectifiers.
10. **AC Input LED**: This LED is normally lit if AC input power is available at the bypass switch. If the LED is not lit, check the AC input.
11. **11. Rectifier Blank Module:** Slot 4 in both shelves is not wired. Do not place any module in these slots.

4.1 Specifications AMPS HP2: Box Bay

Model			AMPS 3-75 (N+1)	AMPS 3-75 (N+1) R	AMPS 2-40	AMPS 2-40R
AC Input	AC Input Voltage		120/208Vac 3-Phase	120/208Vac 3-Phase	120/208Vac 2 Pole (or) 120/240Vac Split-Phase	120/208Vac 2 Pole (or) 120/240Vac Split-Phase
	Full Load inverter AC Input Current (per phase)		190A	190A	160A	160A
	Full Load rectifier AC Input Current (per phase)		x	40A, 3 Pole	x	60A, 2 Pole
	AC Input poles & wiring		4 w + G	4 w + G	3 w + G	3 w + G
	Wiring		3Φ Wye	3Φ Wye	2Φ	2Φ
	AC inverter input Breaker/ fuse See Note: 2		250A 3 Pole	250A 3 Pole	200A 2 Pole	200A 2 Pole
	AC rectifier input Breaker/ fuse See Note: 2		x	50A 3 Pole	x	100A 2 Pole
	Recommended AC Input Wire size, 90ºC copper See Note: 1					
		Inverter	2X 2/0	2X 2/0	2x 1/0	2x 1/0
		Rectifier	x	#6 AWG	x	#2 AWG
AC Output	Total AC Output (Max)		68kVA, 54kW (n+1)	68kVA, 54kW (n+1)	40kVA, 32kW	40kVA, 32kW
	AC Output Voltage		120/208Vac 3-Phase	120/208Vac 3-Phase	120/208Vac 2-Pole (or) 120/240Vac Split-Phase	120/208Vac 2-Pole (or) 120/240Vac Split-Phase
	AC Output poles & wiring		4 w + G	4 w + G	3 w + G	3 w + G
	Wiring		3Φ Wye	3Φ Wye	2Φ	2Φ
	AC Output Current (per Phase)		187.5A	187.5A	167A	167A
	Installed Inverter Input & Output Circuit Breaker		225A, 3 Pole	225A, 3 Pole	225A, 2 Pole	225A, 2 Pole
	Recommended AC Output Wire size, 90ºC copper See Note: 1		2 X2/0	2 X2/0	2x 1/0	2x 1/0

AC Input & Output Connection Terminals
Box lugs are rated for both Aluminum and Copper wire, 2 x 350 KCMIL to 2 x #6 AWG. Fasten clamping screw to 375 in-lbs (42 N-m) for #1 AWG to 350 kcmil wire or 200 in-lbs (23 N-m) for #6 to #2 AWG wire.

Note 1	Inverter AC Input & AC Output connections: Calculations based on full load and t, 0.8 derating with 4 current carrying conductors, (L1,L2,L3,N) @ 40 °C.
Note 2	Consult your local and national electrical codes. AC source must be limited to 10kA Short Circuit Current.

4.1.1 DC Fuse/Breaker AMPS HP2: Box Bay

Alpha recommends using fuses instead of breakers because they provide better fault protection.

NOTE:

The recommendations in Table B are for reference only. A registered professional engineer must review and approve or modify these recommendations in compliance with applicable national and local electrical and building codes.

Table B — Recommended DC fuse/breaker

	Model		AMPS 3-75(n+1) AMPS 3-75(n+1)R	AMPS 2-40 AMPS 2-40R
DC Input	Maximum DC Input wattage		67kW	36kW
	Maximum DC Input Current @ 48Vdc, full load		1396A	750A
	Maximum DC input breaker		2500A, maximum 50kA SCC	
	Recommended minimum DC fuse/ breaker rating (100% rated, per feed)	Single DC feed	1800A	1000A
		Dual DC feed	1200A	500A
		Quad DC feed	600A	250A

4.2 System Pre-Installation

4.2.1 Site Selection

The AMPS HP systems are designed to be installed in a controlled environment, sheltered from rain, excessive dust and other contaminants.

Consider both the floor loading and the physical space required for the power system and the batteries.

4.2.2 Floor Plan Layout

Sufficient free space must be provided at the front and rear of the power system to meet the cooling requirements of the inverters and rectifiers(if installed) in the power system and to allow easy access to the power system components.

Consider the following before selecting a location for the HP power system

- Structure of building able to support the additional weight
- Enough space to meet requirements for access
- Enough space to meet cooling requirements of the rectifiers
- Adequate space to do the install
- Route that equipment will take through the building to reach the site
- Check and record distances to load
- Check and record distances to AC power source
- Check and record distances to batteries/DC power source
- Understand the full load on the DC system
- Window for working hours and other similar restrictions
- Work done in advance
    - » Reinforce floors
    - » Install distribution panels
    - » Install cable racks
    - » Run wiring

4.2.3 Installation Layout AMPS HP2: Box Bay Systems

NOTE:

In the unlikely event that internal components need repair, 1m access around the unit is recommended.

The recommended minimum required clearances around the cabinet are as follows:

- Rear: 12" (30cm) minimum, 18" (46cm) recommended
- Sides: no clearance required.
- Top: 12" (30cm)
- Front: 36" (100cm)

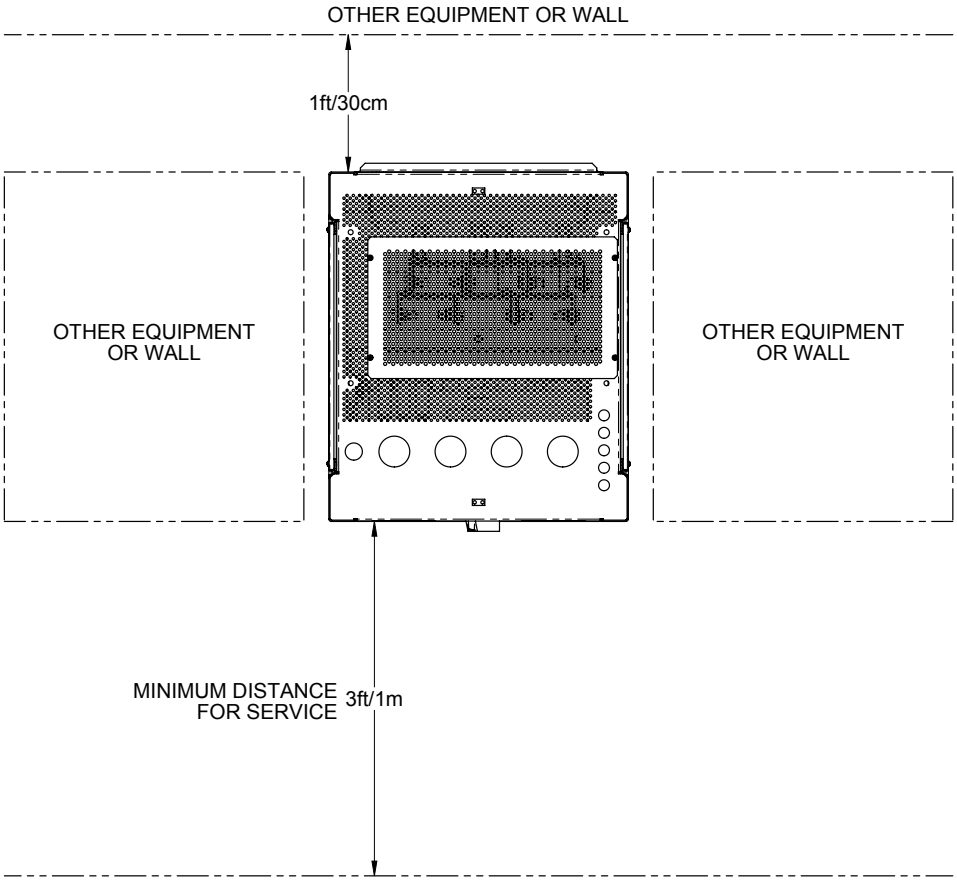


Figure 9 — Installation Layout and Clearances

4.2.4 Transporting the Cabinet

The cabinet is shipped upright on a 123cm x 123cm (48" x 48") pallet. The empty cabinet weighs approximately 320kg (700lb).

The height of the rack, including pallet and shipping material is 232cm (91.25"). When tilting the rack to fit through doors, tilt the rack toward the back and ensure that it is not subjected to sudden shock.

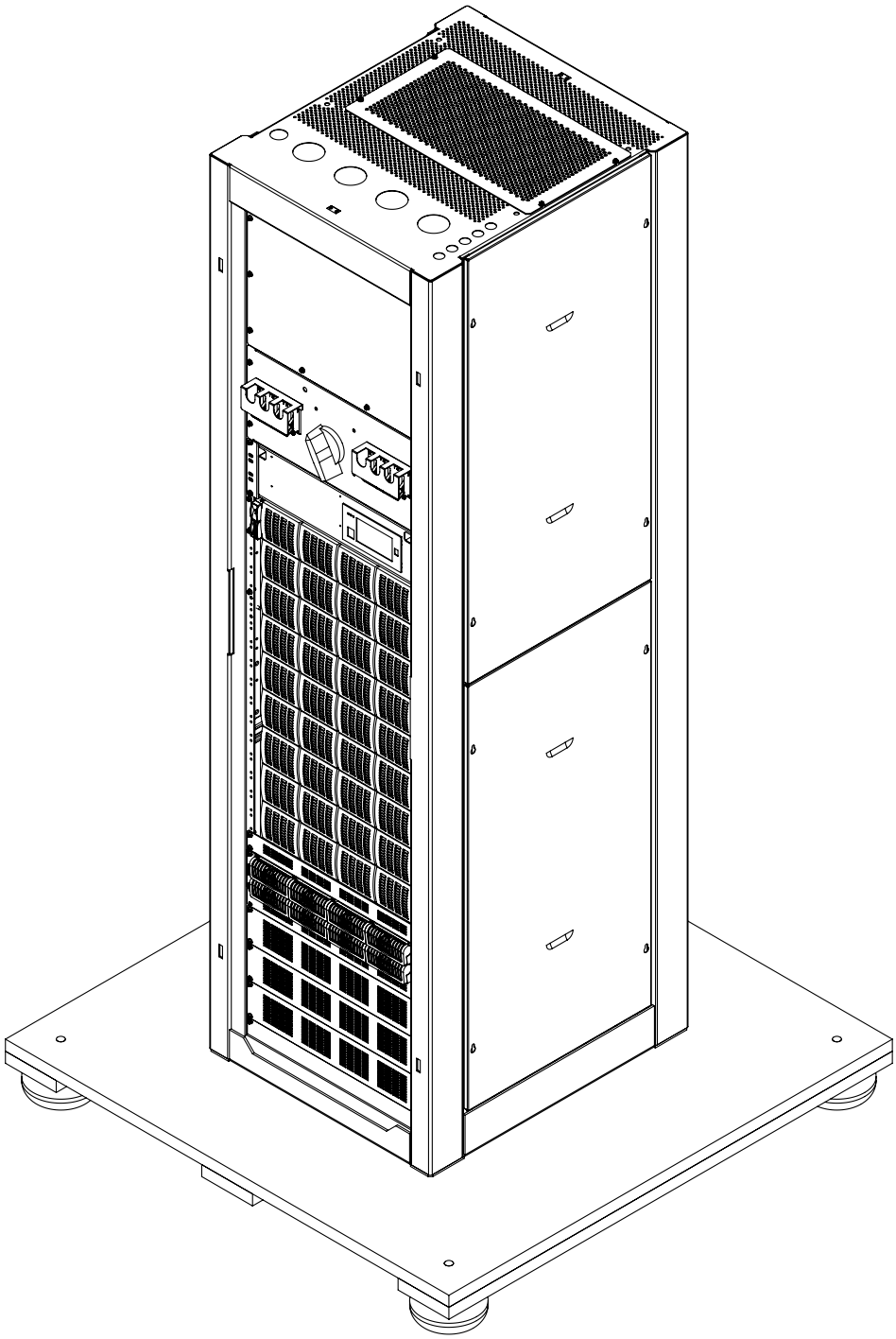


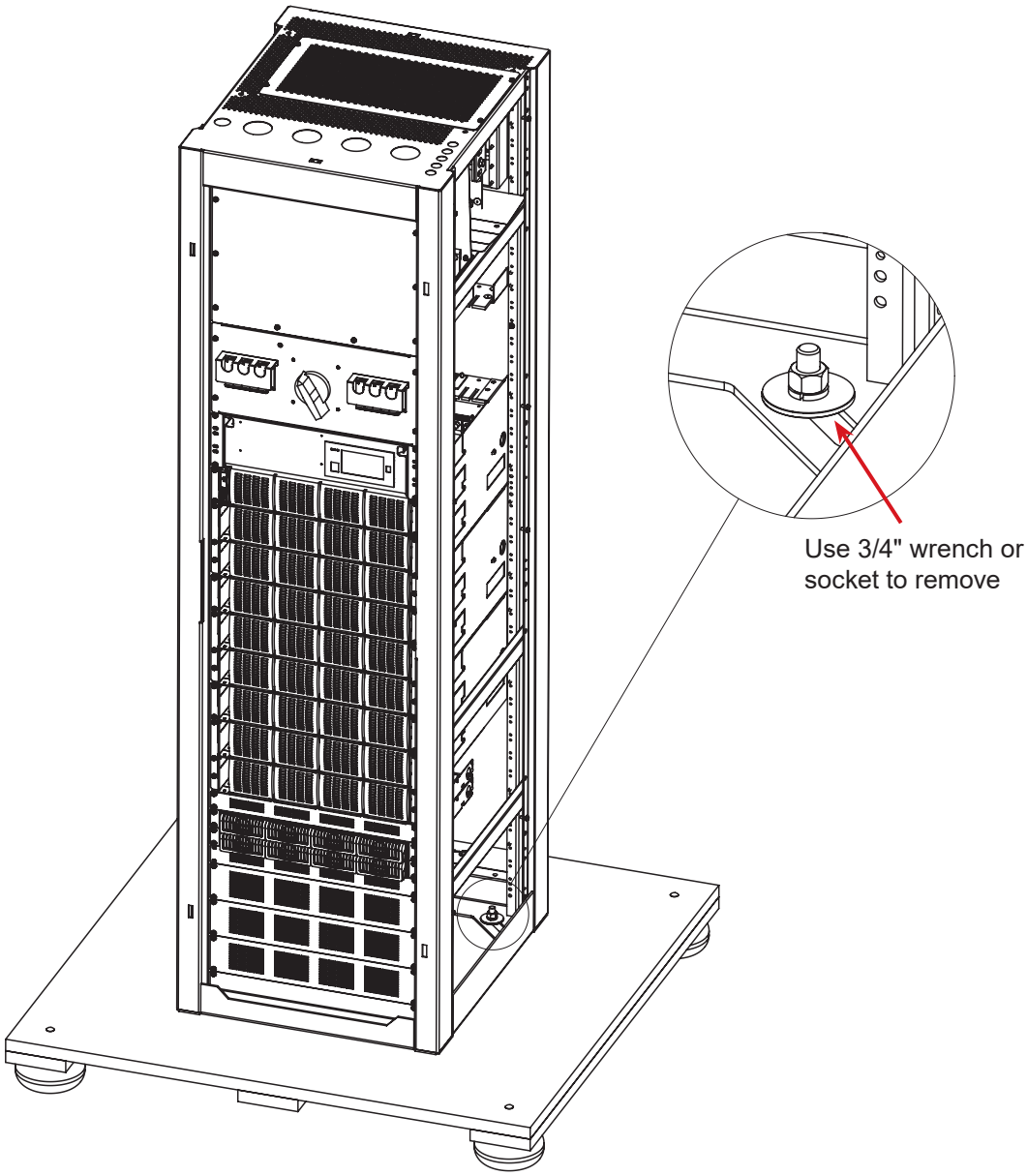
Figure 10 — Transporting the Cabinet

4.2.5 Unpacking Instructions

WARNING!

The AMPS HP2 rack weighs 320kg / 700lb. Care must be taken to ensure that it does not topple over.

1. Loosen the four screws securing the upper side panel, and the four screws securing the lower side panel.
2. Lift off the upper side panel, then lift off the lower side panel.
3. Remove the four bolts securing the AMPS HP2 to the wooden pallet.



4.2.6 Anchoring the Cabinet

The cabinet must be fixed in place by means of anchor bolts. In areas prone to seismic events, use anchors rated for the appropriate Seismic zone.

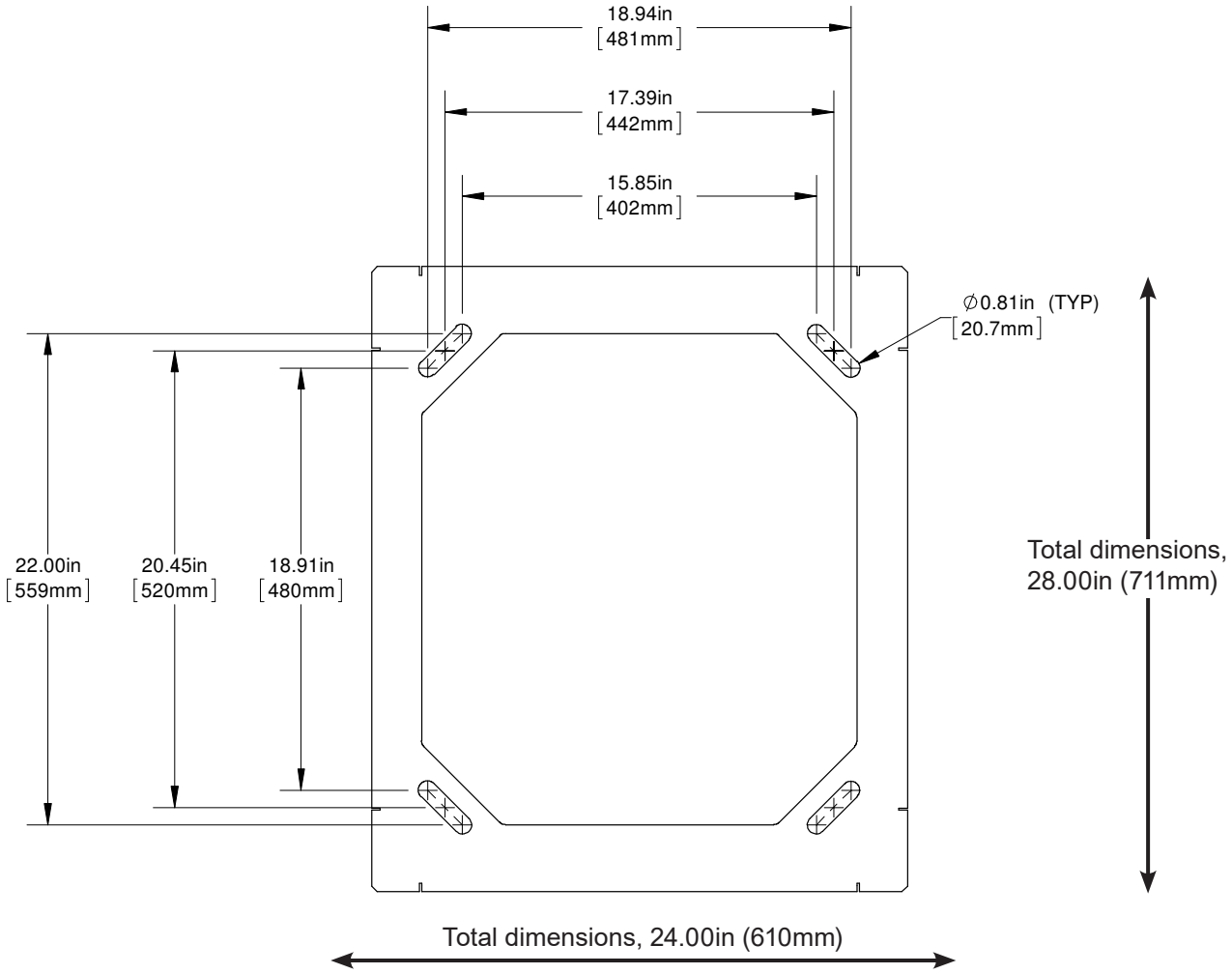


Figure 11 — Mounting Hole Pattern

4.3 System Installation

The AMPS HP2 system is pre-configured from the factory for a single AC feed per phase for inverters, a maintenance bypass switch, and rectifiers if present.

The installer is responsible for connecting the following:

- Utility input to the system (120V line to neutral)
- Battery strings
- System to the load
- Chassis and battery return to the reference ground

Reference Notes:

- DC tie bars are supplied to allow one, two, or four independent battery feeds, see section 4.7.
- If the system is equipped with the optional rectifiers, each rectifier shelf in a hybrid system is only connected to one of the DC- battery feeds: the top shelf to DC1, and the bottom rectifier shelf is connected to DC4. In a system with four independent battery feeds, two of these battery banks will not be charged from the AMPS HP rectifiers. When using two independent A/B feeds, DC1 should be tied to DC2 and DC3 tied to DC4 at the AMPS HP DC connection points. Tie bars are provided.
- Connections and components relating to L3 are only present for 120/208V, 3-phase systems.
- Connections and components relating to L2 are only present for 120/240V split phase and 120/208V 3-phase systems.

4.4 Installation: AMPS HP2: Box Bay

Carefully review the following schematic and installation notes before proceeding with the installation.

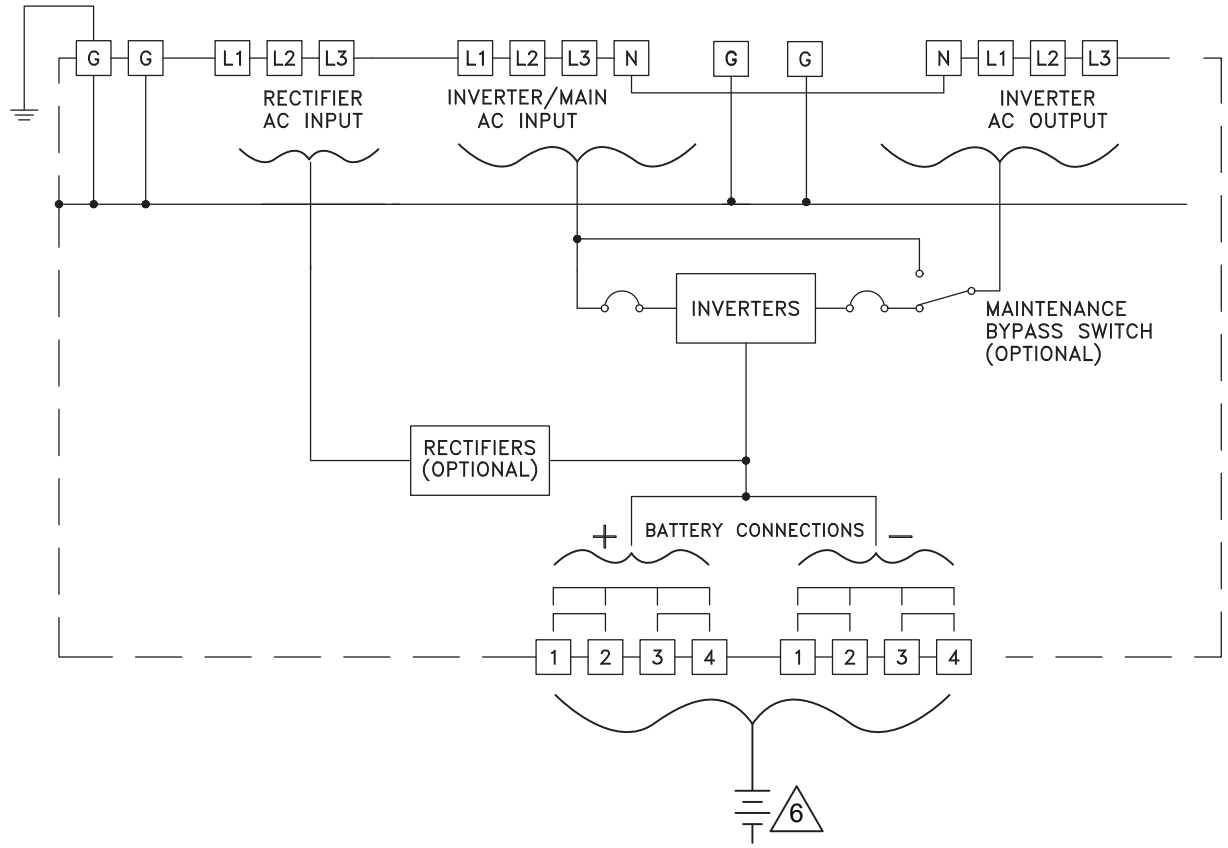


Figure 12 — Battery and Power Connections

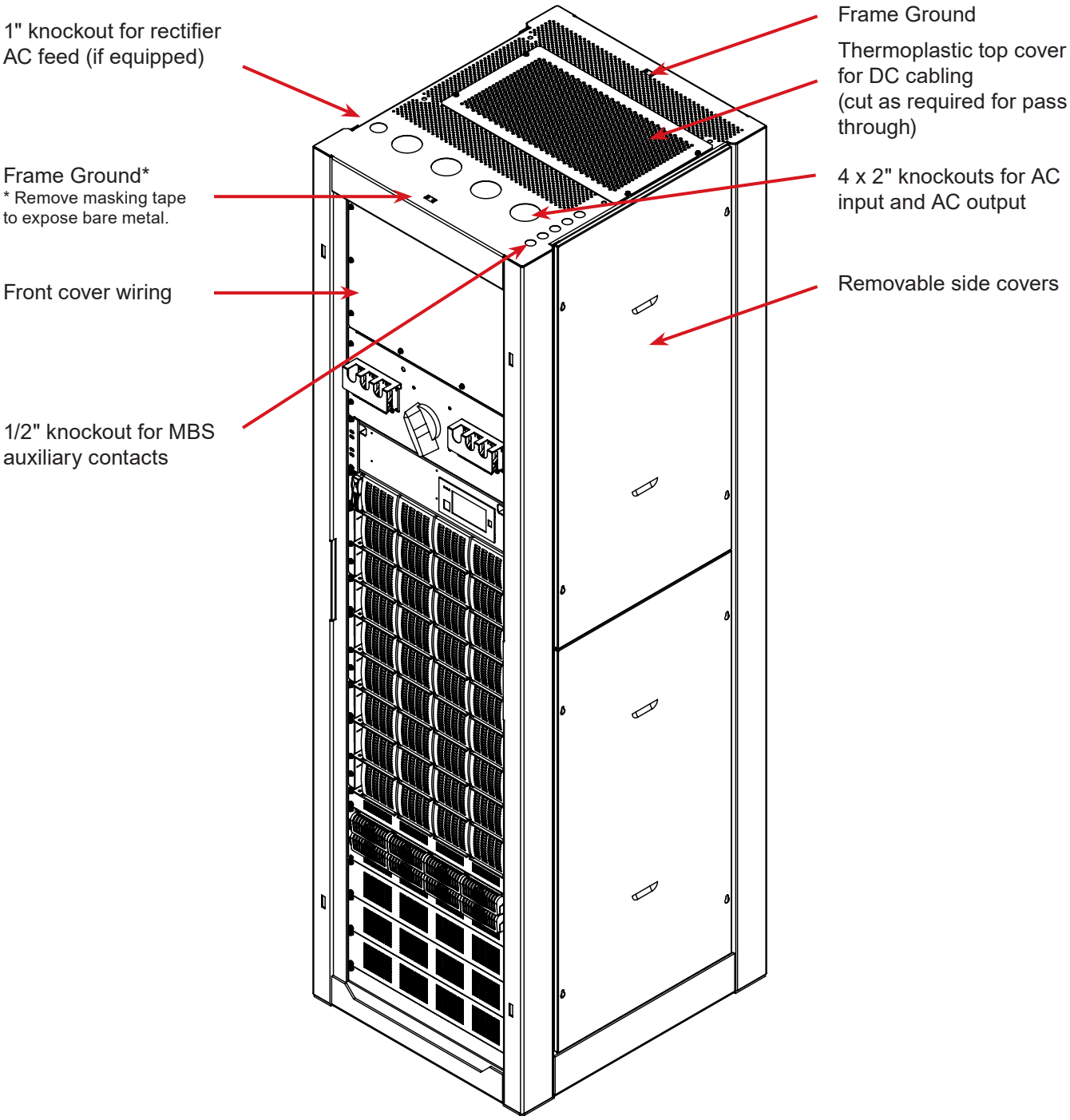


Figure 13 — Top View Showing AC and DC Connection

4.4.1 Wiring Gauge

The required gauge of the AC input, DC+/DC- input and AC output cabling is determined by the current rating, circuit breaker rating, typical ambient temperatures and the applicable local electrical codes. Typically the AC input and standard AC output is five wires (L1, L2, and L3, N, G) up to 350kcmil THHW or RW90 type cable that connects to the HP system with trade size up to 2.5" conduit.

4.4.2 Grounding

Refer to Figure 13 for connection points for frame ground, see Figure 15 for AC input ground and AC output ground.

4.5.1 Installation Notes

1. All wiring must be in accordance with applicable electrical codes.
2. All external wiring by others.
3. Inverter main input must always include a neutral connection.
4. Power and control cables must be in separate conduits.
5. L3 is only used with 3-phase systems.
6. Four independent battery strings can be connected. Tie bars are provided for single or dual DC feed.

4.5 Input/Output Cabling Overview

Connection points are accessed from the top of the unit. A protective panel partitions the AC and DC connections.

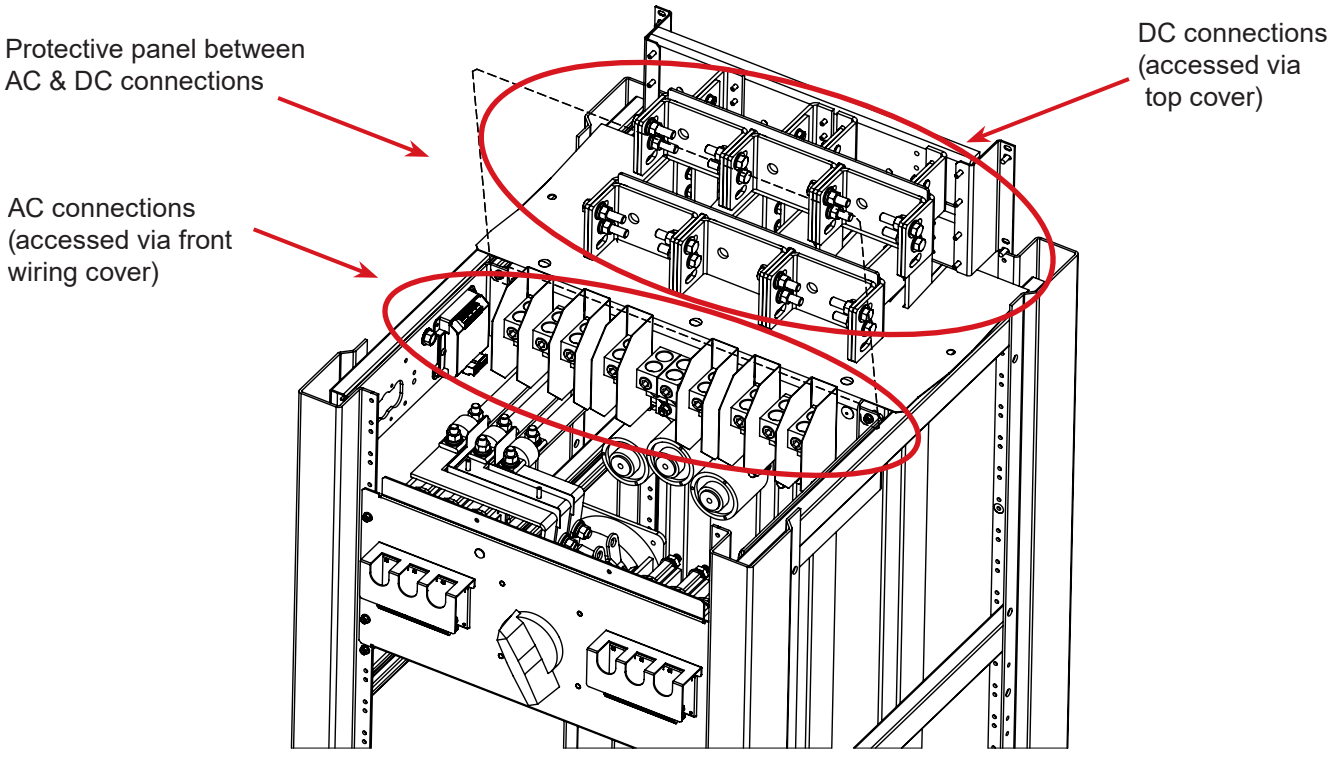


Figure 14 — AC and DC Connection Partitions

4.6 AC Connections

- Access to connection points is provided from the front of the system rack.
- AC wires enter the cabinet through the top.
- AC input and AC output wires are connected to box lugs rated for 350 kcmil to #6 AWG.
- Use 90°C rated copper only.

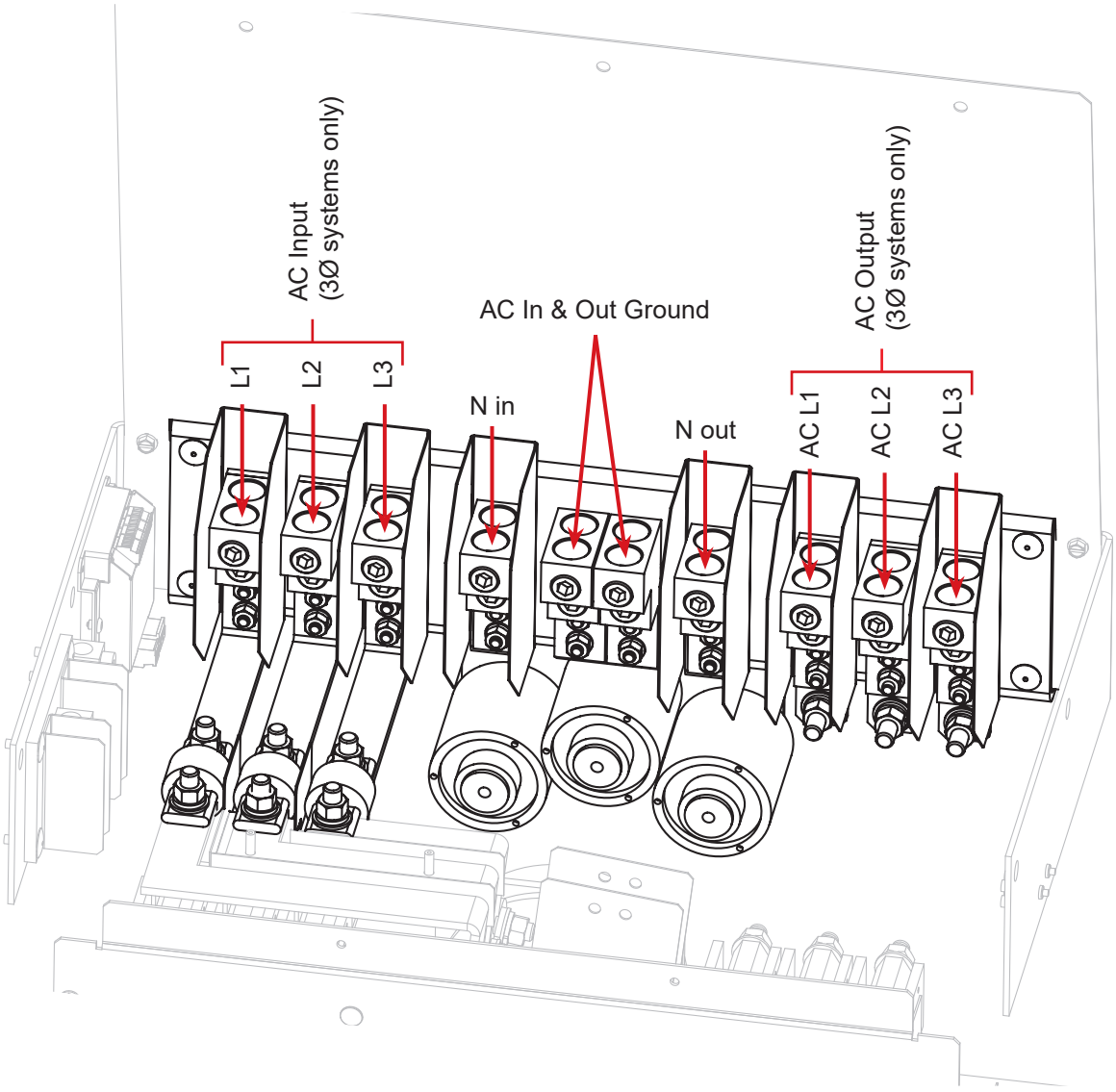


Figure 15 — AC Connections Input/Output

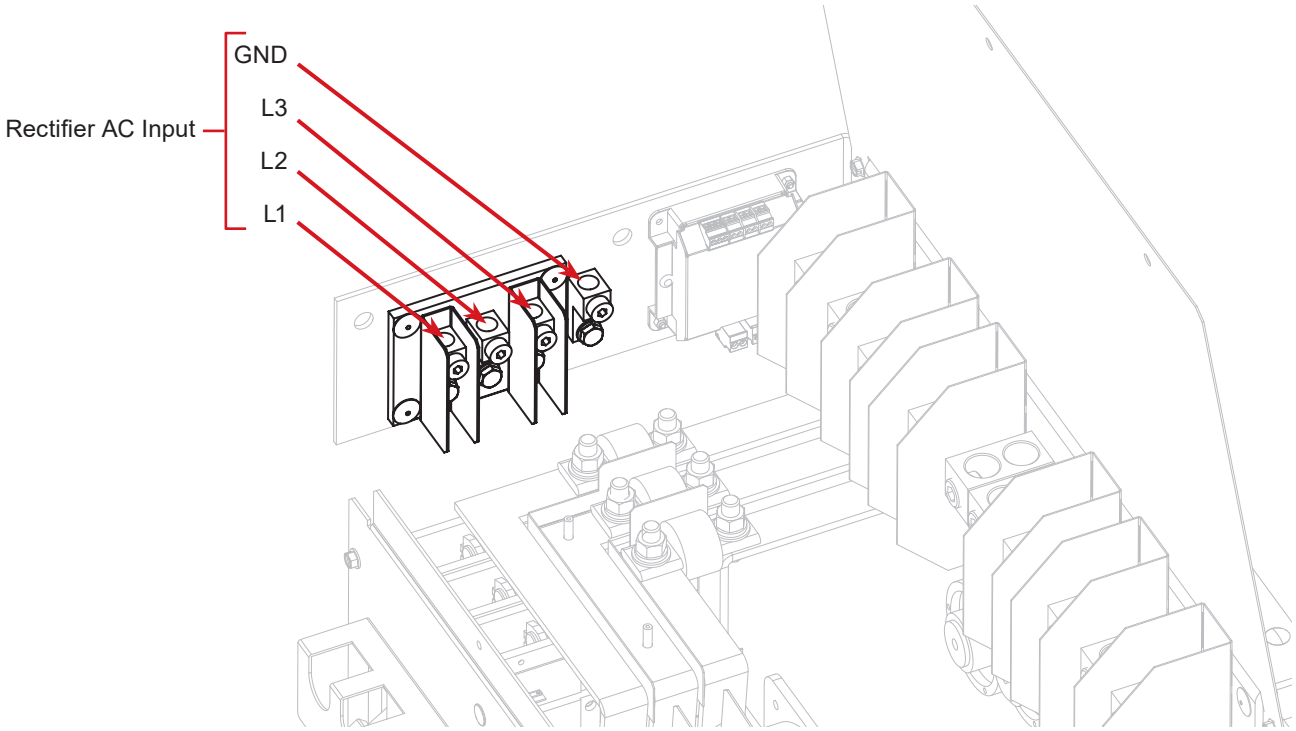


Figure 16 — AC Rectifier Input

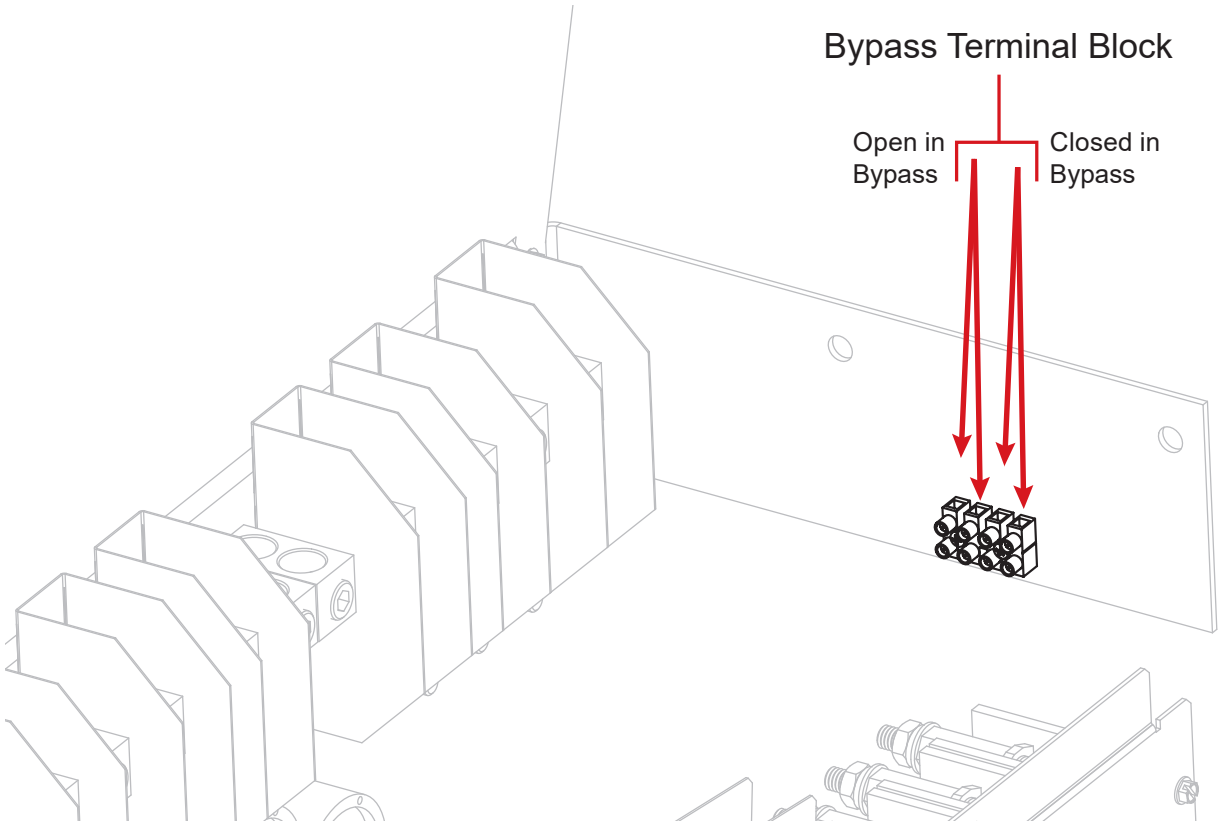


Figure 17 — AC Bypass Terminal Block

4.6.1 AC Connections - Inverter Only

If using the AMPS HP2 without an AC input source, perform the following wiring procedure:

1. Connect the input neutral terminal to the input ground terminal using a bonding conductor.
2. Ground the enclosure to a suitable grounding electrode following local code requirements.

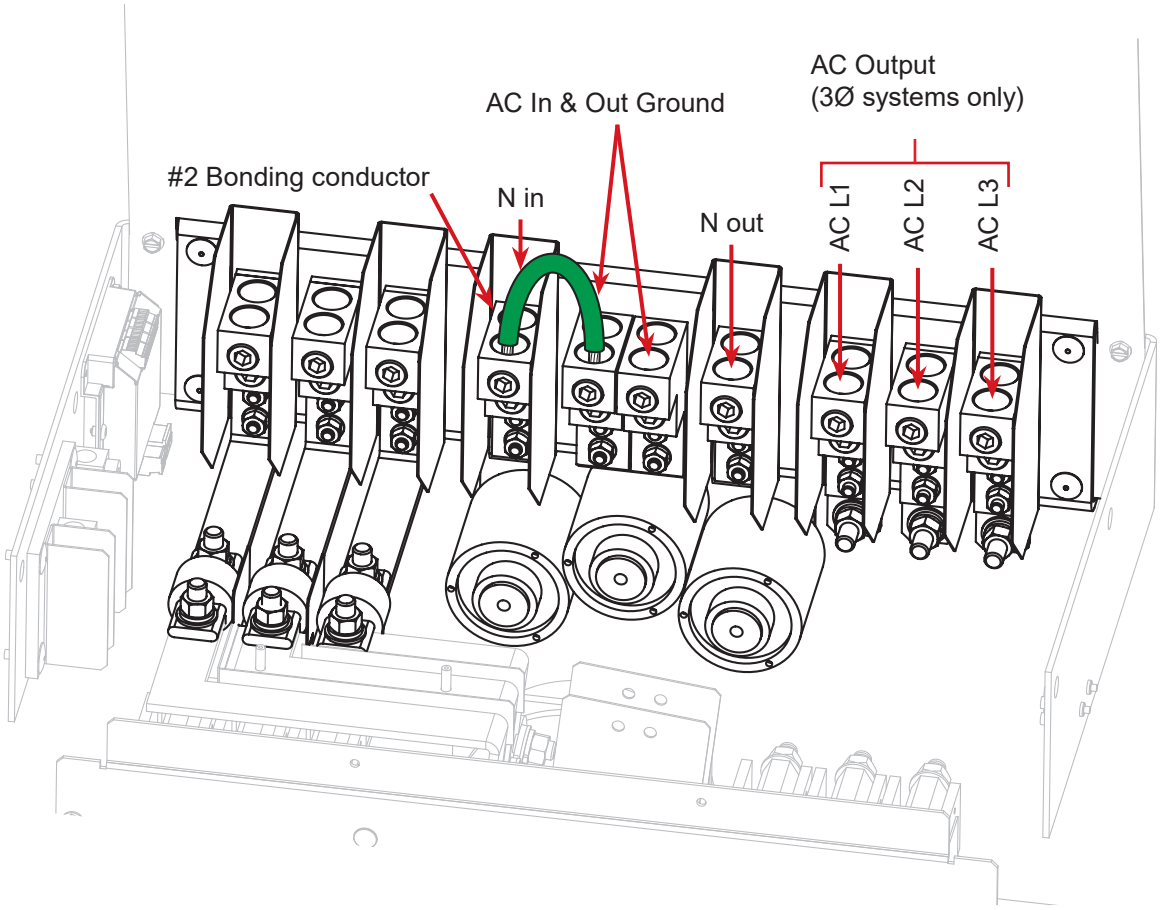
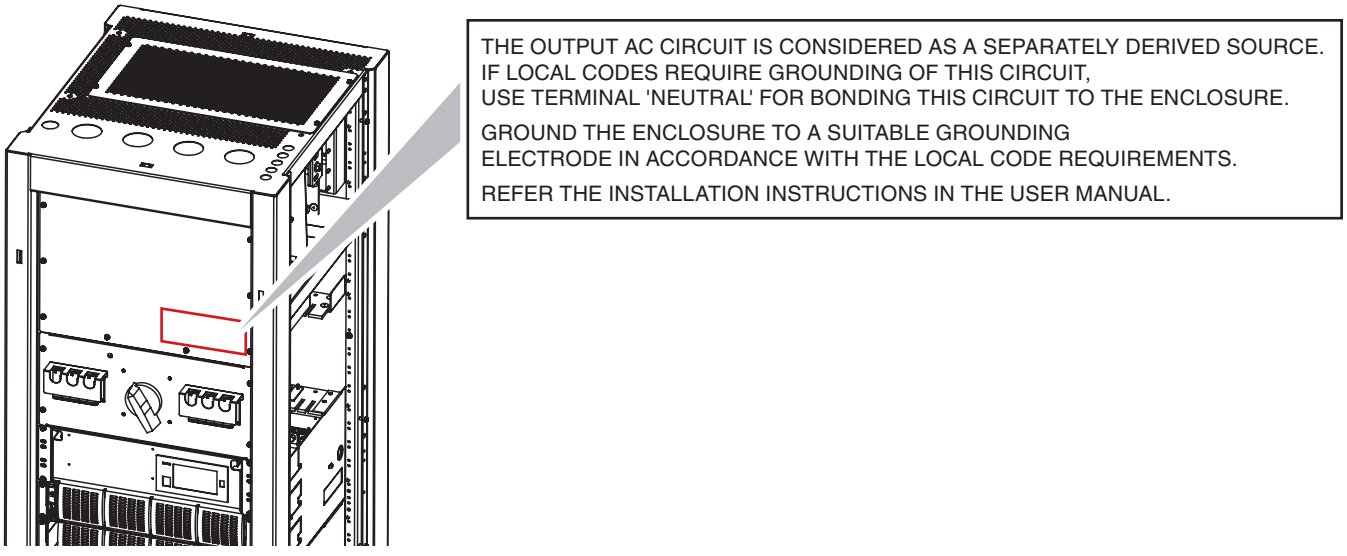


Figure 18 — AC Connections - Inverter Only Mode

3. Once connection is complete, apply this **Separately Derived Source** label the outside of the AC wiring compartment.



4.6.2 Bypass Terminal Block

- The terminal bypass block is provided for customer convenience to monitor the position of the AMPS HP2 bypass switch.
- There are two connection points
    - Normally open
    - Normally closed
- Ratings: 15A/250V

4.7 DC Connections

- Access to connection points is provided through the opening in the top of the system rack
- Access can also be provided by removing the side panels. Note that this will expose the installer to AC conductors and wiring.
- DC wires enter the cabinet either through the top (Top Feed Configured) or the bottom (Bottom Feed Configured) of the cabinet.
- A low voltage disconnect should be provided with the battery system.

4.7.1 DC Battery Cabling

- DC battery cable terminations are designed for two-hole spade lugs (3/8" diameter on 1" centers) crimped to the cabling, then attached to the bus bars.
- Torque specifications for DC wiring (3/8" bolts that attach the DC lugs at the back of the DC distribution box) are 190 – 240 inch/lbs (21.5 – 27.1 N-m).
- Use 90°C rated copper only.

4.7.2 DC Connection Configurations

CAUTION!

A tie bar is only recommended for single feed installations. The use of a tie bar in a two feed installation can cause current loops.

If the system is equipped with optional rectifiers, each rectifier shelf in a hybrid system is only connected to one of the DC- battery feeds:

- Top rectifier shelf to DC1
- Bottom rectifier shelf to DC4

In a system with four independent battery feeds, two of these battery banks will not be charged from the AMPS HP rectifiers. When using two independent A/B feeds, DC1 should be tied to DC2 and DC3 tied to DC4 at the AMPS HP DC connection points. Tie bars are provided.

The following sections cover configuration for top and bottom feed systems as well as single, dual, and four independent battery feed connections.

4.7.3 Top Feed Configured Systems (only)

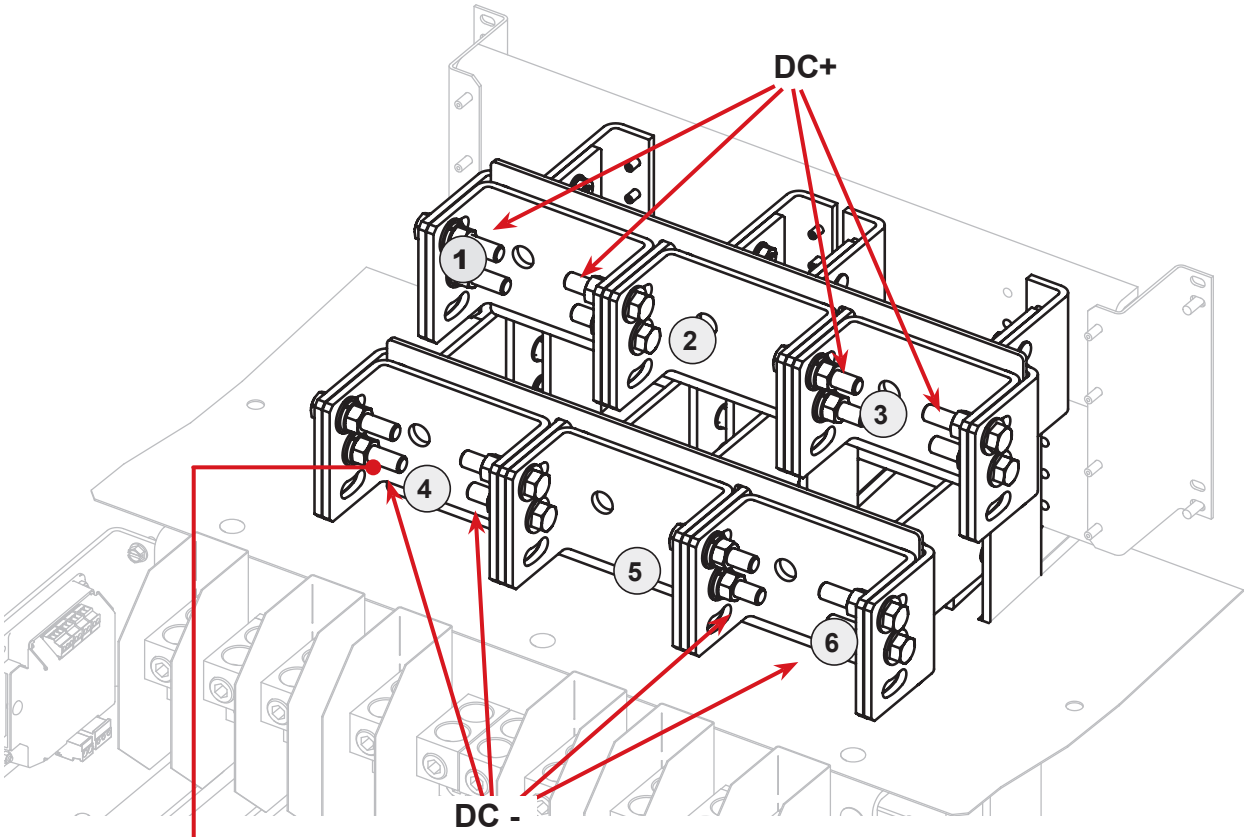
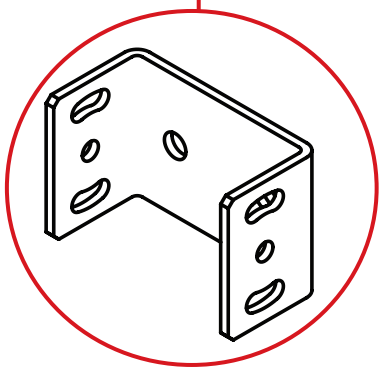


Figure 19 — Top Feed System, Single Battery Feed



Cable Tie Bar: For use between all cable landings (6 total)

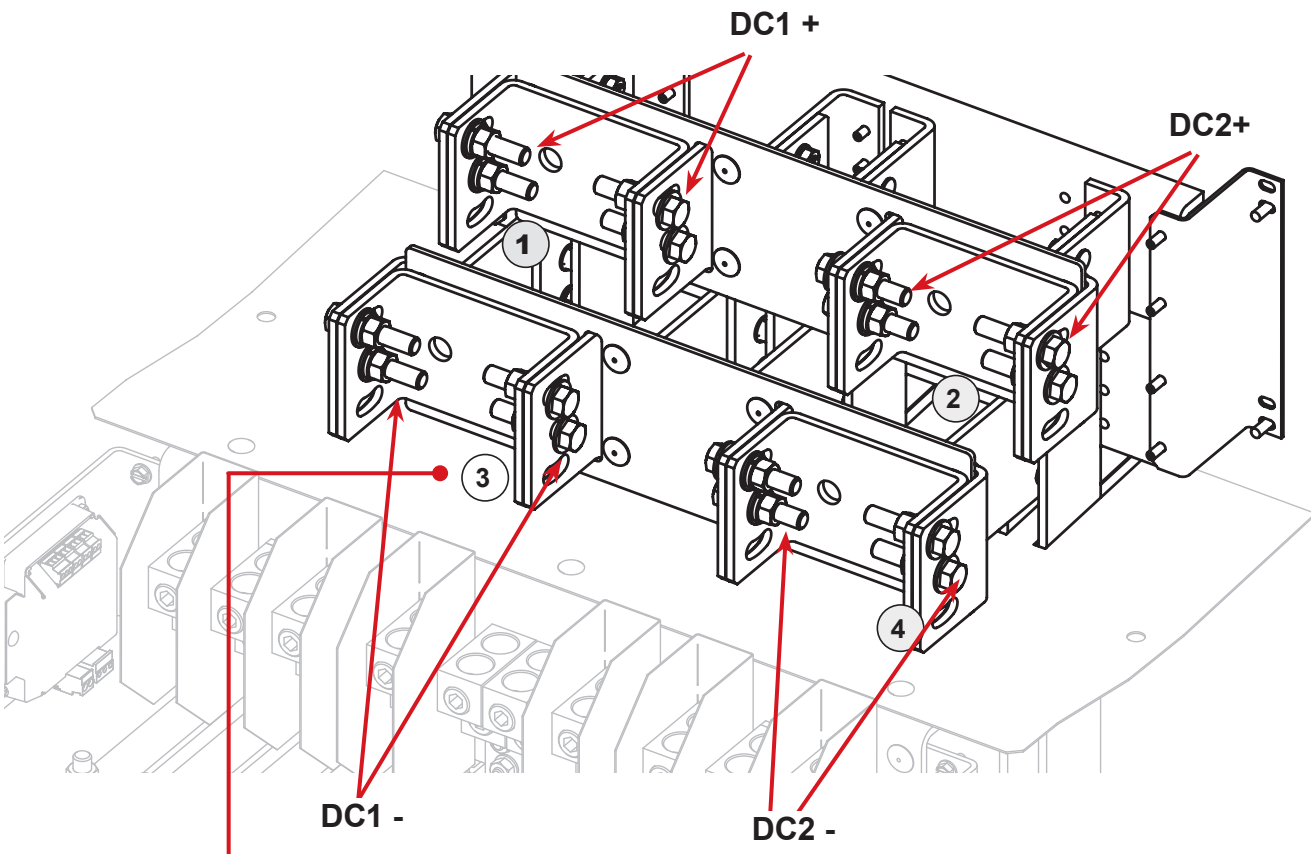
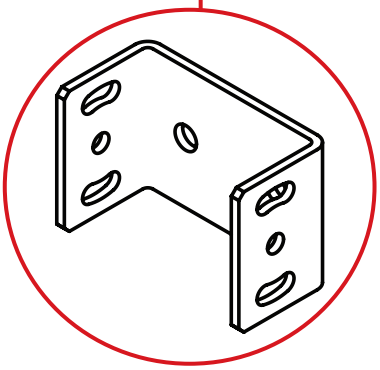


Figure 20 — Top Feed System, Dual Independent Battery Feeds



Cable Tie Bar: For use between all cable landings (4 total)

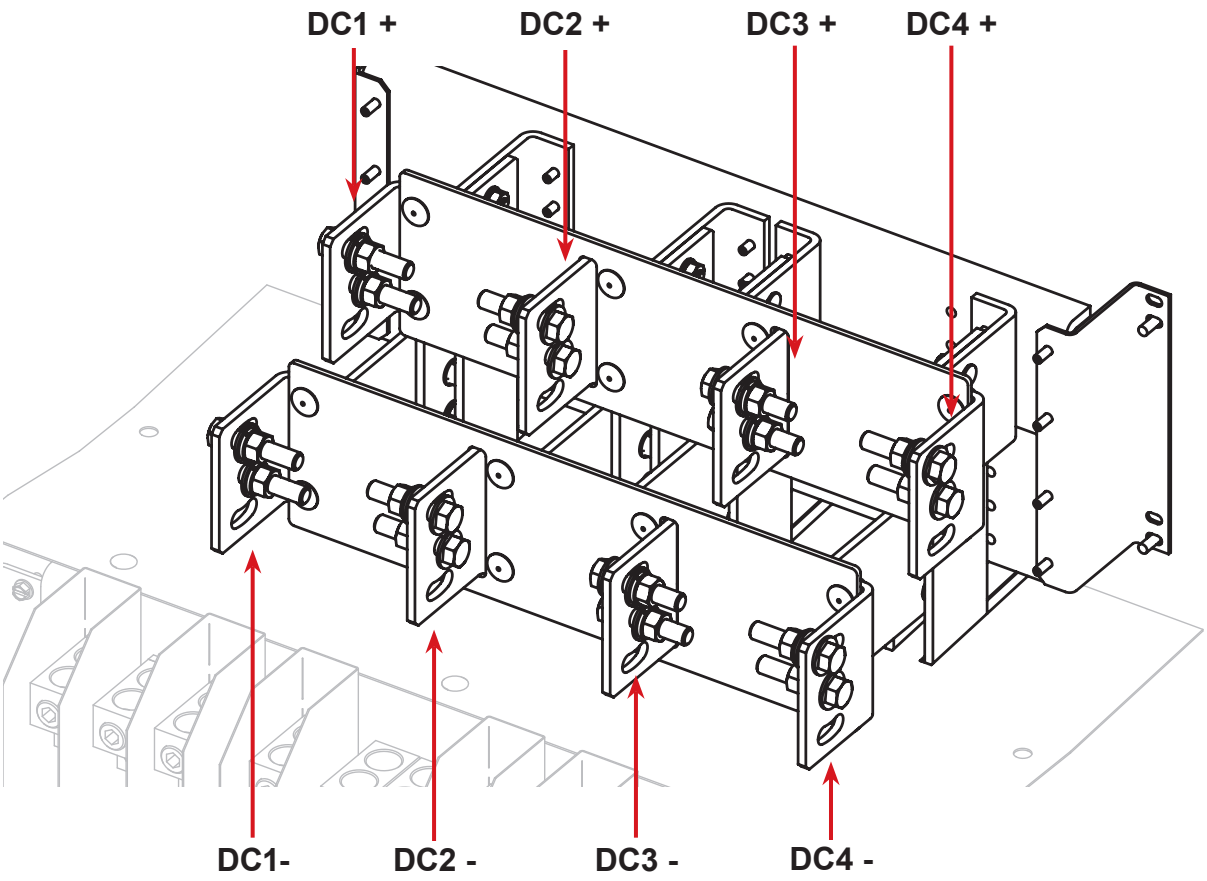


Figure 21 — Top Feed System, Four Independent Battery Feeds

4.7.4 Bottom Feed Factory Configured Systems (only)

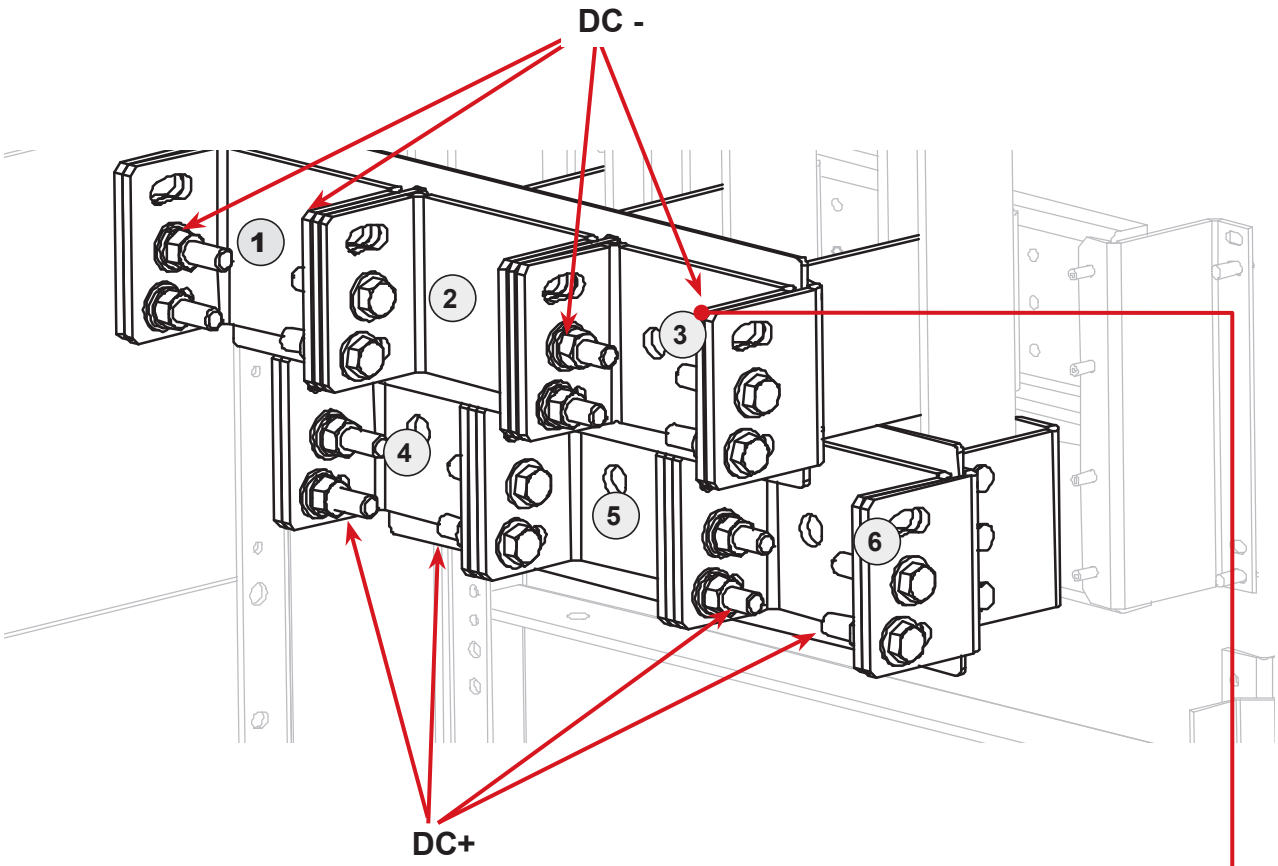
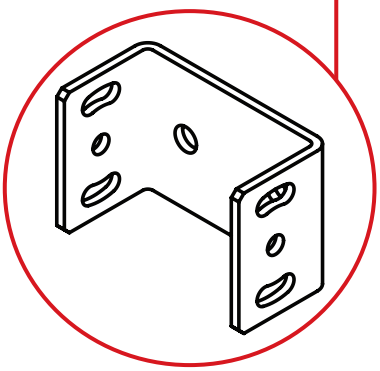


Figure 22 — Bottom Feed System, Single Battery Feed



Cable Tie Bar: For use between all cable landings (6 total)

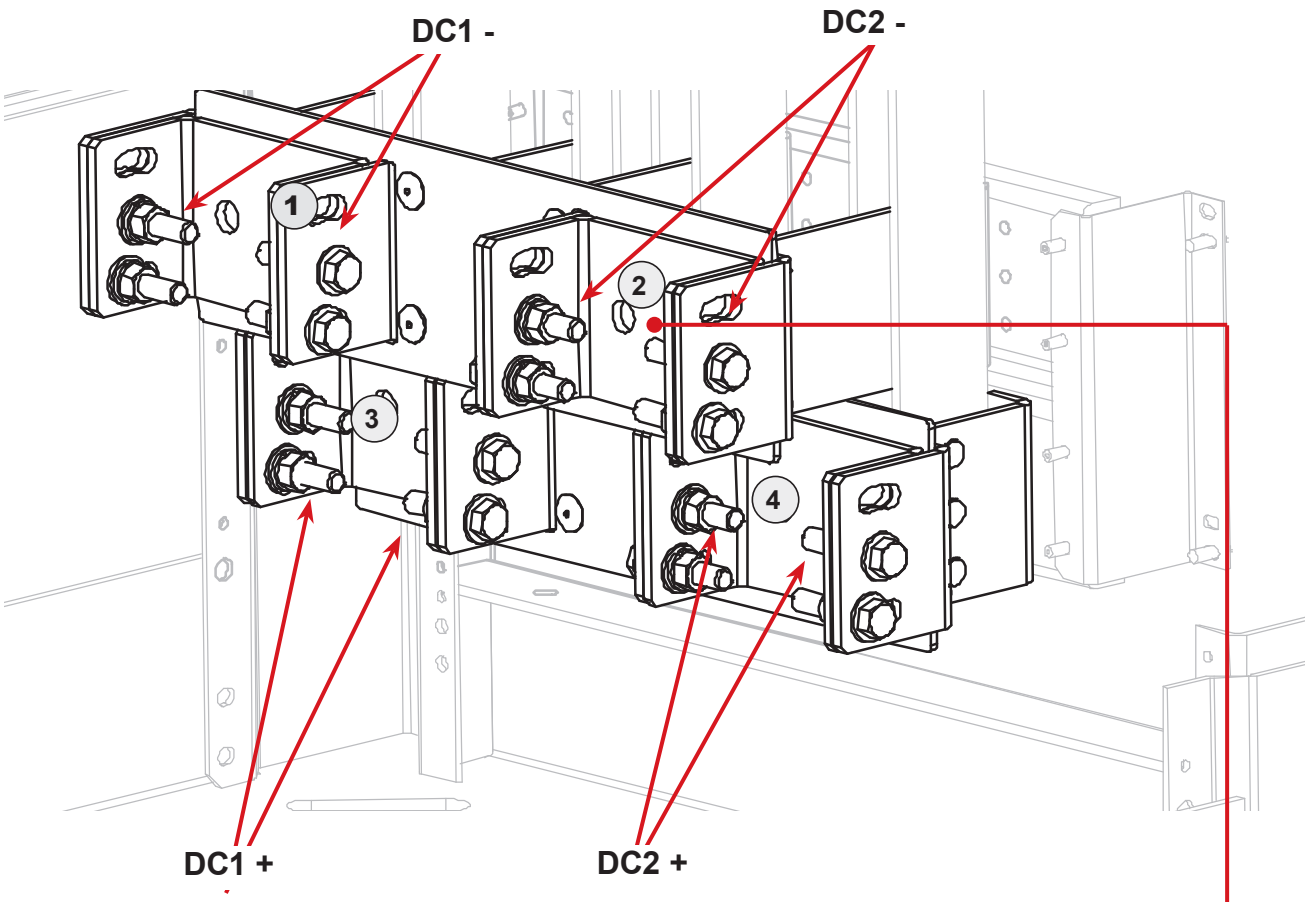
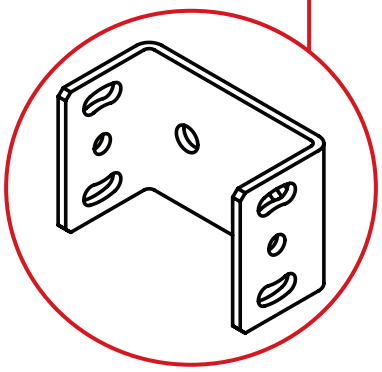


Figure 23 — Bottom Feed System, Dual Independent Battery Feeds



Cable Tie Bar: For use between all cable landings (4 total)

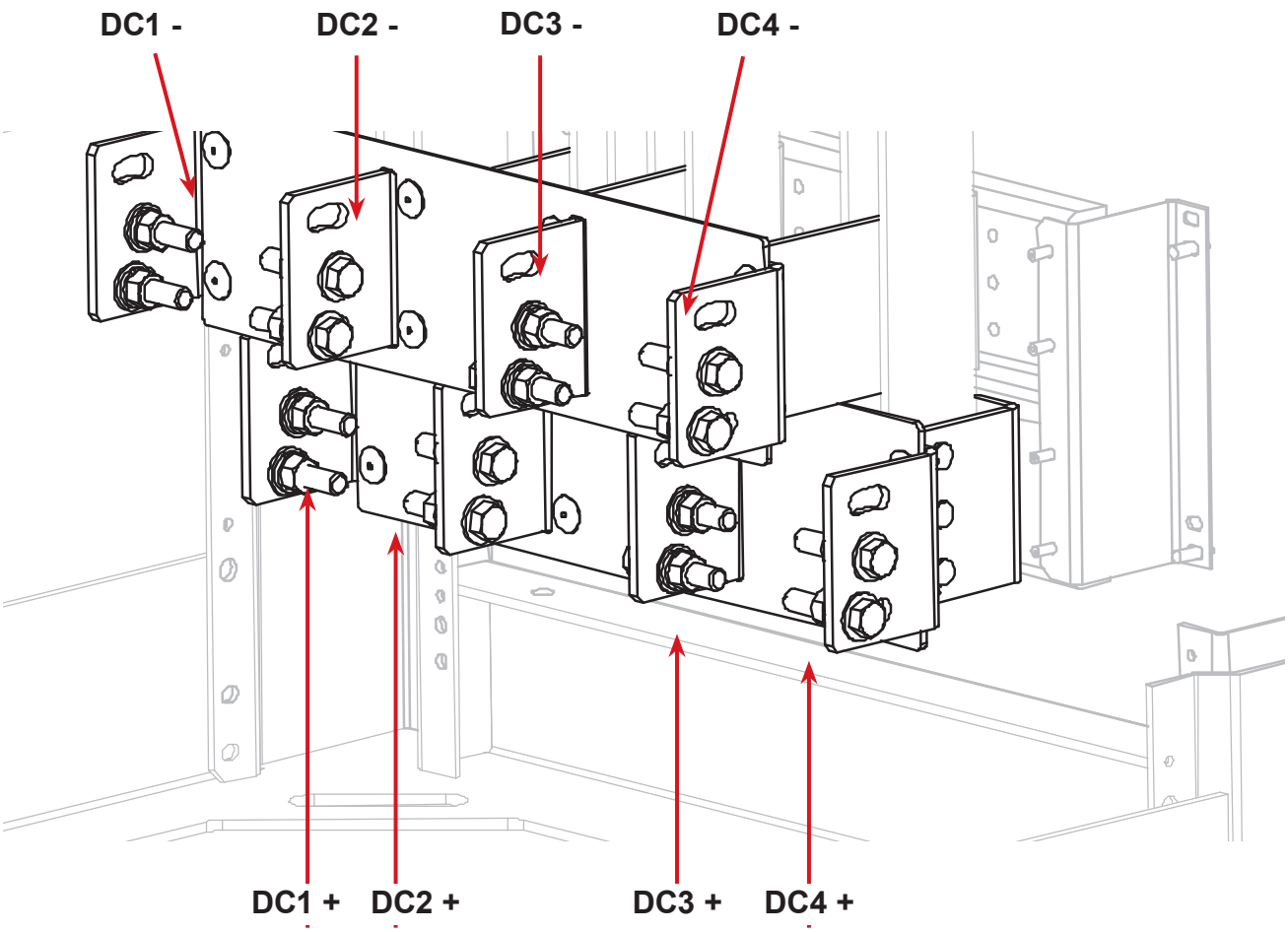


Figure 24 — Bottom Feed System, Four Independent Battery Feeds

4.7.5 Battery Feed Connections

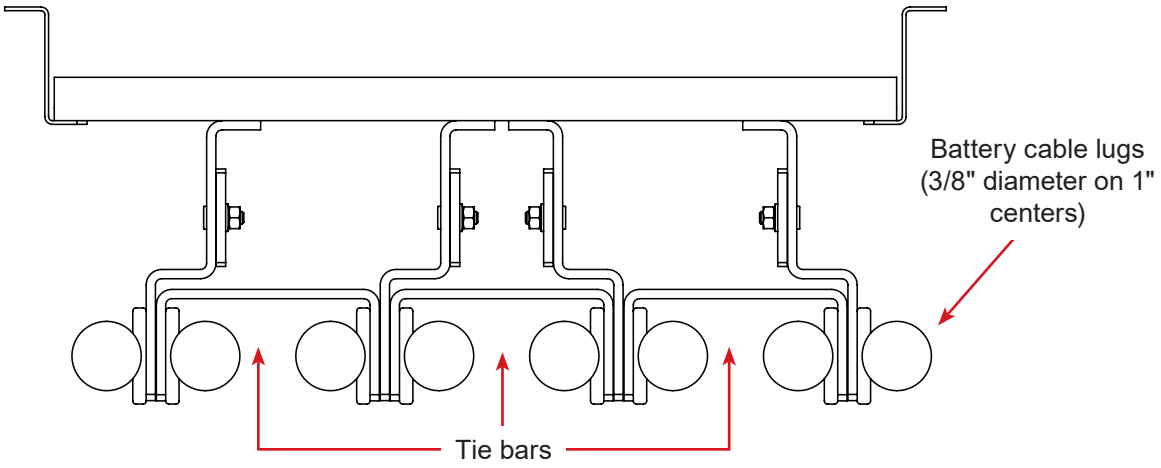


Figure 25 — Single Battery Feed

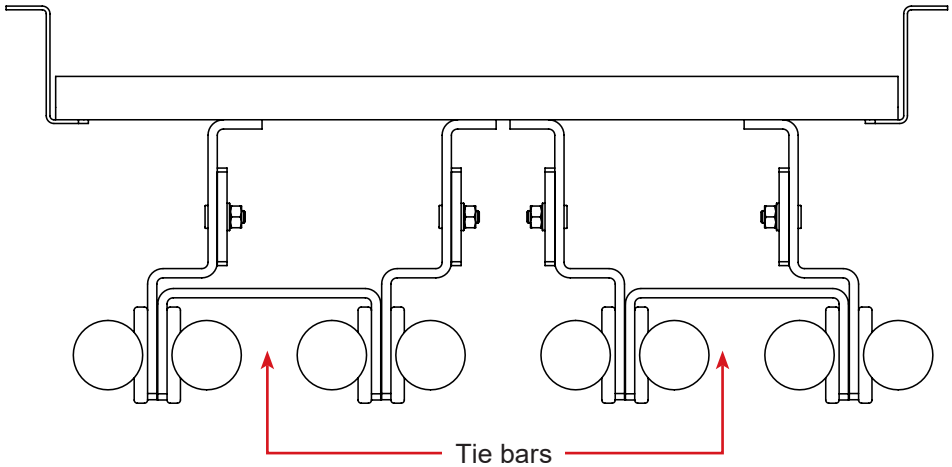


Figure 26 — Dual Independent Battery Feeds

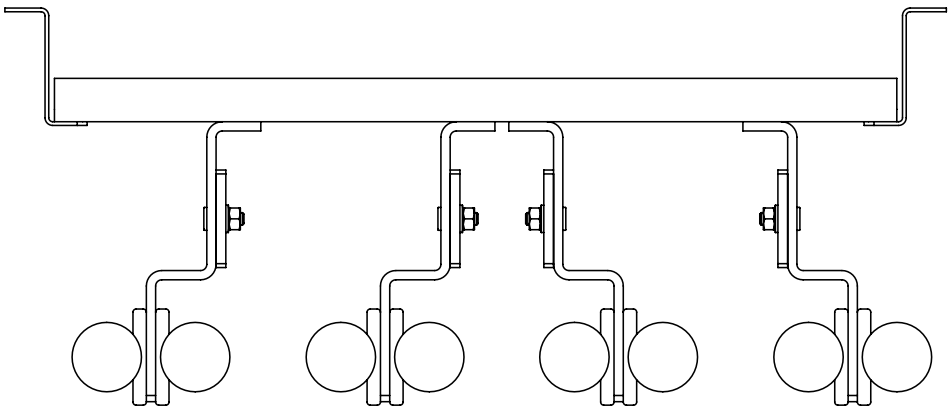


Figure 27 — Four Independent Battery Feeds (no tie bars)

5. AMPS HP2: Rack Mount Systems

The AMPS HP2 consists of a number of individual subsystems designed to work together to provide highly reliable, filtered power in support of the load. A typical AMPS HP2 rack mount system contains the following:

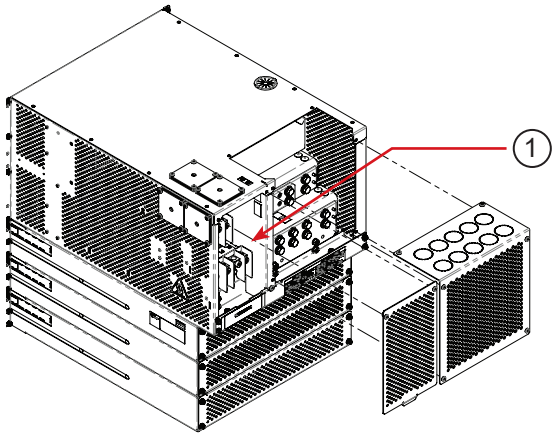


Figure 28 — AMPS HP2 Rack Mount, back view

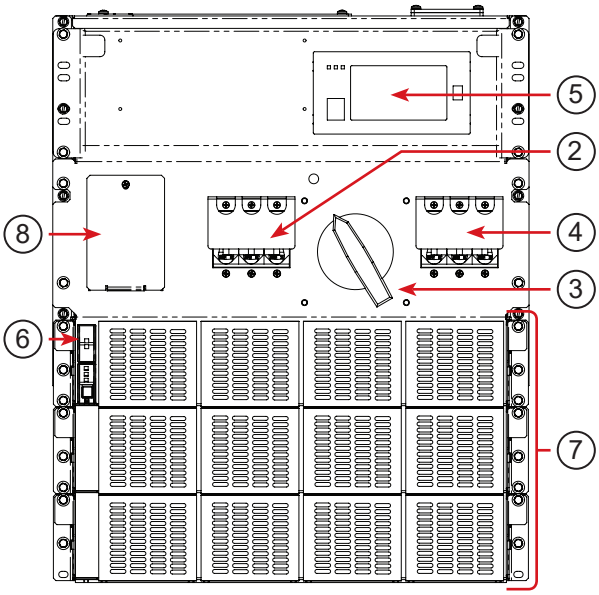


Figure 29 — AMPS HP2 Rack Mount, front view

1. **Main Wiring Access Panel:** AC input and output as well as Safety Extra-Low Voltage (SELV) DC battery connections are accessed through the back panels and fed through the opening at the top of the rack. AC can also be fed through the side.
2. **Inverter AC Input Breaker:** Serves as the main disconnect for the inverter AC input.
3. **Maintenance Bypass Switch (MBS):** Can be used to route power directly from the AC input to the AC output, bypassing the inverter modules.
4. **Inverter AC Output Breaker:** Serves as the main disconnect for the inverter AC outputs.
5. **CXC HP Controller with Ethernet/SNMP:** Monitors and manages both inverter and rectifier modules through a web-based interface and local LCD touch screen. This is a SELV controller.
6. **T2S Inverter Control Card:** Communicates with the CXC Unified controller. This is a SELV Controller.
7. **Inverter Modules and shelves:** Up to three shelves containing 4 hot-swappable 2500VA / 2000W inverter modules on each shelf.
8. **TVSS Module cover**

5.1 Specifications AMPS HP2: Rack Mount

Model			AMPS-3-30	AMPS-2-20	AMPS-1-10
AC Input	**AC Input Voltage**		120/208Vac 3-Phase	120/208Vac 2-Pole (or) 120/240Vac Split-Phase	120V Single Phase
	Full Load inverter AC Input Current (per phase)		80A	80A	80A
	AC Input poles & wiring		4 w + G	3 w + G	2 w + G
	Wiring		3Φ Wye	2Φ	1Φ
	AC inverter input Breaker/ fuse See Note: 2		100A, 3 Pole	100A, 2 Pole	100A, 1 Pole
	Recommended AC Input Wire size, 90ºC copper See Note: 1	**Inverter**	1/0	1/0	1/0
AC Output	**Total AC Output (Max)**		30kVA, 24kW	20kVA, 16kW	10kVA, 8kW
	AC Output Voltage		120/208Vac 3-Phase	120/208Vac 2-Pole (or) 120/240Vac Split-Phase	120V Single Phase
	AC Output poles & wiring		4 w + G	3 w + G	2 w + G
	Wiring		3Φ Wye	2Φ	1Φ
	AC Output Current (per Phase)		80A	80A	80A
	Installed Inverter Input & Output Circuit Breaker		100A, 3 Pole	100A, 2 Pole	100A, 1 Pole
	Recommended AC Output Wire size, 90ºC copper See Note: 1		1/0	1/0	1/0
AC Input & Output Connection Terminals: Box lugs are rated for both Aluminum and Copper wire, #2/0 to #6 AWG. Fasten clamping screw to 120in-lb. (14N-m).					
Note 1	Inverter AC Input & AC Output connections: Calculations based on full load and t, 0.8 derating with 4 current carrying conductors, (L1,L2,L3,N) @ 40°C				
Note 2	Consult your local and national electrical codes. AC source must be limited to 5kA Short Circuit Current.				

5.1.1 DC Fuse/Breaker AMPS HP2: Rack Mount

Alpha recommends using fuses instead of breakers because they provide better fault protection.

NOTE:

The recommendations in Table C are for reference only. A registered professional engineer must review and approve or modify these recommendations in compliance with applicable national and local electrical and building codes.

Table C — Recommended DC fuse/breaker

	Model		AMPS-3-30	AMPS 2-2-20	AMPS-1-10
DC input	Maximum DC Input wattage		27kW	18kW	9kW
	Maximum DC Input Current @ 48Vdc, full load		555A	375A	188A
	Recommended minimum DC fuse/ breaker rating (100% rated, per feed)	Single DC feed	700A	500A	250A
		Dual DC feed	350A	250A	125A

5.2 System Pre-Installation

5.2.1 Site Selection

The AMPS HP systems are designed to be installed in a controlled environment, sheltered from rain, excessive dust and other contaminants.

5.2.2 Floor Plan Layout

Sufficient free space must be provided at the front and rear of the power system to meet the cooling requirements of the inverters and rectifiers(if installed) in the power system and to allow easy access to the power system components.

Consider the following before selecting a location for the HP power system:

- Structure of building able to support the additional weight
- Enough space to meet requirements for access
- Enough space to meet cooling requirements of the rectifiers
- Adequate space to do the install
- Route that equipment will take through the building to reach the site
- Check and record distances to load
- Check and record distances to AC power source
- Check and record distances to batteries/DC power source
- Understand the full load on the DC system
- Window for working hours and other similar restrictions
- Work done in advance
    - » Reinforce floors
    - » Install distribution panels
    - » Install cable racks
    - » Run wiring

5.2.3 Installation Layout AMPS HP2: Rack Mount

NOTE:

In the unlikely event that internal components need repair, 1m access in front and back of the unit is recommended.

Recommended minimum required clearances around the relay rack are as follows:

- Rear: 36" (100cm)
- Sides: no clearance required.
- Top: 7" (18cm) clearance, from the back is required.
- Bottom: no clearance required.
- Front: 36" (100cm).

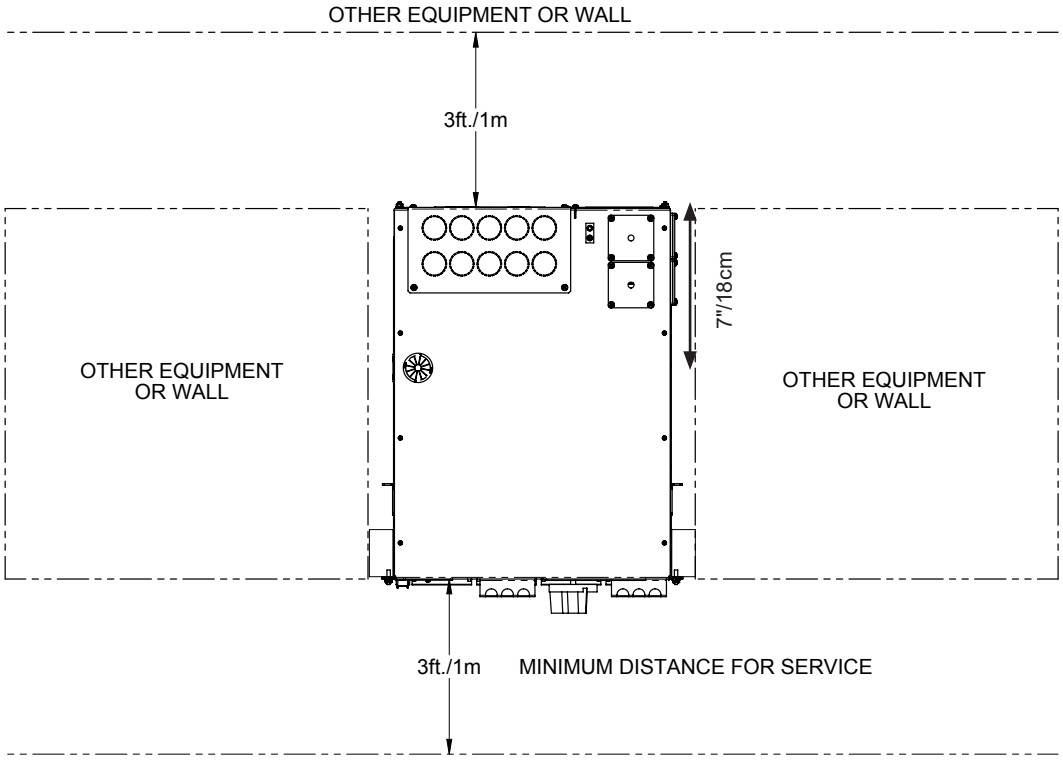
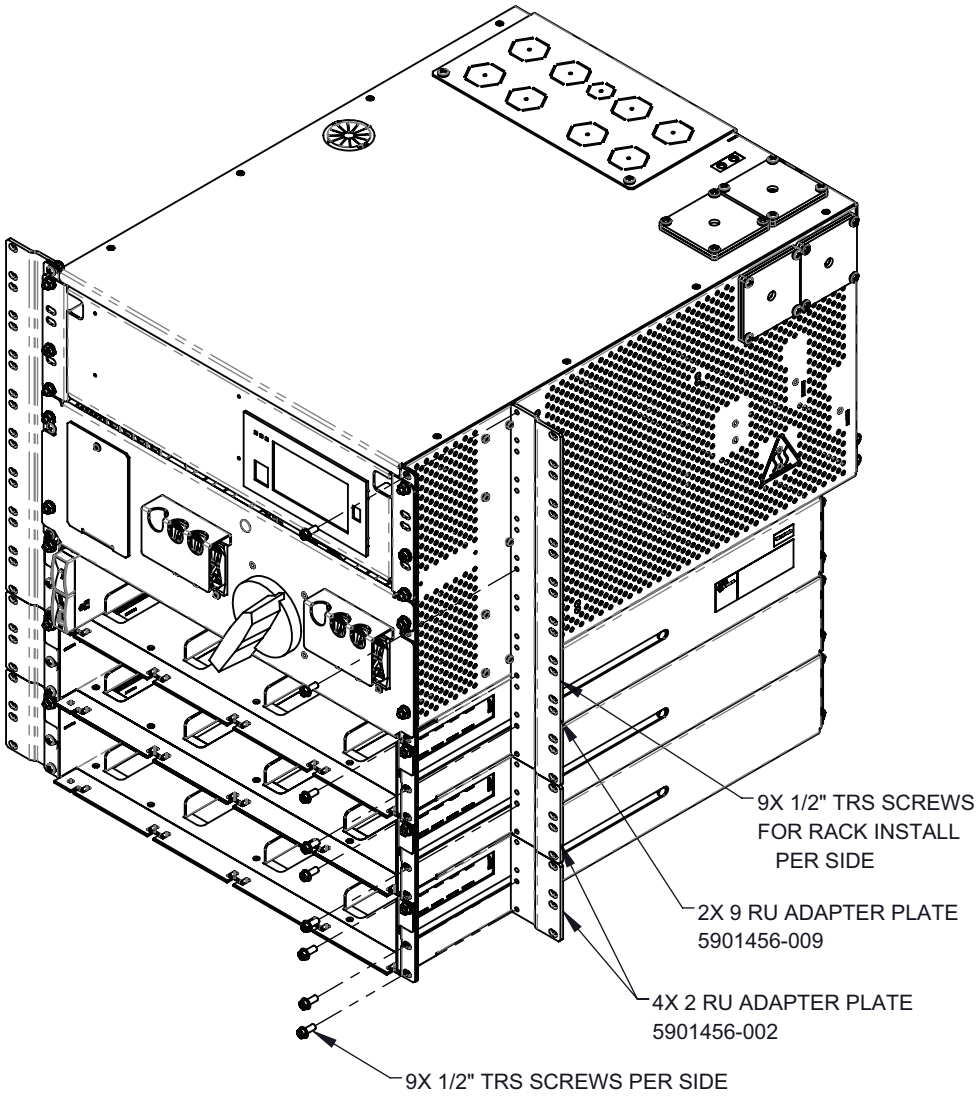


Figure 30 — Installation Layout and Clearances

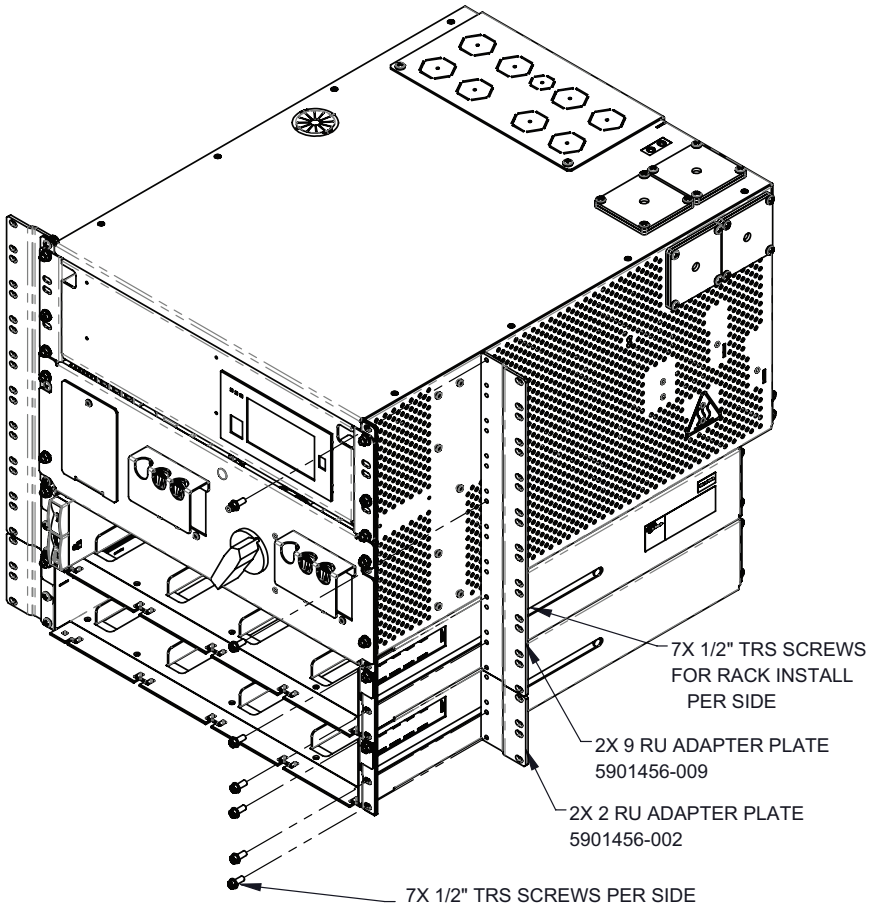
5.2.4 Installing Into 23" Racks

The AMPS HP2 Rack Mount system can be front mounted or mid mounted into a 23" rack using the adapter plates as shown in the following figures.

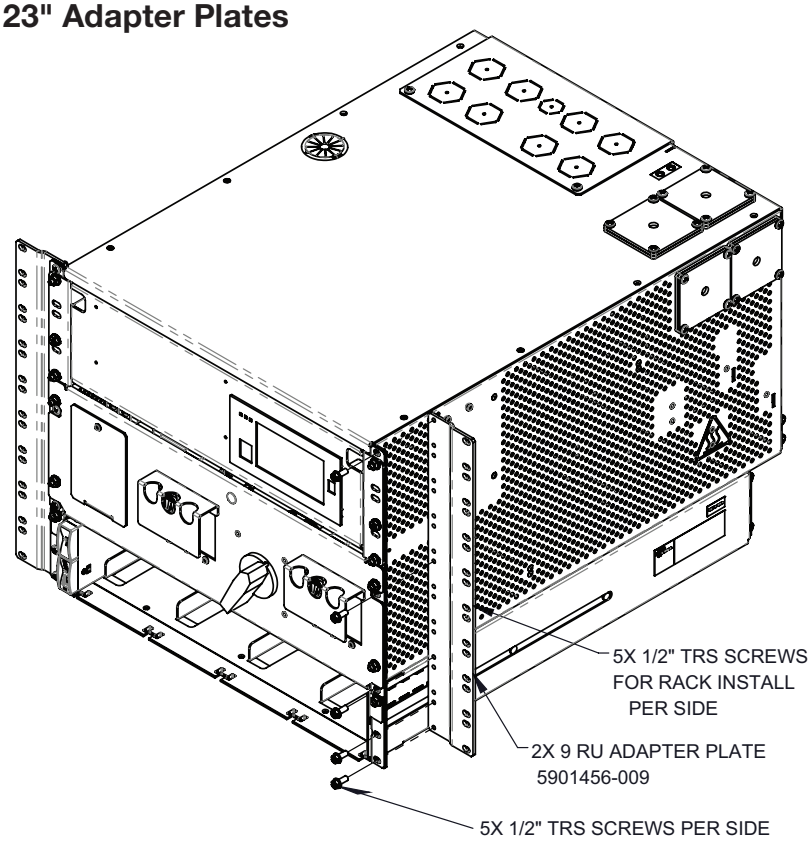
Front Mount 30KVA with 19 - 23" Adapter Plates



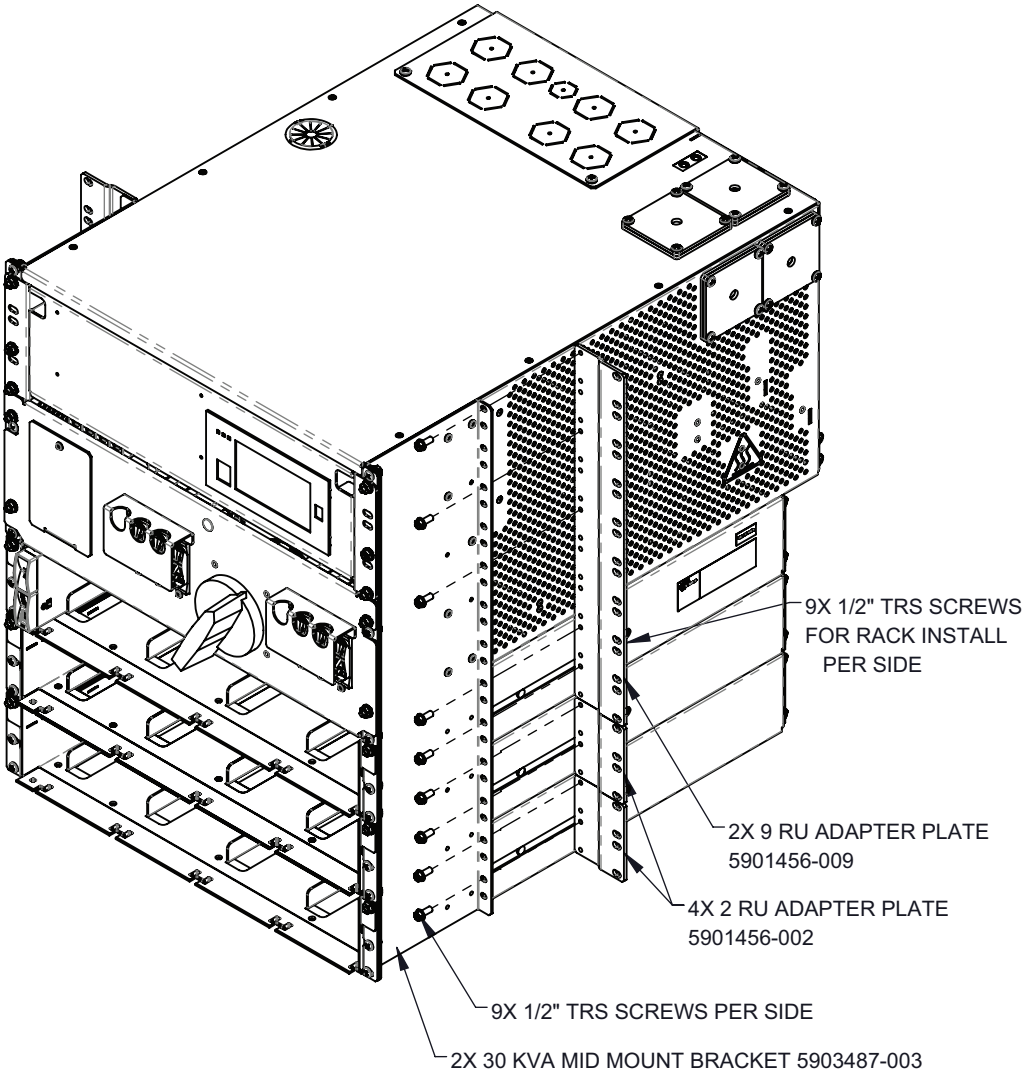
Front Mount 20KVA with 19 - 23" Adapter Plates



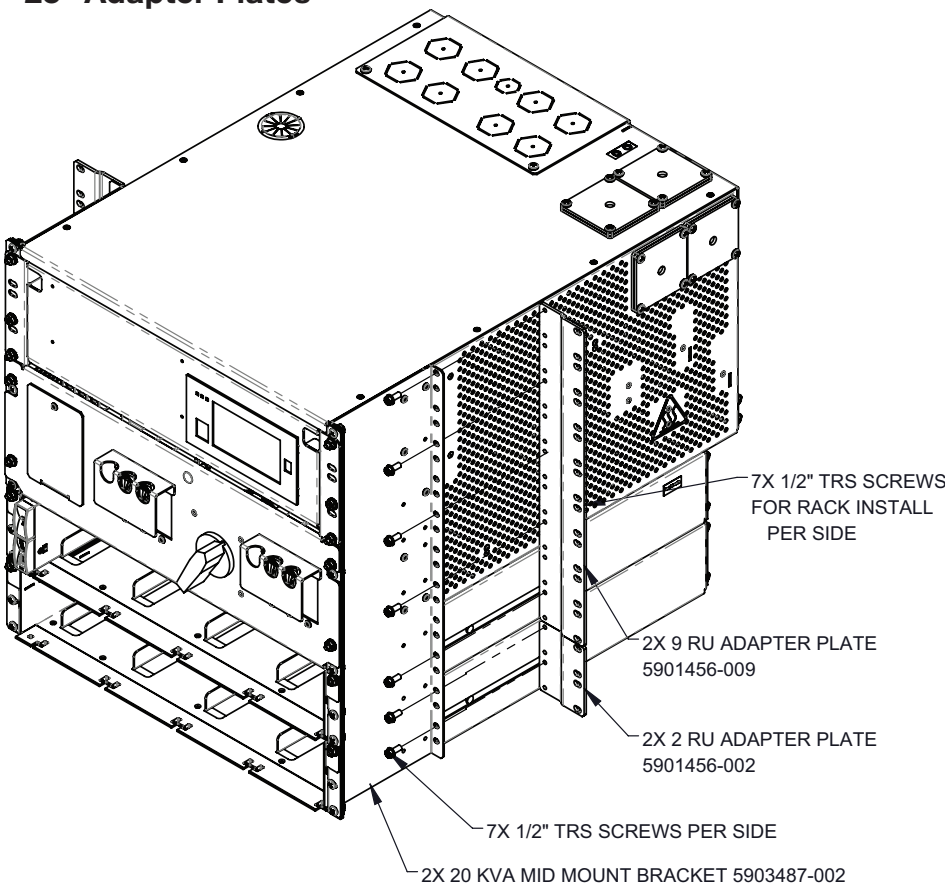
Front Mount 10KVA with 19 - 23" Adapter Plates



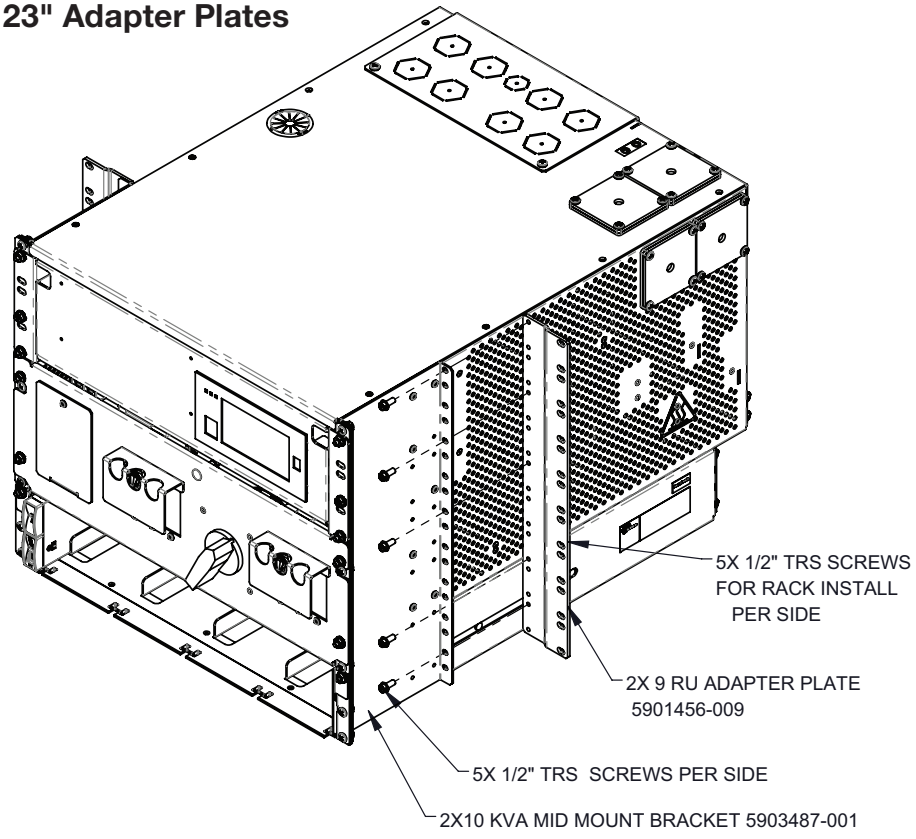
Mid Mount 30KVA with 19 - 23" Adapter Plates



Mid Mount 20KVA with 19 - 23" Adapter Plates



Mid Mount 10KVA with 19 - 23" Adapter Plates



5.3 System Installation

The AMPS HP2 system is pre-configured from the factory for a single AC feed per phase for inverters, and a maintenance bypass switch.

The installer is responsible for connecting the following:

- Utility input to the system (120V line to neutral)
- Battery strings
- System to the load
- Chassis and battery return to the reference ground

Reference Notes:

- Connections and components relating to L3 are only present for 120/208V, 3-phase systems.
- Connections and components relating to L2 are only present for 120/240V split phase and 120/208V 3-phase systems.

5.4 Installation: AMPS HP2: Rack Mount

Carefully review the following schematic and installation notes before proceeding with the installation.

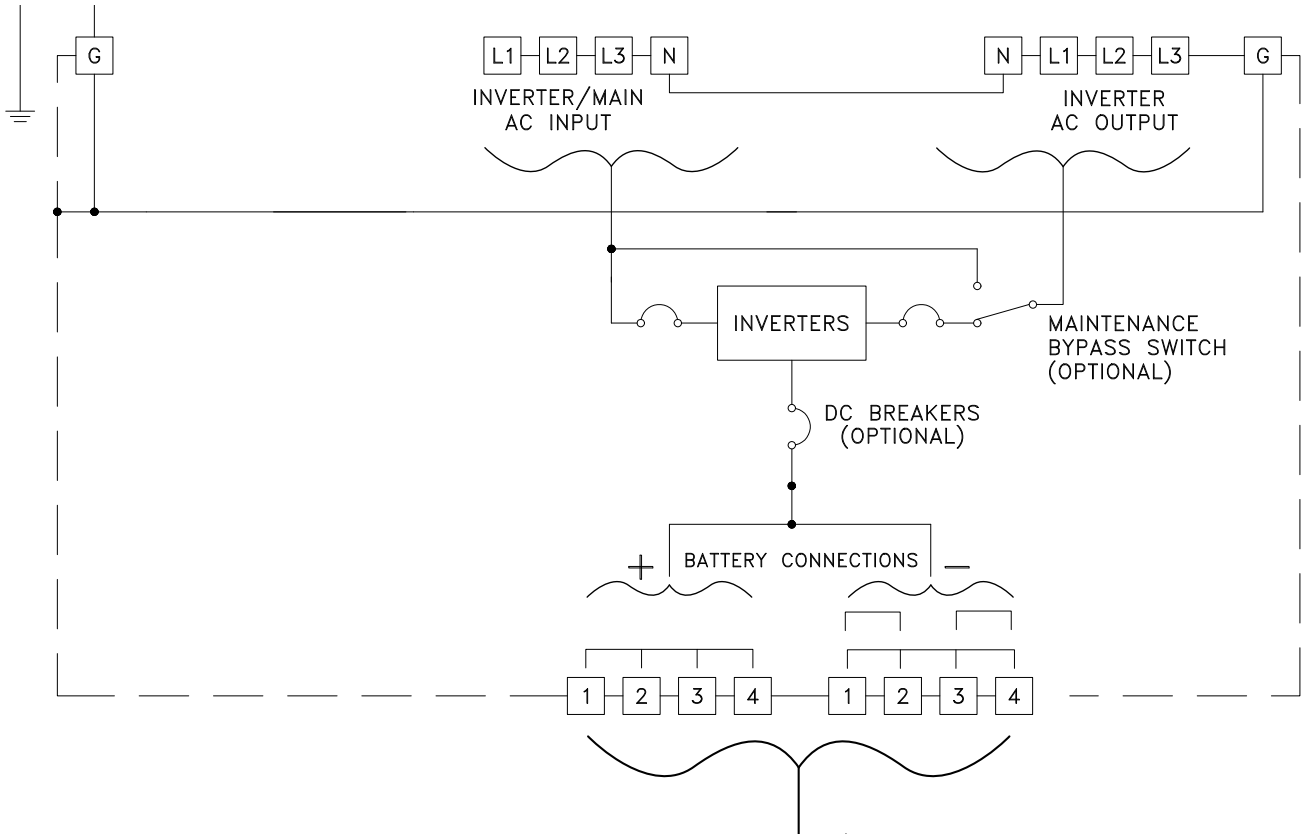


Figure 31 — Battery and Power Connections

Installation notes:

1. All wiring must be in accordance with applicable electrical codes.
2. All external wiring by others.
3. Inverter main input must always include a neutral connection.
4. Power and control cables must be in separate conduits.
5. L3 is only used with 3-phase systems.
6. Four DC connections available per polarity bulk-feed or 2-feed.

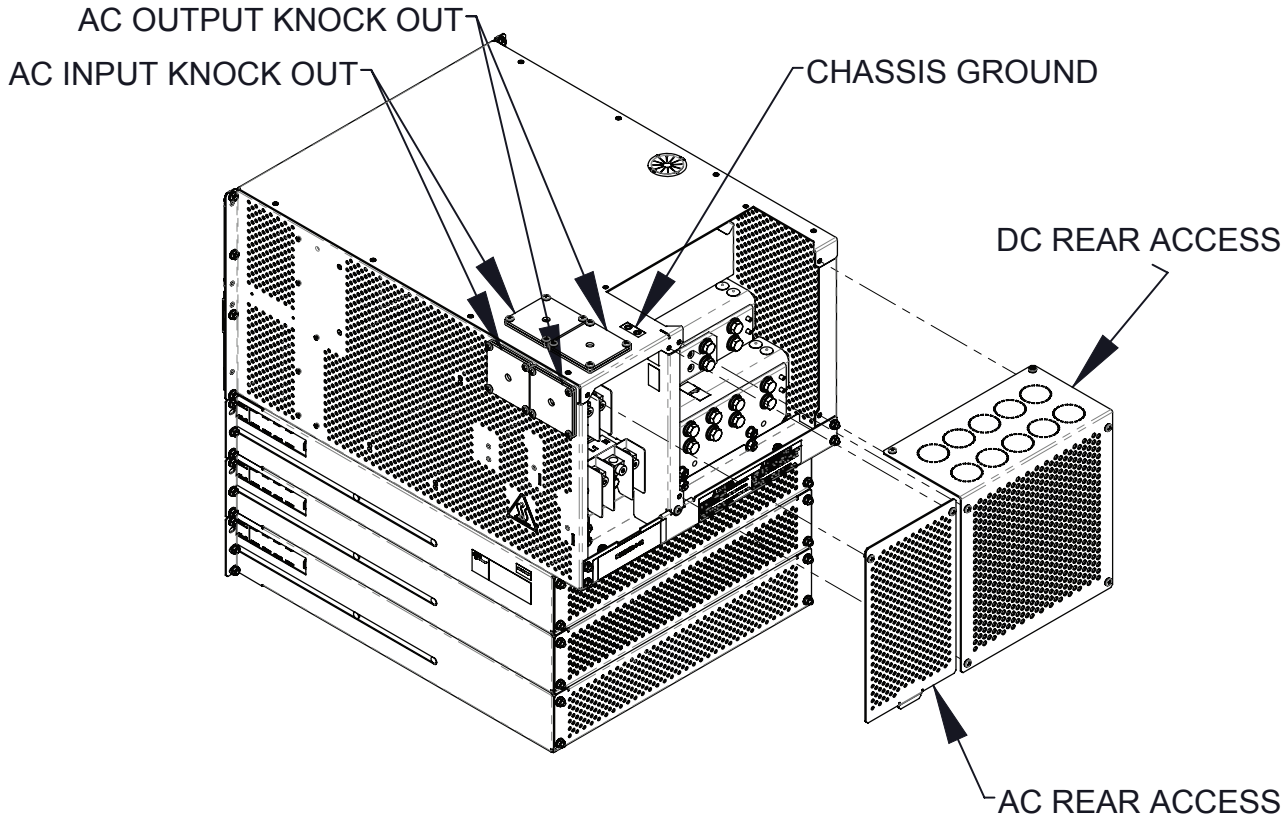


Figure 32 — AC and DC Connection Locations

5.4.1 Wiring Gauge

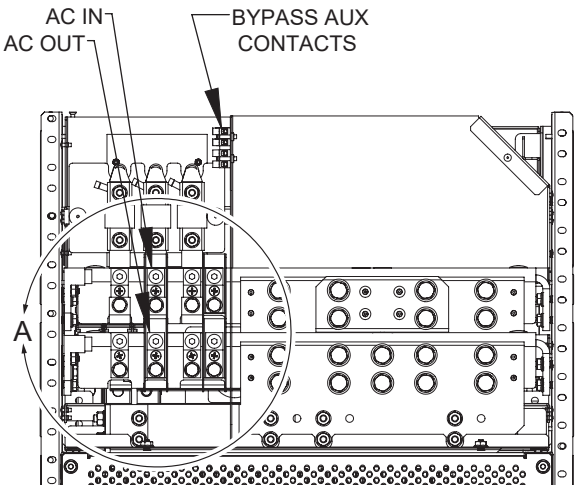
The required gauge of the AC input, DC+/DC- input and AC output cabling is determined by the current rating, circuit breaker rating, typical ambient temperatures and the applicable local electrical codes. Typically the AC input and standard AC output is five wires (L1, L2, and L3, N, G) up to 2/0 THHW or RW90 type cable that connects to the HP system with trade size up to 2.5" conduit.

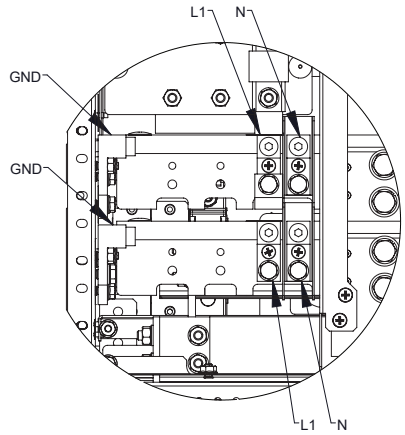
5.4.2 Grounding

Refer to Figure 32 for connection points for frame ground, and Figure 33 for the AC input ground and AC output ground.

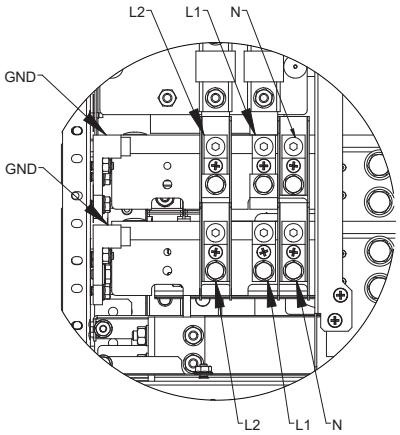
5.5 AC Connections

- Access to connection points is provided from the front of the system rack.
- AC wires enter the cabinet through the top.
- AC input and AC output wires are connected to box lugs rated for 2/0 to #10AWG.

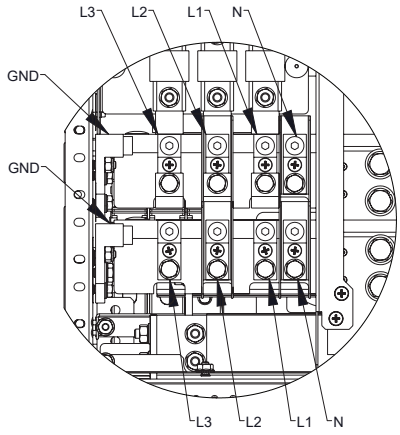




Detail A, AC Input if 10kva



Detail A, AC Input if 20kva



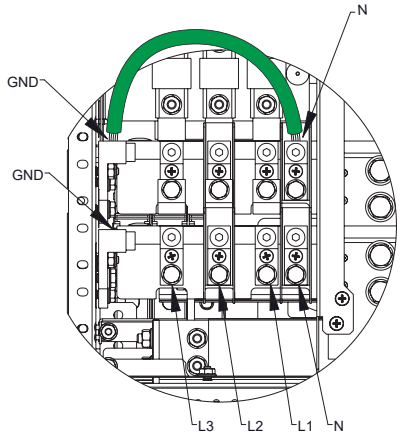
Detail A, AC Input if 30kva

Figure 33 — AC and DC Connections

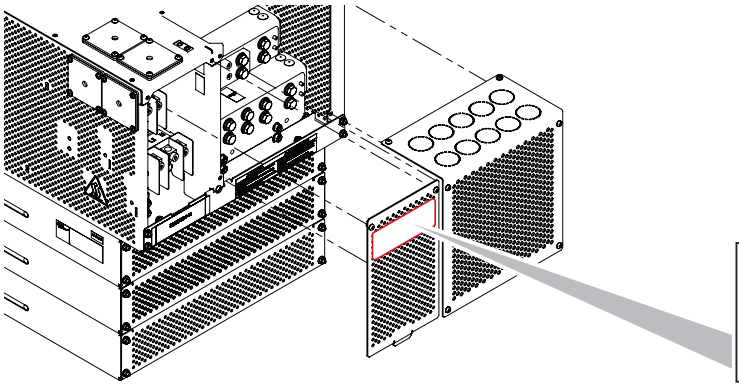
5.5.1 AC Connections - Inverter Only

If using the AMPS HP2 without an AC input source, perform the following wiring procedure:

1. Connect the input neutral terminal to the input ground terminal using a bonding conductor.
2. Ground the enclosure to a suitable grounding electrode following local code requirements.
3. Once connection is complete, apply this **Separately Derived Source** label the outside of the AC wiring compartment.



Detail A, Inverter Only Mode



THE OUTPUT AC CIRCUIT IS CONSIDERED AS A SEPARATELY DERIVED SOURCE.
IF LOCAL CODES REQUIRE GROUNDING OF THIS CIRCUIT,
USE TERMINAL 'NEUTRAL' FOR BONDING THIS CIRCUIT TO THE ENCLOSURE.
GROUND THE ENCLOSURE TO A SUITABLE GROUNDING
ELECTRODE IN ACCORDANCE WITH THE LOCAL CODE REQUIREMENTS.
REFER THE INSTALLATION INSTRUCTIONS IN THE USER MANUAL.

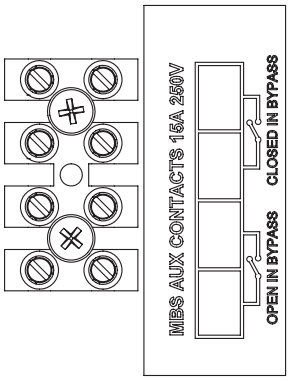


Figure 34 — Bypass Aux Contacts 3-30

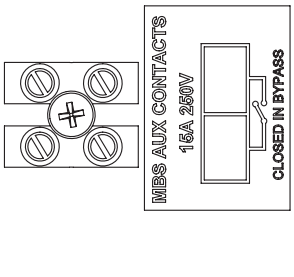


Figure 35 — Bypass Aux Contacts 1-10 and 2-20

5.6 DC Connections

- Access to connection points is provided through the opening in the top and back of the system rack.
- DC wires enter the cabinet through the top of the cabinet.
- A low voltage disconnect should be provided with the battery system.

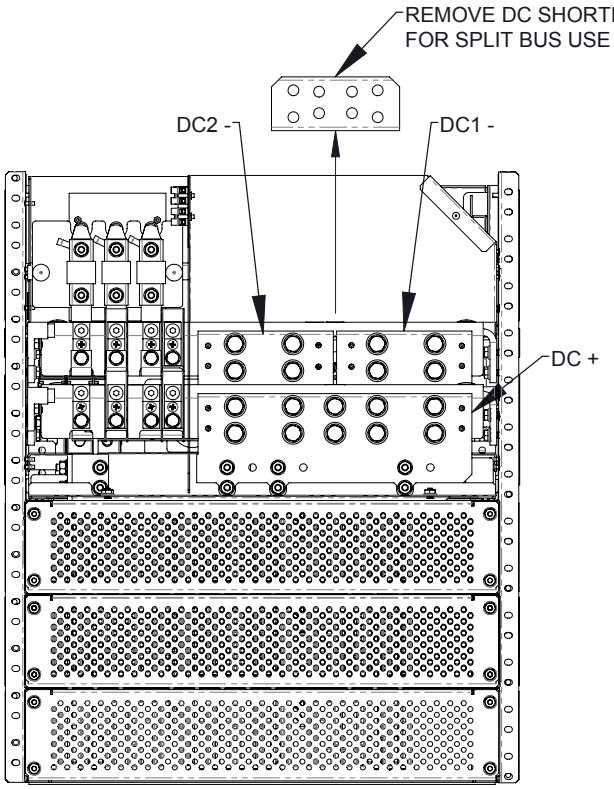


Figure 36 — DC Connections, DC1 and DC2

5.6.1 DC Battery Cabling

DC battery cable terminations are designed for two-hole spade lugs (3/8" diameter on 1" centers) crimped to the cabling, then attached to the bus bars. See Figure 33.

Torque specifications for DC wiring (3/8" bolts that attach the DC lugs at the back of the DC distribution box) are 190 – 240 inch/lbs (21.5 – 27.1 N-m).

6. Features

6.1 Cordex HP Controller

The Cordex™ HP (CXC HP) controller provides centralized setup, control and monitoring of power systems. This ranges from simple monitoring and threshold alarms for temperature, voltage and current, to advanced battery charging and diagnostic features.

The controller supports dual Ethernet ports and a 4.3” LCD screen to allow simultaneous network, LCD and local laptop access to the controller including both web and SNMP interfaces.

The CXC HP supports to dual CAN ports to allow up to 256 power and/or ADIO modules to be controlled and monitored. The controller uses external analog and digital input and output (ADIO) peripherals to monitor electrical signals (temperature, voltage, temperature) and generate electrical signals through relays. The most commonly used ADIO peripheral is the L-ADIO for low voltage systems which includes:

- 8 digital inputs
- 4 voltage sensors
- 4 temperature sensors
- 4 current sensors
- 12 Form C relay outputs

The CXC HP has the following features:

- Front touchscreen: full color LCD touchscreen display, to access controls and menu items by using fingertip touch or a stylus.
- Home button: provides the ability to go directly back to the home screen from any menu.
- Front panel reset: for emergency use only to restart the CXC HP if the unit touch screen or home button are not responding.
- Front panel LEDs: for alarms, progress and status indication.
- Audio speaker: built-in audio tones during active alarms, and can be disabled if required.
- Ethernet: dual ports 10/100 BaseT Ethernet connection on both the front and rear of the controller for remote or local communication.

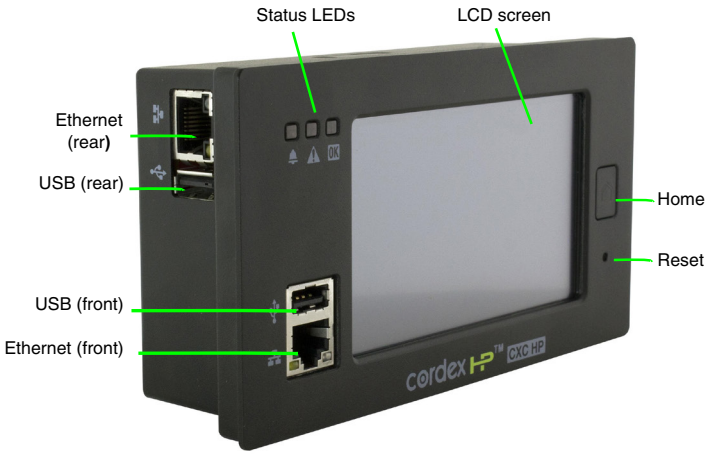


Figure 37 — Cordex CXC HP Controller

- USB: dual ports on both the front and rear of the controller for upgrades and file management via a standard USB flash drive.
- CAN: dual independent CAN bus ports for communication with the Alpha Cordex™ and AMPS family of products, which allows for a greater number of devices.
- Real-time clock with field replaceable lithium battery: allows for timestamps on alarms and events.
- System fail alarm/relay: which activates when there is a major internal failure. During such a condition the unit attempts to reset.

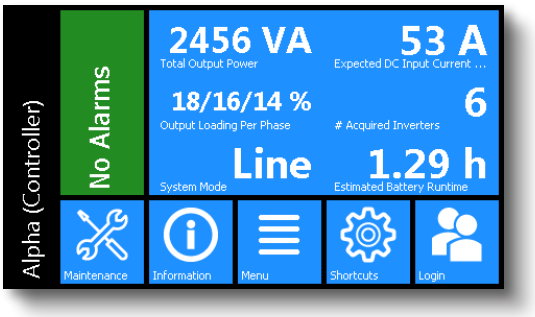


Figure 38 — LCD Color Touchscreen Display

6.1.1 Web Interface Features

This section provides an overview of the Inverter system features via the controller's web interface. Refer to the Cordex HP Controller Software manual (0350058-J0) for more details.

Inverter System Menus

The Inverter system consists of menus to access inverter alarms, signals and settings. From the main dashboard go to **Power System > Inverter System**. Features include:

- Status: provides a view of the systems general details
- Configure System: provides the configuration menu, system properties and system alarms
- Inventory: provides submenus for the inverters, breakers, fuses and bypass switches and T2S
- Phase and Group Data: provides a view of the AC Output Phases, AC Input Groups and the DC Input Groups.
- Live Alerts: provides a table of alerts including the type and the alert name.
- System Functions: provides three submenus Zero phase shift, AC Input power limit and Manual DC Priority.

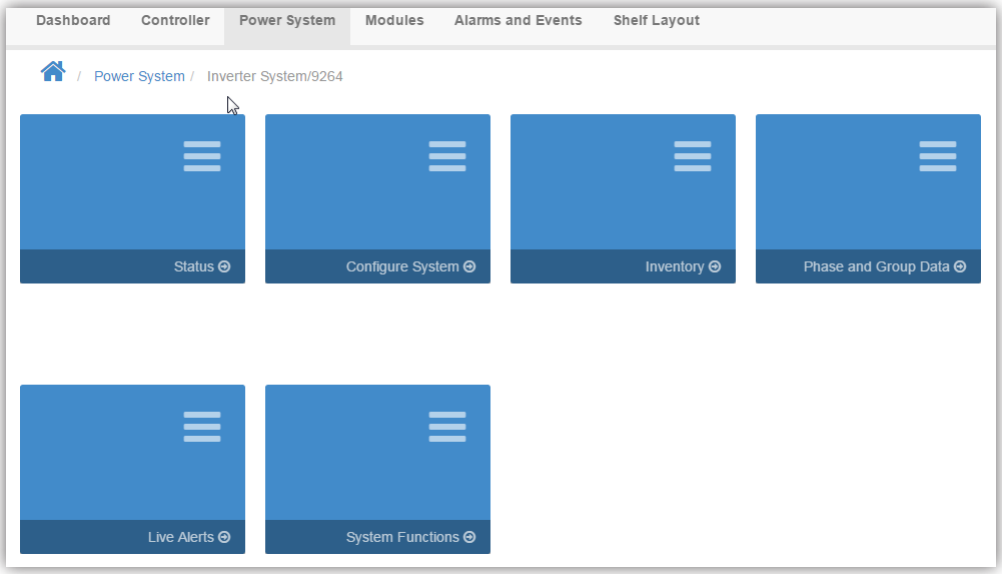


Figure 39 — Inverter System Menus

6.2 L-ADIO

The L-ADIO is the standard analog and digital I/O peripheral for low voltage (<60Vdc) systems. The L-ADIO communicates on CAN bus to the controller and provides user access to I/O management via the CXC HP controller.

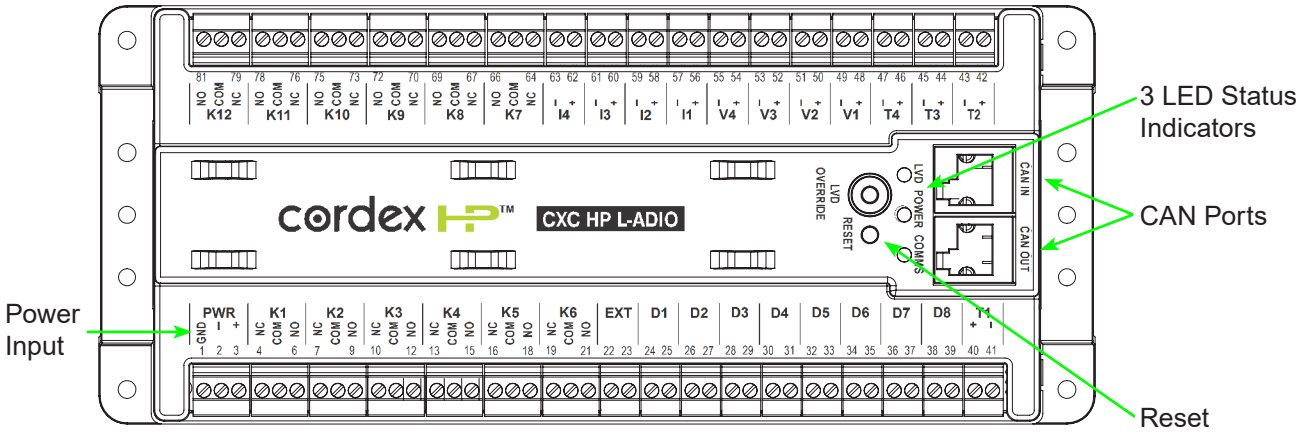


Figure 40 — L-ADIO I/O Peripheral

6.2.1 Analog Inputs

Four voltage inputs, V1 – V4, are provided for a variety of voltage monitoring requirements. The input channels can measure a signal between -60Vdc to +60Vdc.

Four current input channels, I1 – I4, provide monitoring of current; e.g., discharge (load) and charge (battery). The CXC HP is capable of monitoring standard shunts of 25, 50 and 100mV as well as application specifications of up to 250mV. The shunt current rating can be configured via the controller and is set by default to 800A 25mV. The input range for this signal is -250mV to +250mV.

Four temperature input channels, T1 – T4, provide monitoring of temperature probes (thermistors). These are typically used for either ambient temperature, or for battery post monitoring to enable battery temperature compensation. The temperature sensor is provided by Alpha in various lengths. The input range for this signal is 0V to 5V and is powered internally from the L-ADIO.

6.2.2 Digital Inputs

The L-ADIO can accommodate up to eight digital input channels, D1 – D8. Each channel responds to a zero or system voltage potential at the input to activate or deactivate the appropriate condition. These channels can monitor digital alarm/control signals from rectifiers, converters and many other types of equipment. An additional digital input, “EXT” is reserved for monitoring an external LVD override.

6.2.3 Alarm and Control Output Relays

Each L-ADIO contains twelve Form C alarm output relays to extend alarms and to control external apparatus. Each internally generated alarm or control signal may be mapped to any one of the 12 relays, several signals may be mapped to just one relay or none at all.

6.2.4 LED Indication

Each L-ADIO contains three LEDs for peripheral status indication.

LVD – Yellow = LVD Override Engaged

Power – Blue = Power present to device

Comms – Green = L-ADIO has been acquired by CXC HP

6.2.5 Front Panel Reset Button

A reset button is located on the front panel. It takes approximately 15 seconds before the unit is reacquired after pressing the reset button.

During a reset condition, the L-ADIO will keep relays in their last known state to prevent false alarm notifications and possible changing system LVD states.

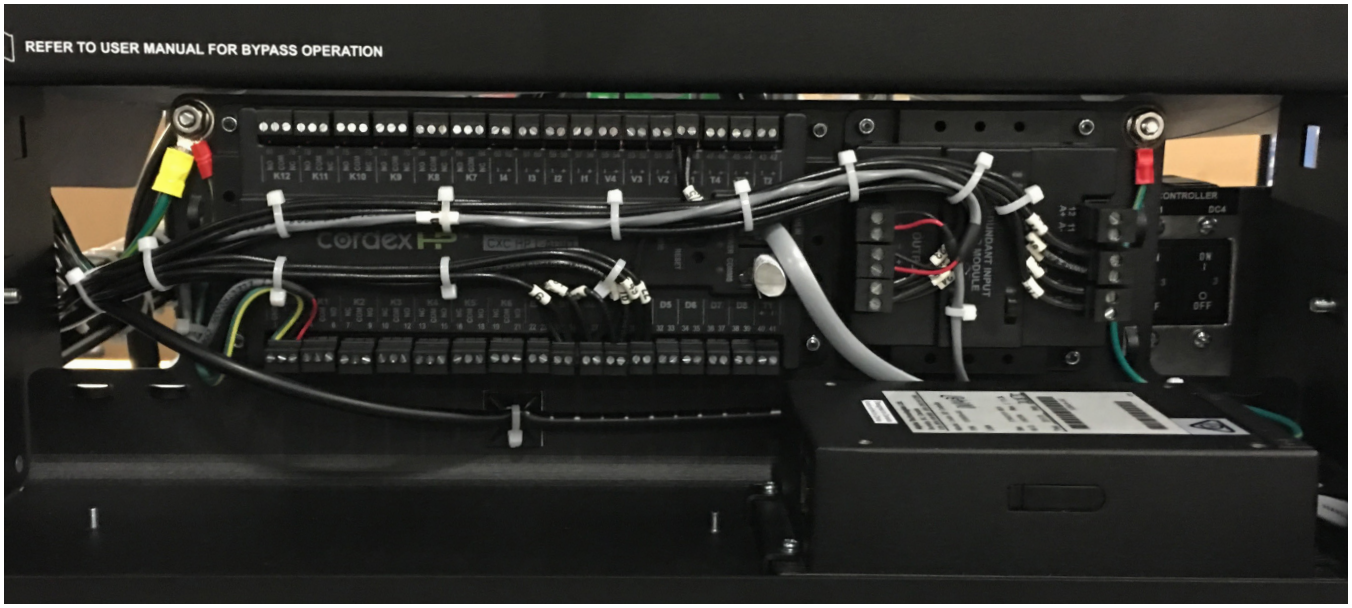
CAUTION – Pressing the reset button will cause the L-ADIO to lose communication with the controller.

6.2.6 Communication and Control Connections

Remove two screws and fold the controller front panel down to access the communication and control connectors.

NOTE:

The breakers located behind the CXC HP protect the wiring to the CXC HP and alarm contacts.



6.3 T2S Inverter Control Card

The CXC HP unified system controller monitors and manages inverter modules by communicating with the T2S inverter control card. The T2S may be useful in troubleshooting inverter alarms.

LEDs 1 through 3 on the front panel of the T2S indicate the following alarm conditions:

- Major Alarm LED
- Minor Alarm LED

NOTE: USB port functionality is disabled as of T2S software version 2.91. The T2S can be accessed from the CXC HP with current software versions.

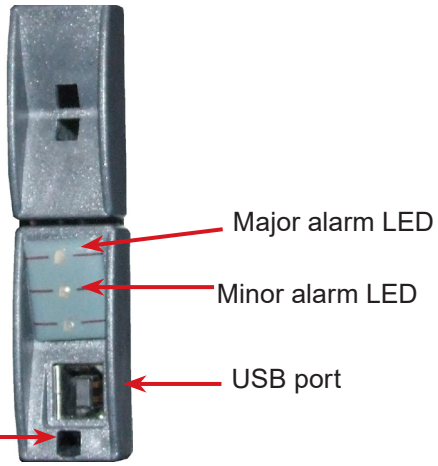


Figure 41 — T2S front panel

6.4 Inverter Module Indicators

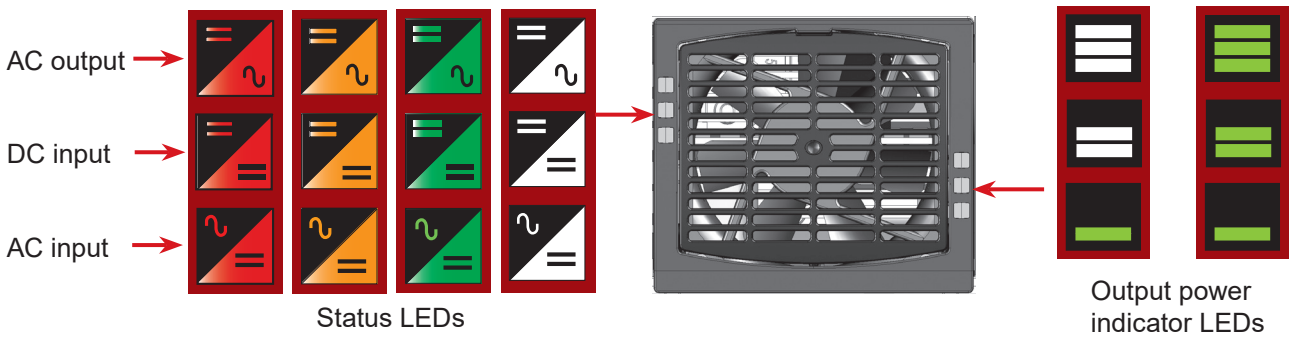


Figure 42 — Fig. 4.1 Inverter Module Status, Power LEDs

6.4.1 Status LEDs

Inverter Status LED	Description	Remedial action
OFF	No input power or forced stop	Check AC input
Permanent green	AC Input OK, normal operation	None required
Flashing green	Inverter OK but conditions are not within normal parameters	Check upstream and surrounding equipment
Flashing green/orange alternating	Recovery mode after boost (10 In short circuit condition)	Wait for a while
Permanent orange	Starting-up mode	Wait
Flashing orange	Modules cannot start	Insert T2S
Flashing red	Recoverable fault	Wait or attempt to clear fault condition by removing and reinserting the module
Permanent red	Non recoverable fault	Attempt to clear fault condition by removing and reinserting the module Download T2S inverter alarm logs Record the alarm(s) Send module back for repair

Output Power (redundancy not counted)

The output power LEDs (located on the right side of the module's front panel indicate the amount of power (percentage of rated power) provided by the module. The number of bars that are illuminated combined with whether or not they are on steady or flashing indicate the output power level or overload condition as shown in the figure below.

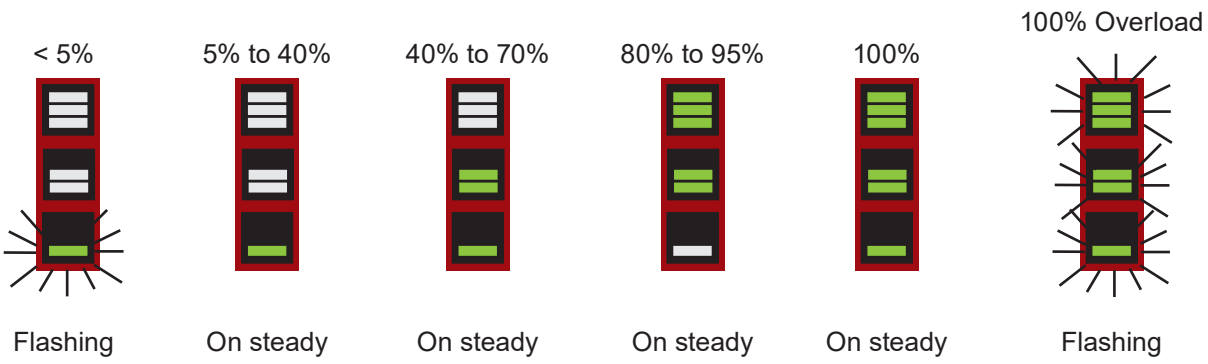


Figure 43 — Output Power Indicator LEDs

6.5 Rectifier Features

6.5.1 Front Panel LEDs

The front panel LEDs indicate the rectifier status summary and patterned response to Locate Module command. Refer to the Cordex CXRF 48-2.4 kW manual for further details.

ALARM / FAULT (1)

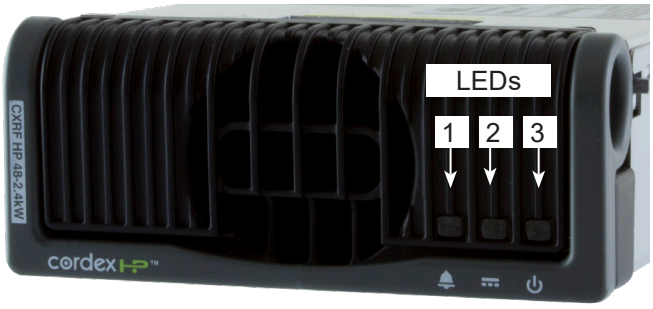


Figure 44 — Rectifier Front Panel LEDs

The red LED is on during an active Module Fail alarm if the module is unable to source power due to a fault condition. Refer to the relevant controller manual for fault details.

The LED flashes (~2Hz) when a minor alarm is detected if the modules output capability has been reduced or a minor failure is detected.

DC ON (2)

The green LED is on when the rectifier is delivering power to the load. The LED goes out when the rectifier is off. For example, when commanded by the CXC HP.

AC ON (3)

The green LED is on when the AC input voltage is qualified and within the specified range 90Vac to 310Vac and frequency 44 to 66 Hz.

LED Activity During the Locate Module Command from CXC HP

The **Locate Module** command from the CXC HP, causes the LEDs of the target rectifier to flash in a cyclical pattern. This flashing normally lasts 60 seconds.

LED Activity During Power Save

When a rectifier is put into power save mode, only the AC ON LED remains illuminated.

6.5.2 Rectifier Rear Panel

Refer to the Cordex CXRF 48-2.4 kW manual for shelf power and communications connections details.

6.5.3 True Module Fail Alarm

The power modules have a “true” fail alarm that provides a true indication of the power module’s ability to source current. When the module’s output current drops below 2.5% of the rated output, a low output current condition is detected and the Module Fail detection circuit is activated. This circuit momentarily ramps up the output voltage to determine if the module will source current. If no increase in current is detected, the **Module Fail** alarm is activated. The module will test once every 60 seconds for the condition until a current is detected. The output voltage ramping ceases upon detection of current. A minimum 2.5% load is required to avoid the **Ramp Test Fail** alarm. This load can be provided with the parallel system battery. Activation of this alarm could indicate a failed module or a failed load.

To avoid nuisance alarms for Cordex rectifier systems without batteries, and/or with a very light load (below 2.5% of the rated output), the ramp test should be disabled. Disable the Ramp Test via the controller.

6.5.4 Heat Dissipation

Each rectifier module is equipped with a front-mounted, variable-speed fan. The fan speed is determined based on ambient temperature, temperature and the load. Air flow is front-to-rear with the exhaust air exiting through internal vents at the rear of the unit.

6.5.5 Over Temperature Protection

Blockage or obstruction to the air flow can result in the internal temperature to rise and reduce the output power or even shut down the rectifier. The rectifier will resume normal operation when the temperature reduces to a safe level. Over temperature shut down can also occur when a fan failure has occurred.

6.5.6 Wide AC Range

The rectifier delivers up to 2400W of power between 187Vac and 310Vac input voltage. The rectifier can deliver up to 1200W between 90Vac and 187Vac. During start up the rectifier begins to provide power for input voltage >95Vac and shuts down if the input voltage drops below 85Vac. The THD and power factor will be out of specs for input >277Vac.

6.5.7 AC Inrush/Transient Suppression

To prevent a surge on the AC input line, the inrush current of a rectifier module is limited to the full load steady state line current. Modules are also protected from input lightning and transient surges in accordance with IEEE/ANSI C62.41 Category B3 standards.

6.5.8 Soft Start

A soft start feature is used to eliminate an instantaneous demand on the AC power source. A soft start, sometimes referred to as a “current walk-in”, works by gradually (up to five seconds) ramping up the DC output current limit from zero to the actual or defined customer setting. The rectifier output voltage is ramped from the minimum voltage to the float voltage. This feature along with Start Delay prevents any instantaneous surge demand from the utility.

6.5.9 Start Delay

The rectifier modules are equipped with a delay timer to stagger-start a series of modules. When multiple modules and multiple shelves, part of a larger system are used in conjunction with a controller, a start delay prevents all rectifiers from starting at the same time and causing an inrush on the utility. The default start delay is set to 1 second and can be adjusted up to 250 seconds on the CXC HP controller. The built-in timer delays the switching ON of the module by the start delay interval (up to 250 seconds), which is set in the CXC HP.

6.5.10 Current Limit/Short Circuit Protection

The current limit function determines the maximum output current limit of the rectifier module, regardless of the output voltage or power. The maximum output current is limited to a constant value down to a short circuit condition. Current limiting can be used to mate the rectifier output current ampacity to the needs of the load and parallel battery to minimize excessive battery recharge currents.

The rectifier will sustain a continuous short circuit at the output terminals. The maximum short circuit current will not exceed 50A per module.

6.5.11 Power Limiting

Each rectifier module is designed to limit the power output to the module specification. This enables more current to be supplied at lower output voltages, and allows matching the output power to the demands of constant-power loads often seen in telecom equipment. This feature can also be used for a faster recharge of flooded batteries paralleled with the load.

6.5.12 High Voltage Shutdown (HVSD)

NOTE:

The current limiting feature overrides the power-limiting feature.

This feature protects the load from over-voltages originating in the rectifiers. The offending rectifier module is shut down when a high output voltage condition occurs. The red Alarm (Module Fail) LED will illuminate. The module will restart automatically. However, if more than three over-voltage conditions occur within one minute, the module will latch off and remain shut down until it is reset by restarting the rectifier via the CXC HP.

6.5.13 Battery Eliminator Operation

Rectifier modules maintain all specifications (except where indicated) with or without a battery or a DC source attached in parallel to the output. Under these conditions there will be no monitoring or control activity if AC power failure occurs.

6.5.14 Mechanical

An integral handle provides a means to both insert and remove the rectifier as well as locking the rectifier in place.

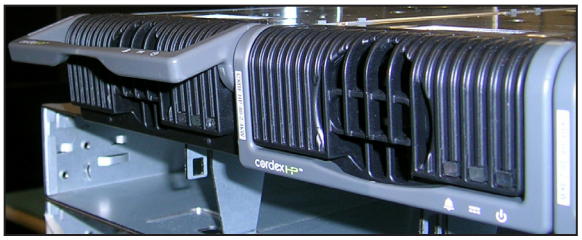


Figure 45 — Locking Handle disengaged/engaged

7. Commissioning the System

7.1 Tools Required

The following tools are required to commission the AMPS HP system for the first time:

- Medium flat screwdriver with approximately 3/8" (5 mm) blade width
- True RMS digital multimeter
- Computer with Ethernet connection and Microsoft Edge, Chrome, Safari or Firefox
- Cat 5 ethernet cable if a computer is directly connected to the CXC HP controller
- Torque wrench
- 3/8" hex driver

7.1.1 Before You Begin

WARNING!

The HP must have no power (AC and DC utility breakers OFF and locked out) and no modules installed prior to start-up.

1. Verify that the AMPS HP system is mechanically secured to the floor or other structure.
2. Verify that the controller breakers behind the controller are ON.
3. Verify that the clearances around the AMPS HP system meet the minimum requirements.
4. Ohm-test the AC and DC bus bars to check for any shorts caused by cut wires, loose bolts, washers and other conductive material. If possible do Megger testing.
5. Verify that the AMPS HP system is correctly and securely grounded to the building grounding system.
6. Verify that the AMPS HP system is correctly and securely connected to the utility and batteries. For the battery connections, follow the manufacturer's recommendations and record the torque values.
7. Torque AC and DC connections. Triple check the polarity of the battery connections.
8. If this system includes rectifiers for charging, verify that all rectifier modules are removed from the rectifier shelves.
9. If this system includes inverters and rectifiers (hybrid system only), verify that all the modules are removed from the shelves.
10. Verify that all breakers at the external load distribution box are switched OFF.
11. Refer to and verify that the following breakers are OFF
    - Inverter AC input circuit breaker
    - Inverter AC output circuit breaker
12. Place the internal MBS switch to INVERTER mode.
13. If external maintenance bypass switch (EMBS) is installed:
    a. EMBS chassis framework should be bonded to building grounding system
    b. Check for continuity in UPS and BYPASS mode as well as dry contacts
    c. Check dry contact signal wiring between AMPS HP2 and EMBS
    d. Refer to EMBS manual for details

14. If a Generator is installed, verify that the transfer switch has a minimum 1 second switching delay or that the transfer is always in phase.

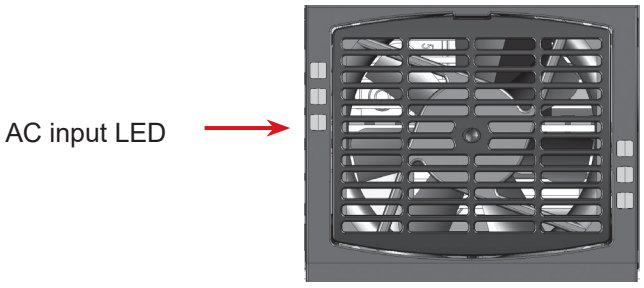


Figure 46 — Inverter Module AC input LED

7.1.2 Starting-up the system

1. Switch on the AC mains/utility power.
2. Verify the AMPS HP system AC input voltages at the AC wiring terminals.

System	Voltage	Value
ALL	Neutral to Earth Ground	~0V
3 phase	L1 to L2, L2 to L3, L3 to L1	~208V
	Neutral to L1 / L2 / L3	120V
2-pole	L1 to L2	~208V
	Neutral to L1 / L2	120V
Split Phase	L1 to L2	~240V
	Neutral to L1 / L2	120V

3. Apply DC to the system, verify that the AMPS system DC inputs at the wiring terminals are between 44Vdc and 55Vdc.
4. Turn on all system inverter input and output breakers.
5. Install one inverter in Slot 1, Shelf 1.

7.2 Commissioning the Inverter System

Once a system has been created, and a T2S is assigned to the system, it can be commissioned. There are three stages to commissioning an inverter system:

1. Setting system options
2. Commissioning seed inverters
3. Adding inverters

The wizard automatically goes to stage two, upon completion of stage one.

7.2.1 Setting System Options

This wizard requests configuration information such as:

- Number of AC Phases
- Number of DC Input Groups
- Number of Shelves Per Phase

The number of AC phases can be set to one, two or three. Refer to the system's connection diagram to determine how many input phases are connected.

The number of DC input groups can be equal to the number of DC feeds hooked up to the system.

To get to the **Commission Inverter System** wizard go to **Power System > Inverter System > Configure System**.

NOTE:

IMPORTANT: Ensure that these values are correct for the proper operation of system commissioning, and for adding new inverters.

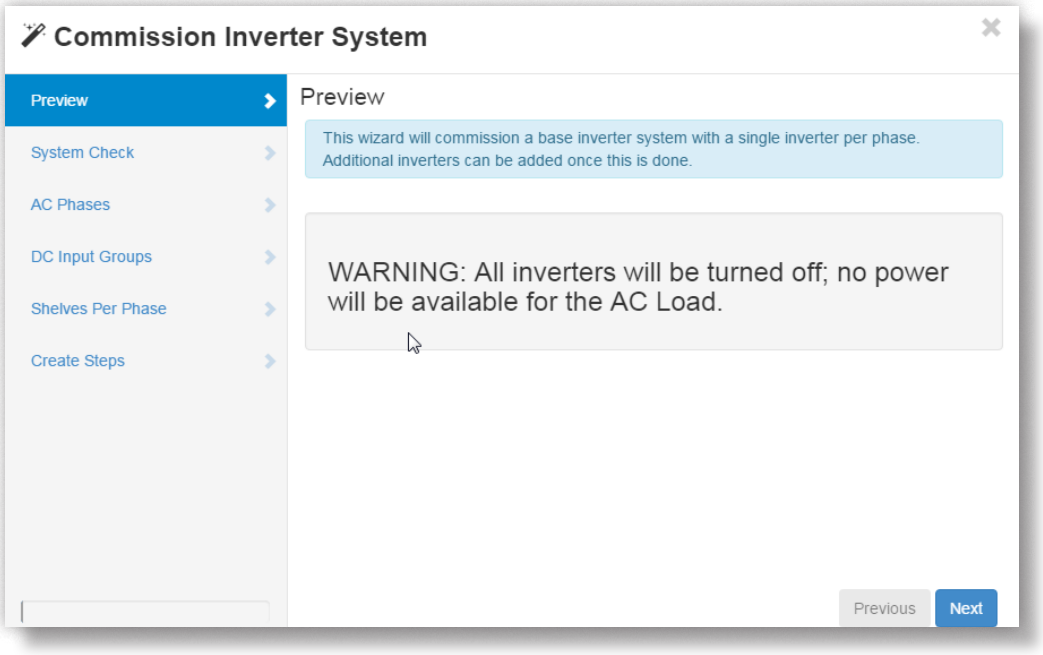


Figure 47 — Commission Inverter System Wizard

7.2.2 Commission Seed Inverters

The second stage of commissioning involves inserting one seed inverter for each phase. The seed inverter provides a reference for all other inverters in the same phase so they can learn their power configuration and the phase shift. The commission wizard steps the user through the process. Once this is complete, there will be one inverter per phase in the system.

WARNING!

Follow all the wizard instructions: If a mistake is made during commissioning or the wizard encounters an error, commissioning must start over.

7.2.3 Adding Inverters

The third stage of commissioning involves inserting the rest of the inverters. The wizard guides the user through this process. This process takes time, and it is recommended that users follow the instructions within the wizard.

When each inverter is inserted it learns its power configuration from the other inverters already inserted in the phase. The controller sets the values for: AC input group, DC input group and the location information of bay, shelf slot ID. The correct phase number and phase shift from the other inverters already inserted in the phase.

NOTE:

IMPORTANT: After successful configuration and commissioning of the system it is recommended to make a backup of the system from the LCD in the Shortcuts > Backup menu. This will allow restoring of the configuration in the event of a CXC HP controller replacement.

7.2.4 Mapping Alarms to Relays

1. Connect a computer to the controller. Refer to the controller software manual. The 48Vdc power must be switched on before the controller can operate. Provide either DC power on the main DC1 connections or switch on at least one rectifier.
2. Go to **Power System > Inverter System > Configure System**.
3. From the **Alarms** table, select the alarm required and then click the edit button make changes.
4. Select the desired relay.
5. After changes have been made, click **Save**.
6. Hook up control wires to the selected relay.

8. Maintenance

8.1 Preventative Maintenance

This equipment requires regular maintenance. The maintenance must be done by qualified service personnel only. Contact Alpha Technologies at 1-888-462-7487 for any assistance with maintenance.

WARNING!

WARNING: HIGH VOLTAGE AND SHOCK HAZARD Use extreme care when working inside the enclosure/shelf while the system is energized. Do not make contact with live components or parts. Static electricity may damage circuit boards, including RAM chips. Always wear a grounded wrist strap when handling or installing circuit boards. Ensure redundant modules or batteries are used to eliminate the threat of service interruptions while performing maintenance on the system's alarms and control settings.

8.1.1 Recommended maintenance schedule

Task:	Interval
Clean ventilation openings	1-6 month
Inspect all cable connections, re-torque if necessary	1 year
Verify alarm/control settings	1 year
Verify alarm relay operation	1 year
Verify circuit breaker operation	1 year

8.1.2 Tools, Spare Parts and Equipment

Table D — Tools		
Required	**Service /Maintenance**	**Commissioning**
Torque wrench	X	X
#2 Philips screw driver	X	X
#2 flat head screw driver (3/16") width head	X	
#1 flat head screw driver (1/8") width head	X	
Small flat head screw driver (1/16") width head	X	X
9/16" hex driver	X	
3/8" hex driver	X	
7/16" combo wrench	X	
7/16" flat gear ratchet	X	
9/16" combo wrench	X	
9/16" flat gear ratchet	X	
11/16" combo wrench	X	
11/16" flat gear ratchet	X	
6" ratchet extension	X	
3" ratchet extension	X	
3/8" ratchet socket	X	
7/16" ratchet socket	X	
7/16" ratchet socket extended neck	X	

Table D — Tools		
9/16" ratchet socket	X	
9/16" ratchet socket extended neck	X	
5/8" ratchet socket	X	
5/8" ratchet socket extended neck	X	
10 mm combo wrench	X	
10 mm flat gear ratchet	X	
3/8" Allen key on a 3/8" ratchet socket	X	X
3/16" Allen key on a 3/8" ratchet socket	X	X
Flash light or trouble light	X	X
Crossover Ethernet cable	X	X
Straight through Ethernet cable	X	X
Computer with Ethernet port and Firefox or Chrome	X	X
True RMS digital multimeter	X	X
Other Recommended Tools	**Service /Maintenance**	**Commissioning**
Needle nose pliers	X	
Side cutters	X	
Wire stripper 10 AWG to 20 AWG	X	
Exacto knife	X	
Measuring tape with inches and cm	X	
Scissors	X	
Rubber mallet 1-1/4" diameter	X	

Table E — Common Spare Parts	
Required	**Service /Maintenance**
014-201-20	AIM2500 inverter module, 2.5kVA, 2.0kW
571-005-10	Inverter black plastic front assembly
7400026	Inverter fan
0180036-080	Cordex HP Controller with AMPS support
741-032-21	Blanking module for inverter or rectifier slot

Table F — Spare Parts, AMPS HP2 models AMPS-3-30, AMPS-2-20 and AMPS-1-10	
Required	**Service /Maintenance**
162-600-19	Surge suppression replacement module, red stripe, Line-Ground, 40kA rating
162-601-19	Surge suppression replacement module, green stripe, Neutral-Ground, 40kA rating
4600112	200A, 300V class T fuse

Table G — Spare Parts, AMPS HP2 models AMPS-3-75 and AMPS-2-40	
Required	**Service /Maintenance**
4600113	400A, 300V class T fuse
162-602-19	Strikesorb 40 TVSS protection module

8.2 Inverter and T2S Maintenance

This section covers inverter and T2S maintenance including: replacing, identifying, alarms and alerts, DC priority and AC input power limit.

8.2.1 Changing the System Configuration

Once the system has been created, most of the system configuration cannot be changed. The number phases, number of DC groups and number of shelves per phase cannot be changed. If any of these values are incorrect the inverter system must be re-commissioned and all inverters unplugged.

If necessary, the DC group, the bay, shelf and slot ID of an individual inverter can be changed manually by navigating to the details of the specific inverter.

8.2.2 Adding or Removing Inverters

After the inverter system has been in service for some time, it is possible that more inverters may needed to increase capacity. The Add Inverters wizard guides users through this process.

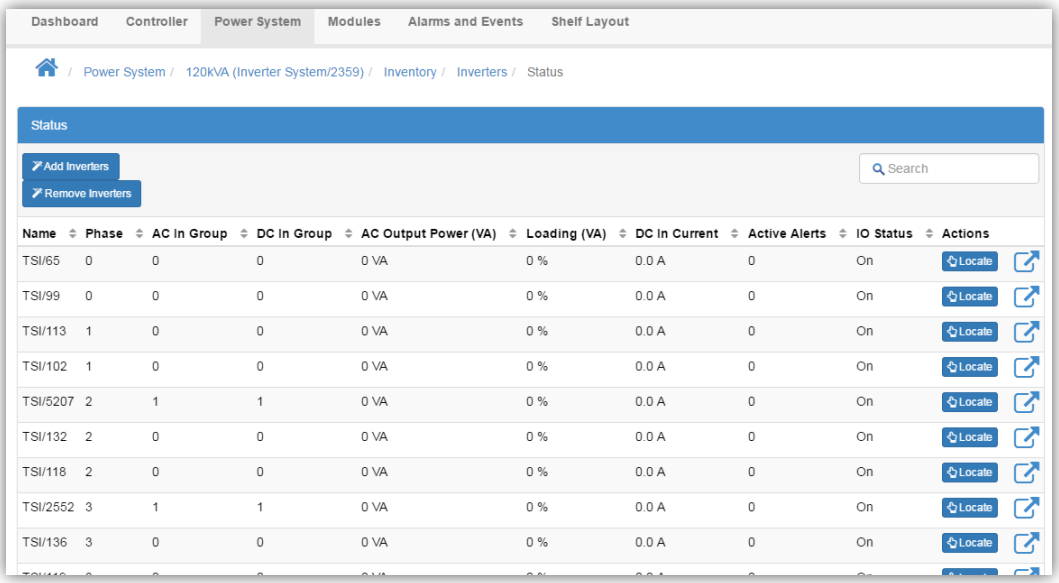


Figure 48 — Add/Remove Inverters

Go to **Power system > Inverter System > Inventory > Inverters > Status** to access the **Add Inverters** wizard. If inverters must be removed from the system, use the **Remove Inverters** wizard.

Go to **Power System> Inverter System > Inventory > Inverters > Status** to access the Remove Inverters wizard.

CAUTION!

To ensure the T2S is configured correctly, it is recommended that you use these wizards to add or remove inverters from the system. This ensures that the correct number of inverters, and the correct number of redundant modules in each phase. This is important for the operation of T2S alerts and alarms.

8.2.3 Taking Power from DC Source

The inverter system can take power from the DC source (usually batteries) under three conditions:

1. AC mains is lost;
2. Manual DC Priority is enabled;
3. AC Input power limit is enabled.

When AC mains is lost, the inverters will always take power from the DC source if available.

Using Manual DC Priority

It is possible to manually instruct the inverters to take some amount power from DC. This can be useful for testing or to manually reduce the AC input power during peak periods. **Manual DC Priority** takes precedence over **AC Input Power Limit** when both are enabled.

To use **Manual DC Priority**:

1. Go to **Power System > Inverter System > System Functions > Manual DC Priority**.
2. From the **Manual DC Priority** table, click edit icon.
3. Select **Enable** in **Manual DC Mode** drop-down menu and click **Save**.
4. Click the edit icon to set the **Desired DC Input Power** to the desired value. This value is a percentage of output power that will be taken from DC (with the rest coming from AC input).
5. **Disable Manual DC Mode** when complete.

8.2.4 Using AC Input Power Limit

The AC Input power limit is a feature that allows the controller to dynamically adjust the amount of power taken by the AC input, by taking some power from the DC input. The controller will continue to take power from the DC input until a user configured threshold is reached or the feature is disabled.

1. Go to **Power System > Inverter System > System Functions > AC Input Power Limit**.
2. Enable the **AC Input Power Limit**.
3. Set the **Desired AC Input Power** to the required value. The controller will attempt to limit the AC input power to this value by taking some power from the DC input.
4. **Disable AC Input Power Limit** when complete or when the battery needs to be charged.

Note: The battery may be depleted and require charging.

8.2.5 Replace Fan

The fan inside each inverter has a limited lifetime. When this lifetime has expired the inverter will have an active alert called **Fan Life Elapsed**. To prevent an unexpected fan failure that could compromise system redundancy, it is recommended that the fan be replaced when this alert occurs.

To clear the alert, go to **Power System > Inverter System > Inventory > Inverters > Status**, and click the details icon of the inverter with the alert, then press the **Clear Fan Life Elapsed Aler**t button.

8.2.6 Identifying an Inverter

If an inverter is in alert it is usually necessary to identify and locate the inverter in the rack. There are two ways to do this:

1. Go to **Power System > Inverter System > Inventory > Inverters > Status**. This view shows all inverters within the system in a table view. One column within the table displays the number of active alerts. Find an inverter with an alert and click the **Locate** button. This will cause the LEDs on the front panel of the inverter to flash for 2 seconds.
2. You can also click the details icon of the inverter. This view shows the bay, shelf and slot ID of the inverter in the **Inverter Mapping** table. Normally this information is populated during system commissioning, but it can also be changed here in case it is incorrect or was not initially set.

If these values have been set, use them to physically locate the inverter. If the values have not been set or appear to be incorrect, you can use the **Locate** button to find the inverter and set the bay, shelf and slot ID as required.

8.2.7 Alarms and Alerts

The inverter system has a set of alarms that are generated by the alerts on the T2S and inverters. The system alarms are shown in the **Active Alarms** table.

To see all the active alerts within the system, go to **Power System > Inverter System > Live Alerts**. This live information comes from the T2S, and is the source of inverter system alarms.

When the inverter system has an active alarm, go to the **Live Alerts** table. The information in this table indicates which T2S or inverter to investigate to find the cause of the alarm.

8.2.8 Replacing a T2S

If a T2S needs to be replaced, use the **Replace T2S wizard** via the controller. Go to **Power System > Inverter System > Inventory > T2Ss** to access the wizard.

8.2.9 Shelf Layout

This is only available via the web dashboard.

When the inverters have been configured with bay, shelf and slot ID, the **Shelf Layout** page displays a physical view of the inverters, the alert status and the output power of each inverter. The text that shows the output power is a link that opens new page to display the inverter details.

NOTE:

Shelf Layout will not update automatically if modules are swapped, added or replaced without using the Add/Remove Inverter command.

8.3 Replacing an AIM2500 Inverter Module

8.3.1 Replacing Inverters

Follow these step to replace one or more inverters:

1. Go to **Power system > Inverter System > Inventory > Inverters > Status**.
2. Pull out the inverters that must be replaced. The information on the **Status** page will help identify inverters in alert. An inverter that is pulled out will not have any values for its data and have a **Forget** button on its row.
3. Press the **Remove Inverters** button to launch the wizard and then follow the instructions.
4. Press the **Add Inverters** button to launch the wizard.
5. The wizard will prompt you to insert inverters in the first available slot starting in phase 1. If the inverter must go into a different phase, use the **Phase Done** button. If the recommended slot is not correct, but the phase is correct, use the **Skip Slot** button to advance to the next available slot.

CAUTION!

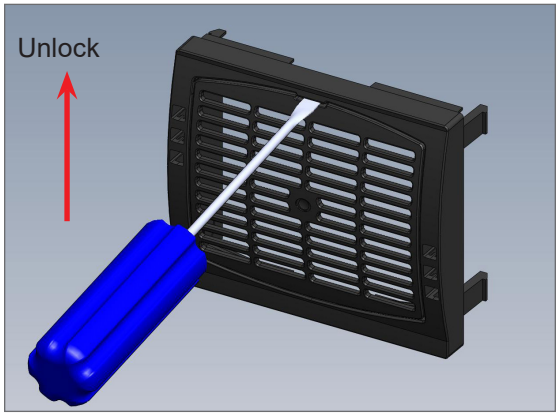
This system is designed for use with Alpha AIM2500 inverter modules (Alpha p/n 014-201-20). Use of alternate inverter hardware and/or unapproved firmware versions may cause system instability and will invalidate system warranty. Consult Alpha customer service or technical support for additional details.

CAUTION!

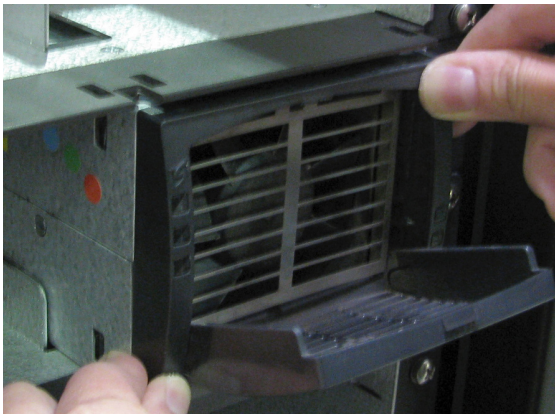
Improper installation or removal of modules can break latching components.

Removing a module from a working system generates an alarm, which will not clear until the module is replaced or the number of modules in that phase is reduced by the number of modules removed.

STEP 1:
Insert a flat head screw driver into the center flap notch and pry open the center flap. Then pull out the module by pulling on the center flap with both hands.



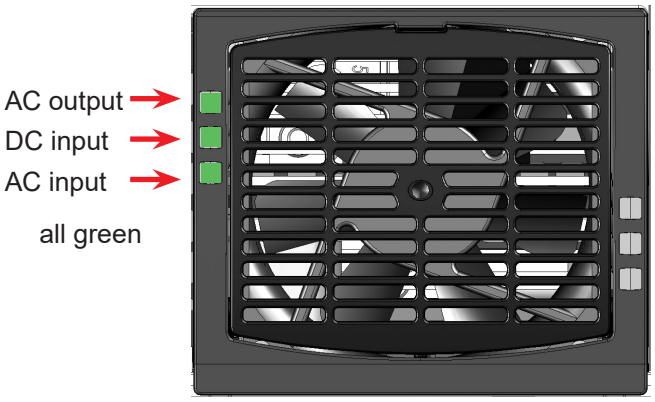
STEP 2:
With the module plastic front grill in the open/unlocked position, slide the module all the way into the slot Press the module into place and ensure connection is engaged. Close the flap.



A new module can take between 5 and 10 minutes to synchronize with the T2S controller and clear any alarms. *Do not interact with the system during the initialization process.*

When the initialization sequence is complete, the three LEDs on the left hand side of the inverter module turn a solid green.

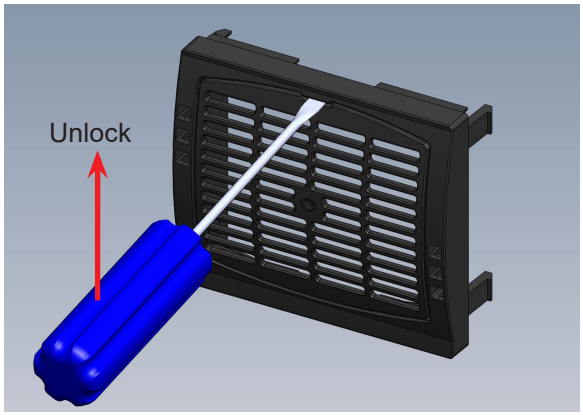
Use the touch display or a web connection to confirm that the # of modules versus actual installed are equal. (**Inverters > AC Output Groups** on the web interface).



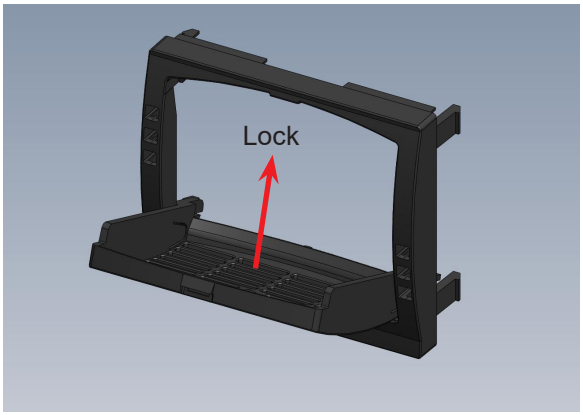
If the system remains in alarm or the inverter information does not appear after five minutes please call Alpha Technologies Technical Support at 1-888-462-7487 for assistance. A laptop with an Ethernet cable is required for troubleshooting activities.

CAUTION!

Improper installation or removal of modules can break latching components.

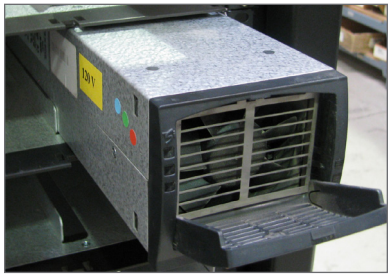


Insert a flat head screw driver into the center flap notch and pry open the center flap. Then pull out the module by pulling on the center flap with both hands.

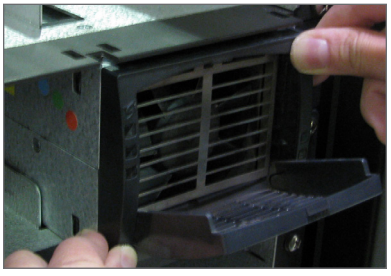


Leave the module plastic front grill in the open/ unlocked position, then slide/push the module all the way into the module slot, and then close the flap.

Figure 49 — Unlocking and Locking an Inverter Module



1. Place module into shelf.



2. Press module into place and ensure connection is engaged.

3. Close cover and snap module into place. If cover does not close easily, repeat Step 2.

Figure 50 — Inserting and Removing an Inverter Module

8.4 Synchronizing the Maintenance Bypass

For system configurations that use a generator for the AC input, the safest way to initiate a maintenance bypass is to follow the instructions in the Initiate **Zero Phase Shift** wizard.

This wizard should be used whenever the inverter system has to be put into or taken out of bypass. This prevents the inverters from turning off when the bypass switch briefly short-circuits the AC input and output.

8.4.1 Implement the following sequence before switching the unit from Inverter mode to Bypass mode.

NOTE:

IMPORTANT: Make sure that the Internal MBS is in Inverter mode.

1. The inverter input breaker should be on. The inverters should be synchronized to the line, and for all status LEDs to turn green.
2. The inverter output breaker should be ON.
3. Go to, **Power System > Inverter System > System Functions > Zero Phase Shift**.
4. Initiate **Zero Phase Shift** wizard.
5. The wizard shifts the phase and voltage of the AC output to match the input.
6. Switch the internal bypass switch to Bypass (within the time limit specified in the **Zero Phase Shift** wizard). If present, switch the external bypass switch to Line.

8.4.2 Implement the following steps before switching the unit from Bypass mode to Inverter mode:

NOTE:

IMPORTANT: Make sure that the Internal MBS is in Bypass mode.

1. Switch external bypass to UPS.
2. Switch on the inverter input breaker. Wait for the inverters to synchronize to the line, and for all status LEDs to turn green.
3. Switch on the inverter output breaker.
4. Go to, **Power System > Inverter System > System Functions > Zero Phase Shift**.
5. Initiate **Zero Phase Shift** wizard.
6. The wizard shifts the phase and voltage of the AC output to match the input.
7. Finally, switch the Internal MBS from Bypass to Inverter (within the time limit specified in the **Zero Phase Shift** wizard).

8.5 Fuse Replacement (Box Bay)

These fuses are sized to blow only if there is a short on the bypass line. These fuses must be replaced by a qualified service person.

1. Put critical loads on External Bypass, refer to 8.4.1.

WARNING!

There may still be live parts inside the system and shock hazards may be present throughout this procedure.

2. Remove all AC and DC power sources from the AMPS HP2 UPS.
3. Remove the AC wiring panel.
4. Remove the 3/8-16 nuts securing the fuse to the bus bars. Use a 9/16" socket to remove the nut and a 9/16" wrench to keep the bolt from turning.
5. Replace fuse and re-install hardware. Torque to 30 ft.-lbs.

CAUTION!

Risk of electric shock and fire hazard. Replace fuse with same type and same rating.

6. Replace the fuse with a fuse of the same rating and type:

Replaceable parts	
Alpha part number	**Description**
4600113	400A, 300V ClassT Fuse

7. Put critical loads on UPS, refer to 8.4.2.

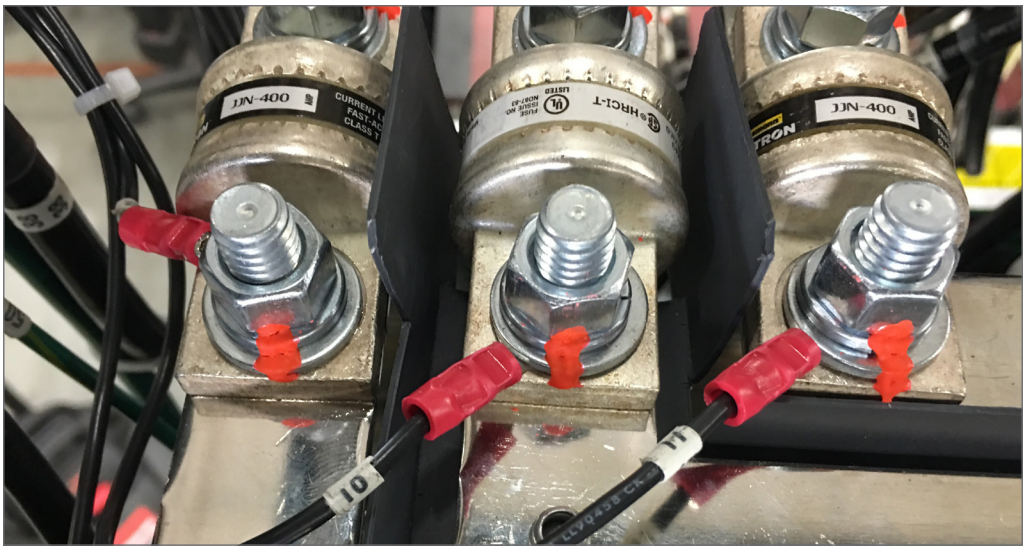


Figure 51 — MBS Fuse Locations

8.6 TVSS Replacement (Box Bay)

Make sure the spare parts are available on site.

WARNING!

There may still be live parts inside the system and shock hazards may be present throughout this procedure.

Replaceable parts	
Alpha part number	**Description**
162-602-19	Strikesorb 40 TVSS protection module

WARNING!

To prevent electrical hazards such as short circuits, ensure that the system is free of debris such as metal filings, screws, etc. after the installation is complete.

Front Access Replacement

1. Follow steps in 8.4.1 to safely transfer load to the External MBS.
2. Remove all AC and DC power sources from the AMPS HP2 UPS.
3. Remove the AC wiring panel.
4. Remove the 1/4-20 bolts securing the cables to each TVSS module.
5. Twist the TVSS modules counterclockwise to remove.
6. Replace the TVSS modules and reinstall with the copper lock washer. Tighten clockwise until the lock washer flattens.
7. Reinstall the cables with the copper hardware. Torque the copper bolts to 44-in-lbs. (3.7 ft-lbs.)
8. Put critical loads on UPS, refer to 8.4.2

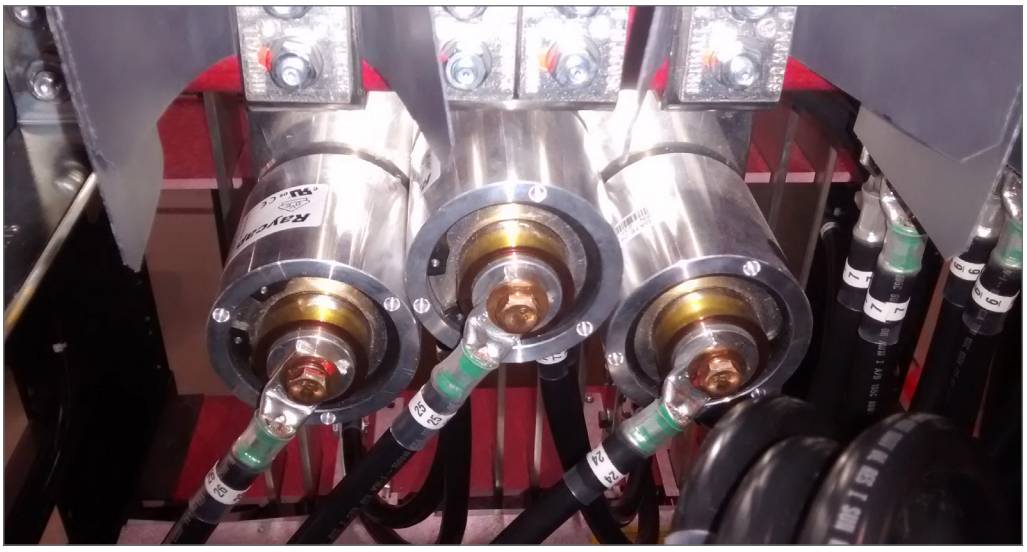
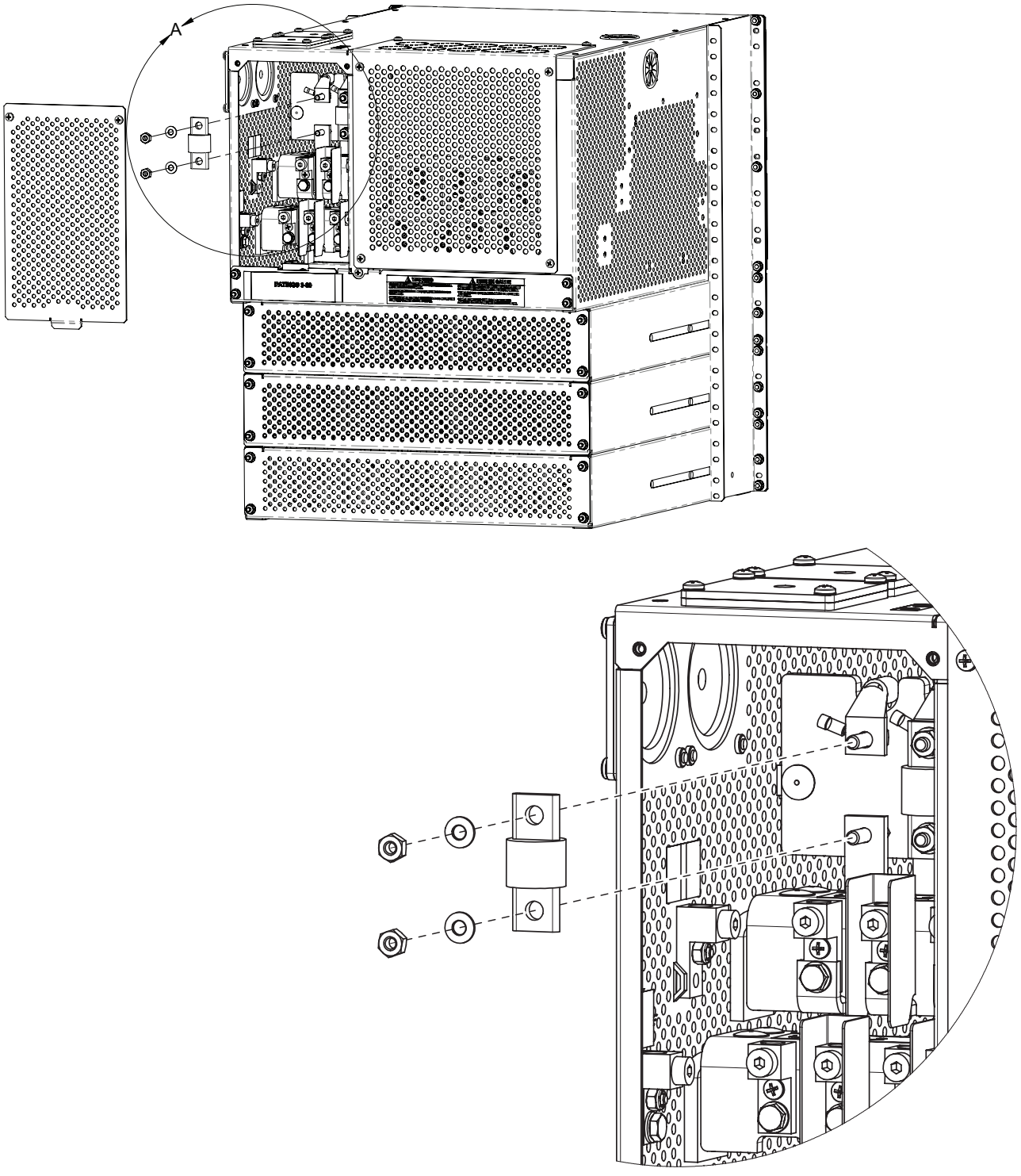


Figure 52 — TVSS Protection Modules

8.7 Fuse Replacement (Rack Mount)

1. Put system into external bypass and remove all AC and DC from the AMPS HP2 system, refer to 8.4.1.
2. Remove the AC cover with a Phillips head screw driver.
3. Remove the fuse using a 7/16 hex nut screwdriver.
4. Replace fuses with the same type and rating: 200A, 300V Class T fuse (Alpha part number 4600112).
5. Put critical loads on UPS, refer to 8.4.2.

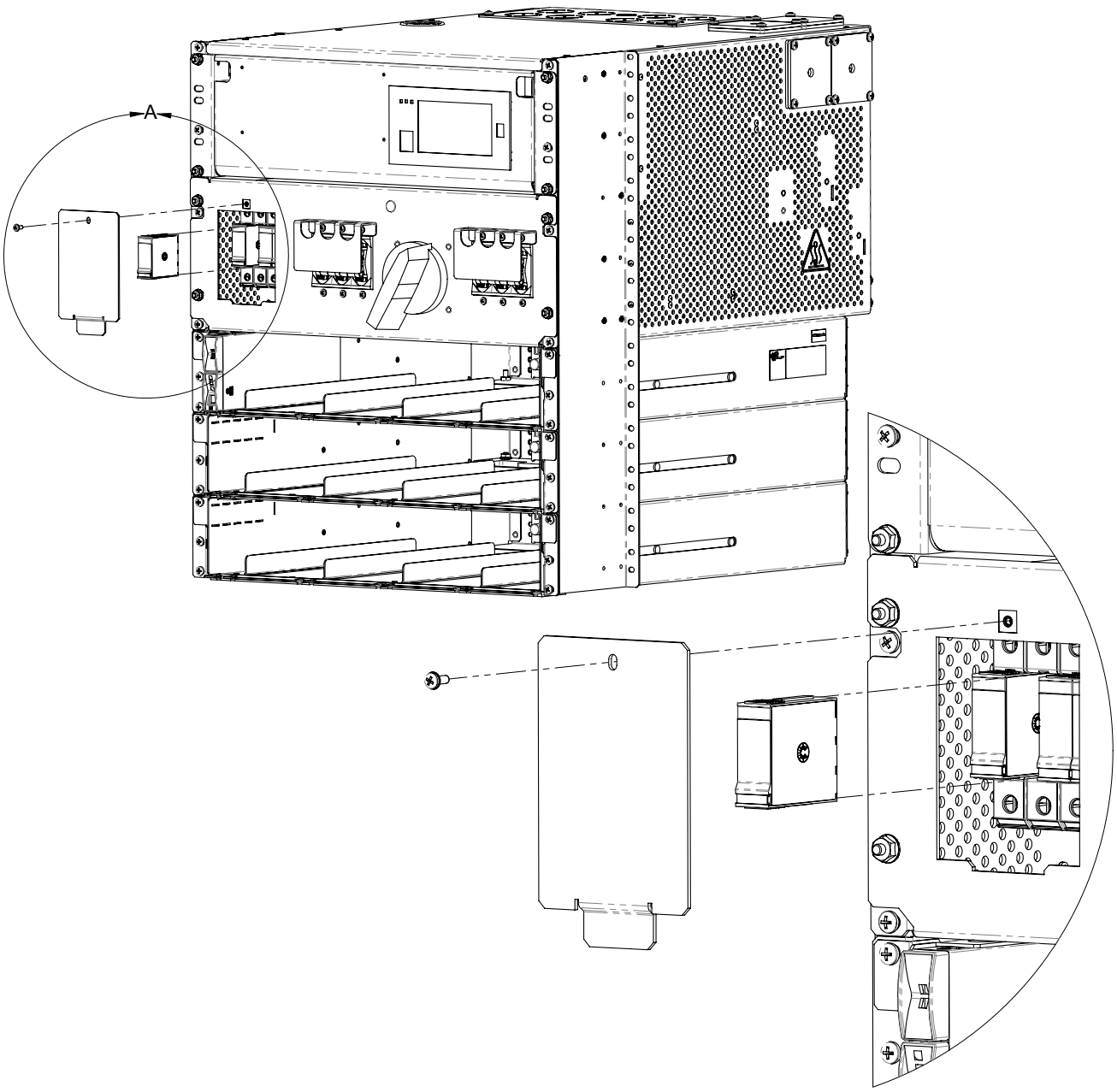


8.8 TVSS Replacement (Rack Mount)

1. Put system into external bypass and remove all AC and DC from the AMPS HP2 system, refer to 8.4.1.
2. Pull out the surge suppression module.
3. Replace the module with one of the same type and rating.

Replaceable parts	
Part number	**Description**
162-600-19	Surge suppression replacement module, red stripe, line-ground, 40kA rating
162-601-19	Surge suppression replacement module, green stripe, neutral-ground, 40kA rating

4. Put critical loads on UPS, refer to 8.4.2.



8.9 Replacing the T2S Inverter Control Card

Replacing the T2S Inverter Control Card, use PN 0180072-001.

CAUTION!

Perform this procedure with the system in bypass mode and/or during a scheduled maintenance window.

Step 1: Removal

To release the T2S from the shelf, insert a small flat screwdriver in the square hole under the USB port and lift up the lock pin. Then pull out the module.

Step 2: Replacement and Initialization

Insert the new T2S into the system. Once inserted, it will take about 10 minutes (or longer with fully loaded systems) for the T2S to initialize with the inverter modules.

CAUTION!

Ignore error/alarm conditions displayed during initialization . Do not remove any system components during the initialization sequence. Interruptions to the initialization sequence can result in software corruption and reduced functionality.

When the T2S is initially inserted, all LEDS are off for a few seconds.

Initialization is in progress:
Top 2 LEDs: solid green.
Bottom LED: off
DO NOT INTERRUPT

Initialization complete:
Top 2 LEDs : solid green
Bottom LED: flashing green

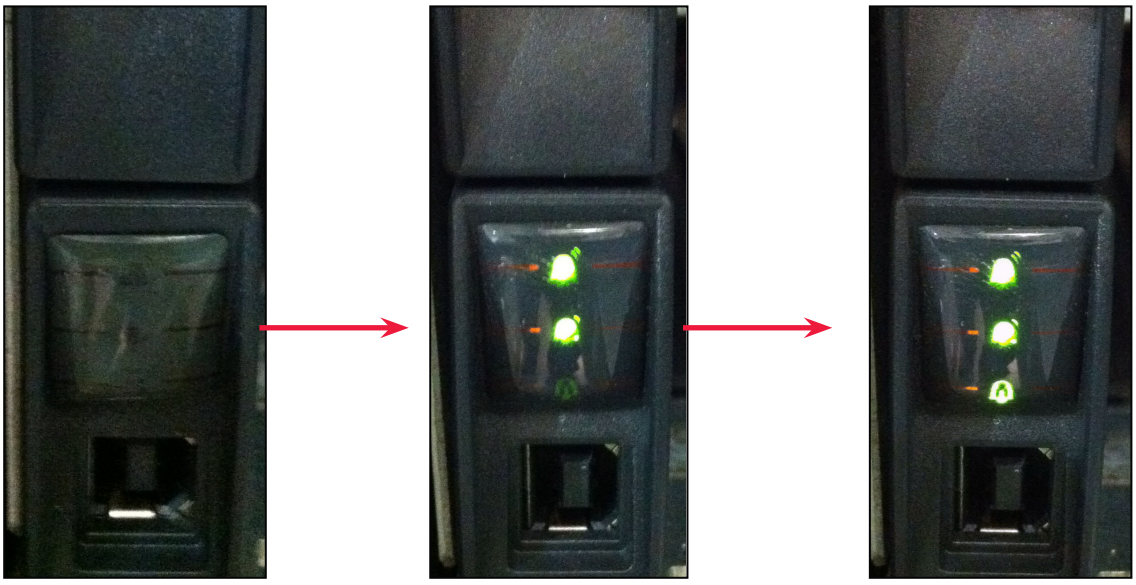


Figure 53 — T2S LED Sequence During Initialization

9. Troubleshooting

9.1 Incorrect System Configuration

If the system has been incorrectly configured with the wrong number of phases, the commissioning wizard will need to be executed again.

If the number of DC Groups is incorrect, it is likely that some inverters have the incorrect DC group number. It is possible to fix this by manually changing the DC group number in the details screen of each inverter.

If the number of shelves per phase is incorrect, it is likely that some inverters have the wrong bay, shelf or slot ID. It is possible to fix this by manually changing these values in the details screen of each inverter.

The details screen for an inverter can be found at **Power System > Inverter System > Inventory > Inverters > Status**. Click the more details icon for the inverter of interest.

WARNING: Executing the commissioning wizard will turn off the inverters and will require them to be unplugged! The system must be bypassed or the load taken off line.

9.2 Wrong Inverter AC Input Group

An inverter's AC input group number is set automatically to the same value as the output phase number. It may take a minute or two for the number to be reflected on the user interface. If this number seems incorrect, unplug the inverter, wait for the fan to stop turning and then reinsert it.

9.3 Wrong Inverter DC Input Group

The DC input group number is set automatically during commissioning, based on the configured number of DC groups as well as the slot ID. If this number seems incorrect, it can be changed from the details screen of the inverter.

9.4 T2S Expert Operations

There are some operations that an expert user may need to more thoroughly troubleshoot an inverter system. These expert operations are:

- Get the configuration file from T2S
- Upload the configuration file to the CXC HP
- Send the uploaded configuration file to the T2S
- Get Log file from the T2S
- Clear the T2S History Log

9.5 Troubleshooting and Clearing System Error Alarm

Occasionally the inverter system will activate a **System Error** alarm. This may happen after momentary AC outages, breaker trips, false communication problems or other unusual events. The **System Error** alarm is a reminder to

WARNING!

These operations are not normally needed during operation of an inverter system. They should only be used by qualified technicians or under the guidance of technical support.

check the T2S log file. It is recommended to download and view the log file for any possible problems. Downloading the log file will also clear the alarm.

To check the T2S log file:

1. Determine which T2S is the source of the alarm. Go to **Power System > Inverter System> Live Alerts** and look for the **Check Log File** alarm in the list. Whenever the **Check Log File** alert is active, the **System Error** alarm will also be active. The **Check Log File** alert will be shown with the serial number of the T2S that is causing the alert.
2. Go to **Power System > Inverter System > Inventory > T2Ss** and click on the details icon of the T2S identified in the previous step.
3. In the **T2S Expert Operations** table click the **Get Log File** from **T2S** button. This will initiate a transfer of the log file from the T2S.
4. Once the log file has been received, click **Download** to save the file to your computer.
5. Open the file and look for any event entries that might indicate a persistent issue. For example, module failures or communication problems. These problems may indicate the need to replace a module or inspect communication wiring.

Once the log file has been transferred from the T2S, the **System Error** alarm will clear.

10. Warranty

Technical Support

In Canada and the USA, call toll free 1-888-462-7487.

Customers outside Canada and the USA, call +1-604-436-5547.

Warranty Statement

For full information details review Alpha's online Warranty Statement at www.alpha.ca/support.

Product Warranty

Alpha warrants that for a period of two (2) years from the date of shipment its products shall be free from defects under normal authorized use consistent with the product specifications and Alpha's instructions, the terms of the manual will take precedence. Alpha authorized Commissioning is mandatory for warranty coverage and shall be conducted by Alpha-trained personnel for 20-75kVA systems. The purchase of AMPS HP2 Commissioning Service is optional for 10kVA systems but highly recommended. Completed commissioning reports shall be submitted for Alpha's record keeping at repairs@alpha.ca.

The warranty provides for repairing, replacing or issuing credit (at Alpha's discretion) for any equipment manufactured by it and returned by the customer to the factory or other authorized location during the warranty period.

There are limitations to this warranty coverage. The warranty does not provide to the customer or other parties any remedies other than the above. It does not provide coverage for any loss of profits, loss of use, costs for removal or installation of defective equipment, damages or consequential damages based upon equipment failure during or after the warranty period. No other obligations are expressed or implied. Warranty also does not cover damage or equipment failure due to cause(s) external to the unit including, but not limited to, environmental conditions, water damage, power surges or any other external influence.

The customer is responsible for all shipping and handling charges. Where products are covered under warranty Alpha will pay the cost of shipping the repaired or replacement unit back to the customer.

Battery Warranty

Note that battery warranty terms and conditions vary by battery and by intended use. Contact your Alpha sales representative or the Technical Support team at the above number to understand your entitlements under Battery Warranty.

Warranty Claims

Any claim under this Limited Warranty must be made in writing to Alpha BEFORE sending material back. Alpha will provide Product return instructions upon approval of return request. A Service Repair Order (SRO) and / or Return Authorization (RA) number will be issued ensuring that your service needs are handled promptly and efficiently.

Claims must be made online at: www.alpha.ca/support

Service Information

For a list of international service centers, refer to the Alpha website: www.alpha.ca/support

11. Certification

About CSA and NRTL

CSA (Canadian Standards Association also known as CSA International) was established in 1919 as an independent testing laboratory in Canada. CSA received its recognition as an NRTL (Nationally Recognized Testing Laboratory) in 1992 from OSHA (Occupational Safety and Health Administration) in the United States of America (Docket No. NRTL-2-92). This was expanded and renewed in 1997, 1999, and 2001. The specific notifications were posted on OSHA's official website as follows:

- Federal Register #: 59:40602 - 40609 [08/09/1994]
- Federal Register #: 64:60240 - 60241 [11/04/1999]
- Federal Register #: 66:35271 - 35278 [07/03/2001]

When these marks appear with the indicator "C and US" or "NRTL/C" it means that the product is certified for both the US and Canadian markets, to the applicable US and Canadian standards. (1)

Alpha rectifier and power system products, bearing the aforementioned CSA marks, are certified to CSA C22.2 No. 950 and UL 1950, or CSA/UL 60950. Alpha UPS products, bearing the aforementioned CSA marks, are certified to CSA C22.2 No. 107.3 and UL 1778.

As part of the reciprocal, US/Canada agreement regarding testing laboratories, the Standards Council of Canada (Canada's national accreditation body) granted Underwriters Laboratories (UL) authority to certify products for sale in Canada. (2)

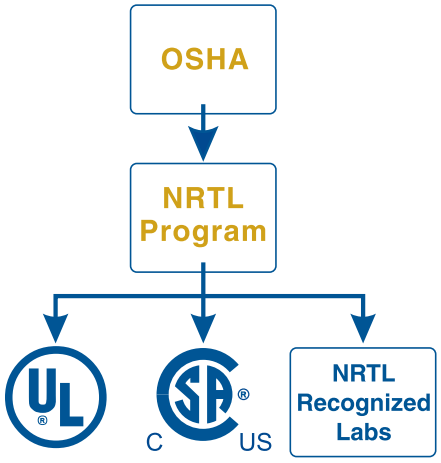
Only Underwriters Laboratories may grant a licence for the use of this mark, which indicates compliance with both Canadian and US requirements. (3)

NRTLs capabilities

NRTLs are third party organizations recognized by OSHA, US Department of Labor, under the NRTL program.

The testing and certifications are based on product safety standards developed by US based standards developing organizations and are often issued by the American National Standards Institute (ANSI). (4)

The NRTL determines that a product meets the requirements of an appropriate consensus-based product safety standard either by successfully testing the product itself, or by verifying that a contract laboratory has done so, and the NRTL certifies that the product meets the requirements of the product safety standard. (4)



Governance of NRTL

The NRTL Program is both national and international in scope with foreign labs permitted.

(1) www.csagroup.org
(2) www.scc.ca
(3) www.ulc.ca
(4) www.osha.gov

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