AMPS80 HP Power System

Installation & Operation Manual

Your Power Solutions Partner

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Installation & Operation Manual

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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Email: **support@alpha.ca**

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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. Save this document for future reference.

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.

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 HOT presents safety information to PREVENT BURNS to the technician or user.

1.2 General Safety

- Only qualified personnel shall install, operate, and service the power system and its components.
- Observe all applicable national and local electrical and building codes when installing the system.
- 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.
- For hybrid models containing rectifiers, replace internal fuses with 200 A, 170 V, DC Type TPL or TGL fuses only.
- 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 AMPS80 HP system can exceed 70°C. 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 battery pack.
- 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.

1.3 External Battery Safety

- The power system requires an over-current protection device for the external batteries. The maximum allowable current is typically 2500 A but can be less depending on the model. Follow the local electrical codes.
- Ensure that the external battery connection is equipped with a disconnect.
- 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 hybrid systems, 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. Spray 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.

1.4 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.

1.5 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!

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.

1.5.1 Safety Ground

The safety ground is a two-part system, comprised of the utility service ground and the power system ground.

Utility Service Ground

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 6’ away from the utility earth connection. This impedance between the system and Earth must not exceed 0.01 Ohms.

1.5.2 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 produces damaging high voltages. The best method to protect the system from damage is to divert these unwanted high-energy transients along a low-impedance path to the ground.

A single-point grounding system provides a low-impedance path to ground. Proper bonding of the ground rods is critical as this will ensure that the components of the grounding system appear as a single point of uniform impedance. Use a surge arresting device that is electrically bonded to the power system ground.

2. Product Description

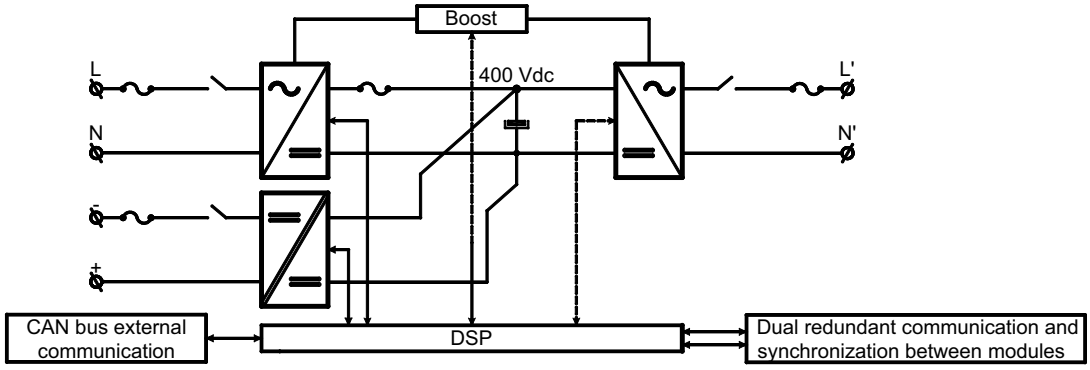
The Alpha Modular Power System 80HP (AMPS80 HP) is a unique, high performance AC and hybrid AC/DC power system that is ideally suited to provide highly reliable back-up power to Cable Headend, Telecom or Server room facilities.

The AMPS80 HP features hot swappable 2.5 kVA/2.0 kW inverter modules and optional 1.8 kW rectifier modules that are the building blocks of a highly reliable power system with 99.999% availability, 94% efficiency, and high power density. A smart, unified controller with an integrated Ethernet/SNMP monitors and manages both inverter and rectifier modules through a web based GUI and a local LCD touch screen. The AMPS80 HP is designed to be installed in a climate-controlled environment where ambient temperatures are between -20°C to 40°C.

2.1 Theory of Operation

Each Alpha inverter module is equipped with both a DC input and an AC input, and also contains an AC-DC and a DC-DC power conversion stage, which feed into an internal DC bus. The DC-AC inverter stage in each module then takes this DC bus voltage and converts it into a 120 Vac output for the critical loads, see diagram below:

AMPS80 HP Module - Block Diagram



The commercial AC input is not directly connected to the AC output and there are two high frequency conversion stages between the commercial AC and the customer's critical loads at all times. The AC output remains regulated when the AC input is between 80 V and 140 V. When the AC input voltage drops below approximately 100 V, the DC-DC input stage starts augmenting AC line power with power from the batteries. Below 80 Vac input, the AC input stage shuts down and all power is drawn from the batteries. There is no "switching" between AC input and DC input. The control system in each module simply decides what fraction of the power to the internal DC bus is acquired from the AC input versus the DC input. Both converter stages are ready to supply full power anytime.

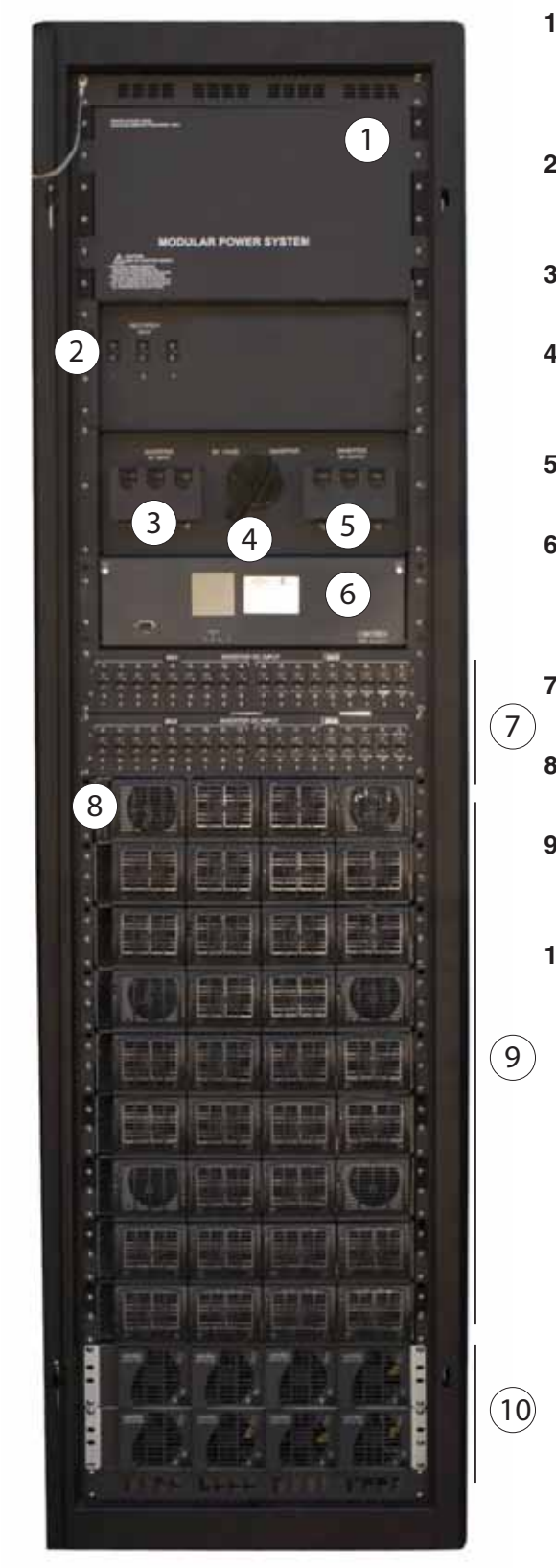
The user can choose either AC or DC input priority. If AC priority is chosen, the AMPS80 HP acts more like an on-line, double conversion UPS. If AC commercial power is available, this power is filtered twice and passed to the AC output. If the AC commercial power fails, the DC converter simply takes over and supplies the power from the batteries.

If DC priority is chosen, AMPS80 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.

One of the largest advantages of the AMPS80 HP is that the "AC bypass" function is built into each module (no single point of failure) and the user can take advantage of the high efficiency AC mode of 94% compared to 82% for typical rectifier/inverter systems without compromising regulation and filtering.

2.2 System Components

The AMPS80 HP is comprised of a number of individual subsystems designed to work together to provide highly reliable, filtered power in support of the load. A typical system will contain the following:



1. **Main Wiring Access Panel:** AC input and output as well as DC battery connections are accessed through the front panel and feed through the opening at the top of the rack.
2. **Rectifier AC Input Breakers (optional):** Provide a means to switch off the rectifiers independently of the inverters.
3. **Inverter AC Input Breaker:** Serves as the main disconnect for the inverter AC input.
4. **Maintenance Bypass Switch (MBS) (optional):** Can be used to route power directly from the AC input to the AC output, bypassing the inverter modules.
5. **Inverter AC Output Breaker:** Serves as the main disconnect for the inverter AC outputs.
6. **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.
7. **DC Input Breakers (optional):** Provide individual DC input breakers for each inverter module.
8. **T2S Inverter Control Card:** Communicates with the CXC Unified controller.
9. **Inverter Modules and shelves:** Up to 9 shelves containing 4 hot-swappable 2500 VA / 2000 W inverter modules on each shelf.
10. **Rectifier Modules and shelves (optional):** Two shelves containing up to four hot-swappable 1800 W rectifier modules on each shelf. The rectifiers are used as the charging component of a hybrid system.

3. System Installation

3.1 Installation Notes

- The AMPS80 HP is designed to be installed in a controlled environment, sheltered from rain, excessive dust and other contaminants.
- The system arrives pre-wired, and the installer is responsible for connecting the utility input to the system, the battery strings, the system to the load, and the chassis and battery return to the reference ground.
- All wiring must be in accordance with applicable electrical codes.
- Access to connection points is provided from the front of the system rack.
- AC wires enter the cabinet through the top. DC wires enter the cabinet either through the top or the bottom of the cabinet.
- 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 must meet the applicable local electrical codes. Typically the AC input and standard AC output is 6 wires (L1, L2, and L3, N, N, G) up to 350 kcmil THHW or RW90 type cable that will connect to the AMPS80 HP system with trade size up to 3.5 conduit.
- A low voltage disconnect should be provided with the battery system.

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.

3.2 Recommended Installation Layout

Minimum required clearances around the cabinet:

- Rear: 12” (30 cm)
- Sides: no clearance required except 75 kVA systems and systems with TVSS option, which require 36" (90 cm)
- Top: 12” (30 cm)
- Front: 33” (100 cm)

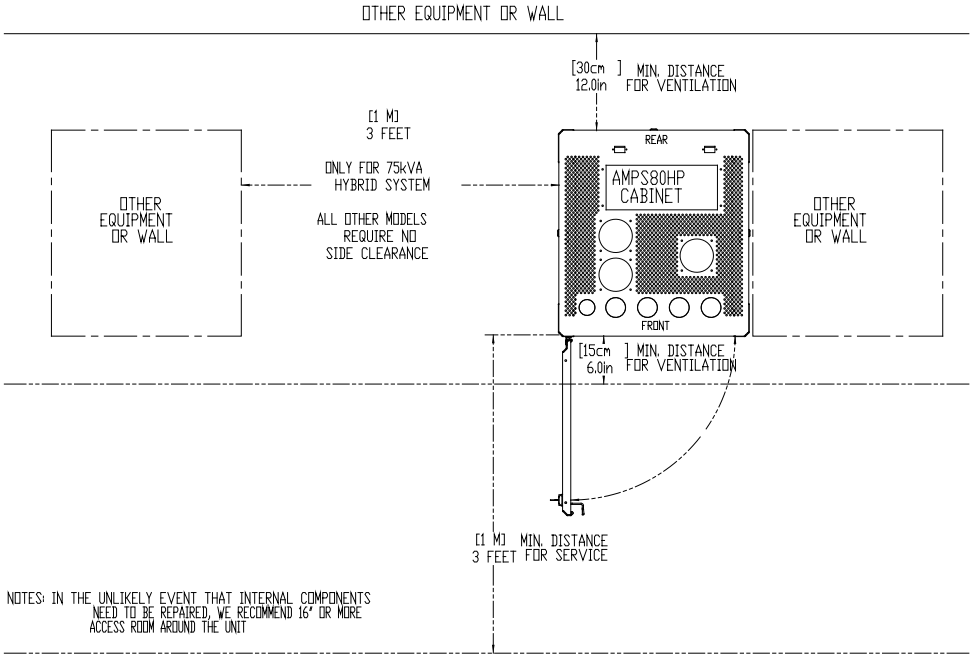


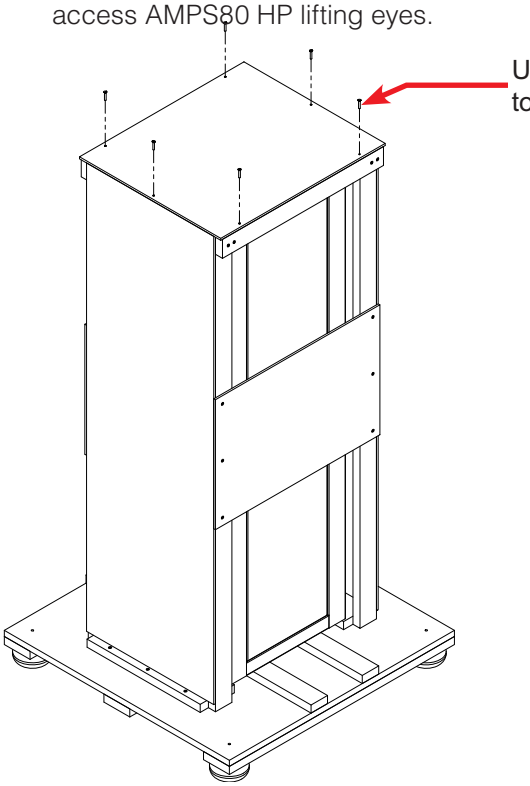
Fig. 3.1 Minimum required clearances around cabinet

3.3 Unpacking Instructions

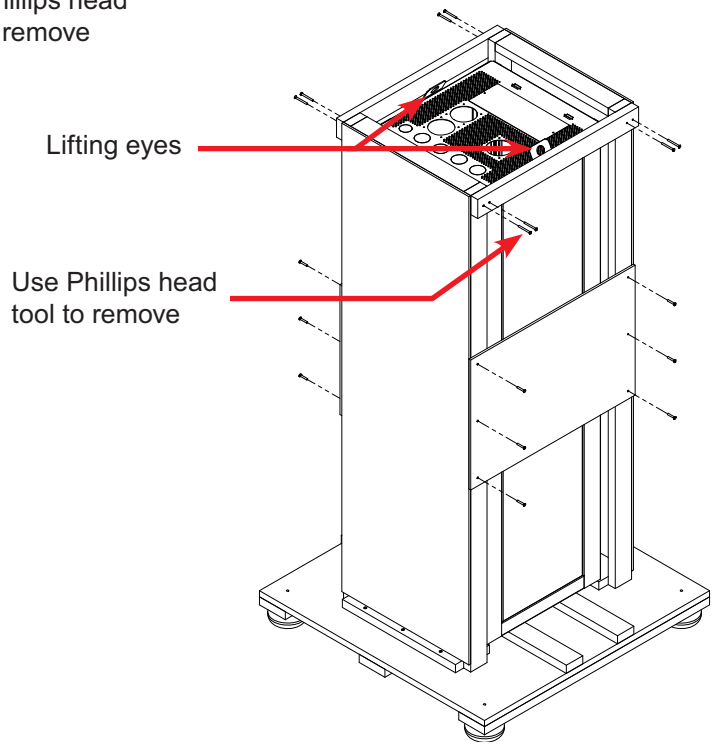
WARNING!

The AMPS80 HP rack weighs 270 kg / 595 lb. Care must be taken to ensure that it does not topple over.

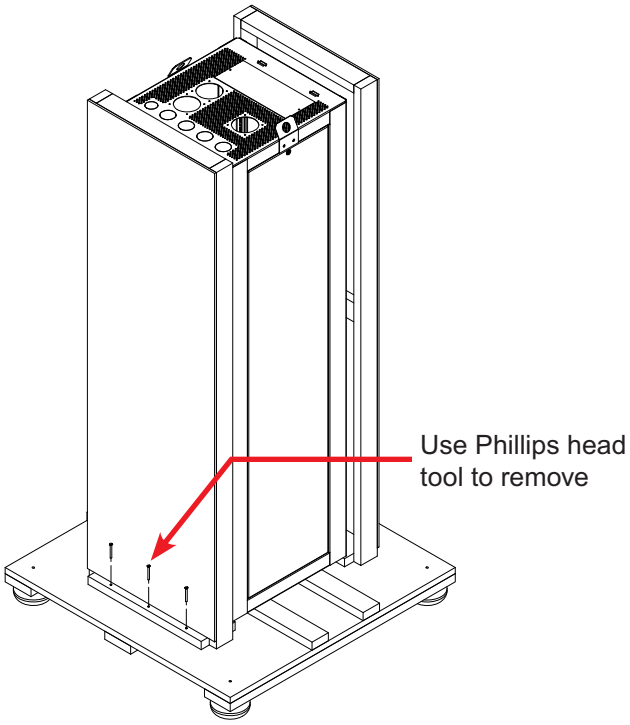
1. Remove 6 screws from top panel to access AMPS80 HP lifting eyes.



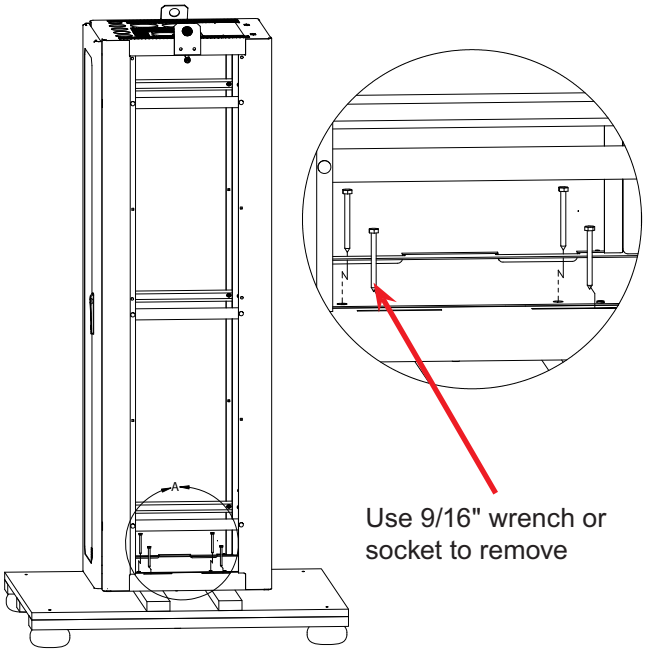
2. Remove 4 screws from each top 2 x 4 and 6 screws from each wooden side piece to gain access to removal of the front and rear wooden frames.



3. Remove 3 screws from the front and rear wooden frames.



4. Remove AMPS80 HP metal side panels to gain access to 4 interior lag bolts. Remove 4 lag bolts to allow removal of the AMPS80 HP from the pallet.



3.4 Transporting the Cabinet

The cabinet is shipped upright on a 122 cm x 122 cm (48" x 48") pallet and may be transported to the installation site either by forklift or overhead crane. The empty cabinet weighs approximately 270 kg (595 lb).

The height of the rack, including pallet and shipping material is 92" (234 cm). When tilting the rack to fit through doors, tilt the rack toward the back and ensure that it is not subjected to sudden shock.

Use the supplied lifting eyes to lift the cabinet from the top. The lifting eyes are accessible by removing the top sheet of wood from the shipping crate.

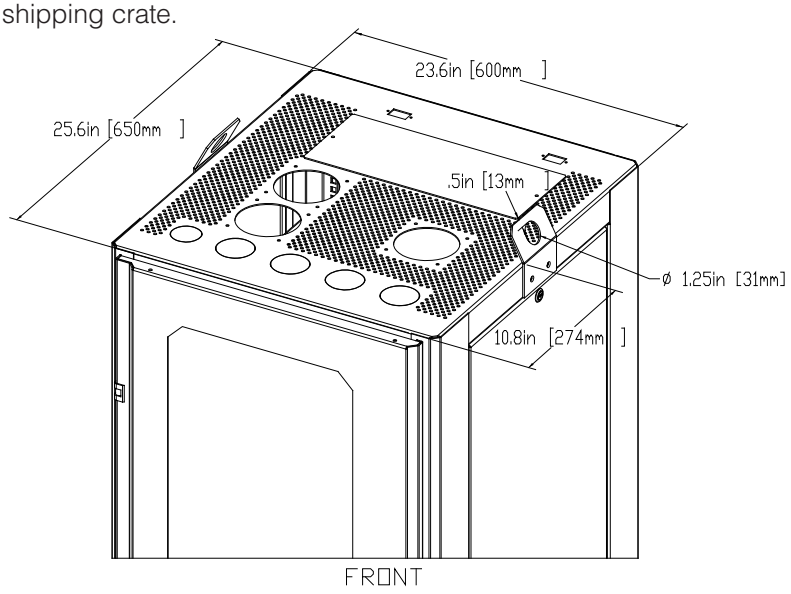


Fig. 3.2 Arrangement of lifting eyes on top of cabinet

3.5 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.

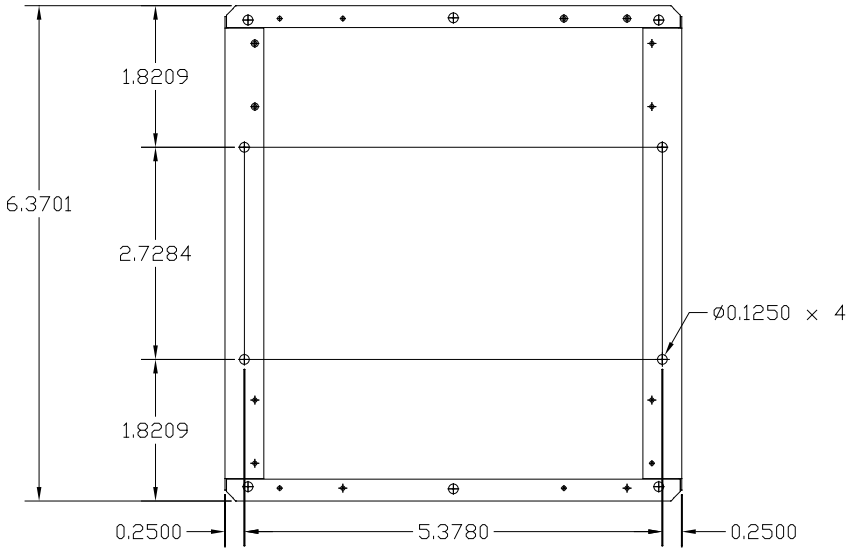


Fig. 3.3 Mounting hole pattern (dimensions in inches)

3.6 Recommended AC and DC Breakers and Wire Sizes

75 kVA, 3-phase systems (AMPS80-3-75...), single AC feed						
	Model		**AMPS80-3-75 Without rectifiers Without MBS**	**AMPS80-3-75-H2 With rectifiers Without MBS**	**AMPS80-3-75, MBS Without rectifiers With MBS**	**AMPS80-3-75-H2, MBS With rectifiers With MBS**
AC input	AC input voltage		120/208 V	120/208 V	120/208 V	120/208 V
	Full load AC input current per phase		177 A	227 A	223 A	273 A
	AC input poles & wiring		4 w + G	4 w + G	4 w + G	4 w + G
	Wiring		3Φ Wye	3Φ Wye	3Φ Wye	3Φ Wye
	Recommended AC input breaker/fuse[2]		225 A	300 A	300 A	350 A
	Recommended AC input wire size 90ºC copper[1]	NEC 30ºC	#3/0	250 kcmil	250 kcmil	350 kcmil
		CEC 30ºC	#4/0	300 kcmil	300 kcmil	See dual feed
		NEC 40ºC	#4/0	300 kcmil	300 kcmil	See dual feed
		CEC 40ºC	250 kcmil	350 kcmil	350 kcmil	See dual feed
AC output	Total maximum AC output		75 kVA, 60 kW	75 kVA, 60 kW	75 kVA, 60 kW	75 kVA, 60 kW
	AC output voltage		120/208 V	120/208 V	120/208 V	120/208 V
	AC output poles & wiring		4 w + G	4 w + G	4 w + G	4 w + G
	Wiring		3Φ Wye	3Φ Wye	3Φ Wye	3Φ Wye
	AC output current per phase		208 A	208 A	208 A	208 A
	Installed inverter input & output circuit breaker		250 A	250 A	250 A	250 A
	Recommended AC output wire size 90ºC copper[1]	NEC 30ºC	#4/0	#4/0	#4/0	#4/0
		CEC 30ºC	250 kcmil	250 kcmil	250 kcmil	250 kcmil
		NEC 40ºC	250 kcmil	250 kcmil	250 kcmil	250 kcmil
		CEC 40ºC	300 kcmil	300 kcmil	300 kcmil	300 kcmil
AC input & output connection terminals	Box lugs are rated for both Aluminum and Copper wire, 350 kcmil to #6 AWG. Fasten clamping screw to 42 N-m (375 in-lbs) for #1 AWG to 350 kcmil wire or 23 N-m (200 in-lbs) for #6 to #2 AWG wire.					
Note 1	Inverter AC Input & AC Output connections: Calculations based on full load and charging current, 0.8 derating with 5 current carrying conductors, (L1,L2,L3,2XN) due to possible high harmonic content load. Temperature correction factor applied when needed.					
Note 2	Maximum AC utility service protection feeding the AMPS80 HP is 400 A. The actual supply circuit breaker must be sized appropriately for the supply wire used. Consult your local and national electrical codes. The AC source must be limited to 18 kA short circuit current. Double neutral is strongly recommended for AC output wiring (and AC input wiring to the MBS) for 3Φ systems with significant non-linear (ie rectified capacitive) loads. Because the AC input to the inverters is power factor corrected, AC wiring solely to the inverters does not require double neutral wiring.					

75 kVA, 3-phase systems (AMPS80-3-75...), dual AC feeds

	Model Dual feed with separate AC feed for inverters/MBS and rectifiers		AMPS80-3-75-H2		AMPS80-3-75-H2, MBS	
AC input	AC feed		Inverter feed	Rectifier feed	Inverter/MBS feed	Rectifier feed
	AC input voltage		120/208 V	208 V	120/208 V	208 V
	Full load AC input current per phase		177 A	50 A	223 A	50 A
	AC input poles & wiring		4 w + G	4 w + G	4 w + G	4 w + G
	Wiring		3Φ Wye	3Φ Wye	3Φ Wye	3Φ Wye
	Recommended AC input breaker/fuse[2]		225 A	70 A	300 A	70 A
	Recommended AC input wire size 90ºC copper[1]	NEC 30ºC	#3/0	#6	250 kcmil	#6
		CEC 30ºC	#4/0	#4	300 kcmil	#4
		NEC 40ºC	#4/0	#6	300 kcmil	#6
		CEC 40ºC	250 kcmil	#4	350 kcmil	#4
AC output	Total maximum AC output		75 kVA, 60 kW		75 kVA, 60 kW	
	AC output voltage		120/208 V		120/208 V	
	AC output poles & wiring		4 w + G		4 w + G	
	Wiring		3Φ Wye		3Φ Wye	
	AC output current per phase		208 A		208 A	
	Installed inverter input & output circuit breaker		250 A		250 A	
	Recommended AC output wire size 90ºC copper[1]	NEC 30ºC	#4/0		#4/0	
		CEC 30ºC	250 kcmil		250 kcmil	
		NEC 40ºC	250 kcmil		250 kcmil	
		CEC 40ºC	300 kcmil		300 kcmil	

AC input & output connection terminals	Box lugs are rated for both Aluminum and Copper wire, 350 kcmil to #6 AWG. Fasten clamping screw to 42 N-m (375 in-lbs) for #1 AWG to 350 kcmil wire or 23 N-m (200 in-lbs) for #6 to #2 AWG wire.
Rectifier connection terminals	Box lugs are rated for both Aluminum and Copper wire, #2/0 to #6 AWG. Fasten clamping screw to 14 N-m (120 in-lbs)
Note 1	Inverter AC Input & AC Output connections: Calculations based on full load and charging current, 0.8 derating with 5 current carrying conductors, (L1,L2,L3,2XN) due to possible high harmonic content load. Temperature correction factor applied when needed.
Note 2	Maximum AC utility service protection feeding the AMPS80 HP is 400 A. The actual supply circuit breaker must be sized appropriately for the supply wire used. Consult your local and national electrical codes. The AC source must be limited to 18 kA short circuit current. Double neutral is strongly recommended for AC output wiring (and AC input wiring to the MBS) for 3Φ systems with significant non-linear (ie rectified capacitive) loads. Because the AC input to the inverters is power factor corrected, AC wiring solely to the inverters does not require double neutral wiring.

40 kVA, split-phase, 2-pole systems (AMPS80-2-40...), single AC feed

	Model		AMPS80-2-40	AMPS80-2-40-H2	AMPS80-2-40, MBS	AMPS80-2-40-H2, MBS
AC input	Feed		Single	Single	Single	Single
	AC input voltage		120/208 V or 120/240 V	120/208 V or 120/240 V	120/208 V or 120/240 V	120/208 V or 120/240 V
	Full load AC input current per phase		148 A	225 A	179 A	256 A
	AC input poles & wiring		3 w + G	3 w + G	3 w + G	3 w + G
	Wiring		2-pole	2-pole	2-pole	2-pole
	Recommended AC input breaker/fuse[2]		200 A	300 A	225 A	350 A
	Recommended AC input wire size 90ºC copper[1]	NEC 30ºC	#2/0	250 kcmil	#3/0	350 kcmil
		CEC 30ºC	#3/0	300 kcmil	#4/0	See dual feed
		NEC 40ºC	#3/0	250 kcmil	#3/0	See dual feed
		CEC 40ºC	#3/0l	300 kcmil	#4/0	See dual feed
AC output	Total maximum AC output		40 kVA, 32 kW	40 kVA, 32 kW	40 kVA, 32 kW	40 kVA, 32 kW
	AC output voltage		120/208 V or 120/240 V	120/208 V or 120/240 V	120/208 V or 120/240 V	120/208 V or 120/240 V
	AC output poles & wiring		3 w + G	3 w + G	3 w + G	3 w + G
	Wiring		2-pole	2-pole	2-pole	2-pole
	AC output current per phase		167 A	167 A	167 A	167 A
	Installed inverter input & output circuit breaker		250 A	250 A	250 A	250 A
	Recommended AC output wire size 90ºC copper[1]	NEC 30ºC	#4/0	#4/0	#4/0	#4/0
		CEC 30ºC	250 kcmil	250 kcmil	250 kcmil	250 kcmil
		NEC 40ºC	250 kcmil	250 kcmil	250 kcmil	250 kcmil
		CEC 40ºC	300 kcmil	300 kcmil	300 kcmil	300 kcmil
AC input & output connection terminals	Box lugs are rated for both Aluminum and Copper wire, 350 kcmil to #6 AWG. Fasten clamping screw to 42 N-m (375 in-lbs) for #1 AWG to 350 kcmil wire or 23 N-m (200 in-lbs) for #6 to #2 AWG wire.					
Note 1	Inverter AC Input & AC Output connections: Calculations based on full load and charging current, 0.8 derating with 5 current carrying conductors, (L1,L2,L3,2XN) due to possible high harmonic content load. Temperature correction factor applied when needed.					
Note 2	Maximum AC utility service protection feeding the AMPS80 HP is 400 A. The actual supply circuit breaker must be sized appropriately for the supply wire used. Consult your local and national electrical codes. The AC source must be limited to 18 kA short circuit current. Double neutral is strongly recommended for AC output wiring (and AC input wiring to the MBS) for 3Φ systems with significant non-linear (ie rectified capacitive) loads. Because the AC input to the inverters is power factor corrected, AC wiring solely to the inverters does not require double neutral wiring.					

40 kVA, split-phase, 2-pole systems (AMPS80-2-40...), dual AC feeds

	Model Dual feed with separate AC feed for inverters/MBS and rectifiers		AMPS80-2-40-H2		AMPS80-2-40-H2, MBS	
AC input	AC feed		Inverter feed	Rectifier feed	Inverter/MBS feed	Rectifier feed
	AC input voltage		120/208 V or 120/240 V	208 V or 240 V	120/208 V or 120/240 V	208 V or 240 V
	Full load AC input current per phase		148 A	77 A	179 A	77 A
	AC input poles & wiring		3 w + G	3 w + G	3 w + G	3 w + G
	Wiring		2-pole	2-pole	2-pole	2-pole
	Recommended AC input breaker/fuse[2]		200 A	100 A	225 A	100 A
	Recommended AC input wire size 90ºC copper[1]	NEC 30ºC	#2/0	#3	#3/0	#3
		CEC 30ºC	#3/0	#3	#4/0	#3
		NEC 40ºC	#2/0	#3	#3/0	#3
		CEC 40ºC	#2/0	#3	#4/0	#3
AC output	Total maximum AC output		40 kVA, 32 kW		40 kVA, 32 kW	
	AC output voltage		120/208 V or 120/240 V		20/208 V or 120/240 V	
	AC output poles & wiring		3 w + G		3 w + G	
	Wiring		2-pole		2-pole	
	AC output current per phase		167 A		167 A	
	Installed inverter input & output circuit breaker		250 A		250 A	
	Recommended AC output wire size 90ºC copper[1]	NEC 30ºC	#4/0		#4/0	
		CEC 30ºC	250 kcmil		250 kcmil	
		NEC 40ºC	250 kcmil		250 kcmil	
		CEC 40ºC	300 kcmil		300 kcmil	

AC input & output connection terminals	Box lugs are rated for both Aluminum and Copper wire, 350 kcmil to #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.
Rectifier connection terminals	Box lugs are rated for both Aluminum and Copper wire, #2/0 to #6 AWG. Fasten clamping screw to 14 N-m (120 in-lbs)
Note 1	Inverter AC Input & AC Output connections: Calculations based on full load and charging current, 0.8 derating with 5 current carrying conductors, (L1,L2,L3,2XN) due to possible high harmonic content load. Temperature correction factor applied when needed.
Note 2	Maximum AC utility service protection feeding the AMPS80 HP is 400 A. The actual supply circuit breaker must be sized appropriately for the supply wire used. Consult your local and national electrical codes. The AC source must be limited to 18 kA short circuit current. Double neutral is strongly recommended for AC output wiring (and AC input wiring to the MBS) for 3Φ systems with significant non-linear (ie rectified capacitive) loads. Because the AC input to the inverters is power factor corrected, AC wiring solely to the inverters does not require double neutral wiring.

30 kVA, 3-phase systems (AMPS80-3-30...), single AC feed

	Model		AMPS80-3-30	AMPS80-3-30-H2	AMPS80-3-30, MBS	AMPS80-3-30-H2, MBS
AC input	Feed		Single	Single	Single	Single
	AC input voltage		120/208 V	120/208 V	120/208 V	120/208 V
	Full load AC input current per phase		71 A	121 A	88 A	138 A
	AC input poles & wiring		4 w + G	4 w + G	4 w + G	4 w + G
	Wiring		3Φ Wye	3Φ Wye	3Φ Wye	3Φ Wye
	Recommended AC input breaker/fuse[2]		90 A	150 A	125 A	175 A
	Recommended AC input wire size 90ºC copper[1]	NEC 30ºC	#4	#1	#2	#1/0
		CEC 30ºC	#3	#1/0	#2	#2/0
		NEC 40ºC	#3	#1/0	#2	#2/0
		CEC 40ºC	#3	#2/0	#2	#2/0
AC output	Total maximum AC output		30 kVA, 24 kW	30 kVA, 24 kW	30 kVA, 24 kW	30 kVA, 24 kW
	AC output voltage		120/208 V	120/208 V	120/208 V	120/208 V
	AC output poles & wiring		4 w + G	4 w + G	4 w + G	4 w + G
	Wiring		3Φ Wye	3Φ Wye	3Φ Wye	3Φ Wye
	AC output current per phase		83 A	83 A	83 A	83 A
	Installed inverter input & output circuit breaker		125 A	125 A	125 A	125 A
	Recommended AC output wire size 90ºC copper[1]	NEC 30ºC	#2	#2	#2	#2
		CEC 30ºC	#2	#2	#2	#2
		NEC 40ºC	#1	#1	#1	#1
		CEC 40ºC	#1	#1	#1	#1

AC input & output connection terminals	Box lugs are rated for both Aluminum and Copper wire, 350 kcmil to #6 AWG. Fasten clamping screw to 42 N-m (375 in-lbs) for #1 AWG to 350 kcmil wire or 23 N-m (200 in-lbs) for #6 to #2 AWG wire.
Note 1	Inverter AC Input & AC Output connections: Calculations based on full load and charging current, 0.8 derating with 5 current carrying conductors, (L1,L2,L3,2XN) due to possible high harmonic content load. Temperature correction factor applied when needed.
Note 2	Maximum AC utility service protection feeding the AMPS80 HP is 400 A. The actual supply circuit breaker must be sized appropriately for the supply wire used. Consult your local and national electrical codes. The AC source must be limited to 18 kA short circuit current. Double neutral is strongly recommended for AC output wiring (and AC input wiring to the MBS) for 3Φ systems with significant non-linear (ie rectified capacitive) loads. Because the AC input to the inverters is power factor corrected, AC wiring solely to the inverters does not require double neutral wiring.

20 kVA, split-phase, 2-pole systems (AMPS80-2-20...), single AC feed

	Model		AMPS80-2-20	AMPS80-2-20-H2	AMPS80-2-20, MBS	AMPS80-2-20-H2, MBS
AC input	Feed		Single	Single	Single	Single
	AC input voltage		120/208 V or 120/240 V	120/208 V or 120/240 V	120/208 V or 120/240 V	120/208 V or 120/240 V
	Full load AC input current per phase		71 A	148 A	89 A	166 A
	AC input poles & wiring		3 w + G	3 w + G	3 w + G	3 w + G
	Wiring		2-pole	2-pole	2-pole	2-pole
	Recommended AC input breaker/fuse[2]		90 A	200 A	125 A	225 A
	Recommended AC input wire size 90ºC copper[1]	NEC 30ºC	#4	#2/0	#2	#3/0
		CEC 30ºC	#3	#3/0	#2	#4/0
		NEC 40ºC	#4	#2/0	#2	#3/0
		CEC 40ºC	#3	#3/0	#2	#4/0
AC output	Total maximum AC output		20 kVA, 16 kW	20 kVA, 16 kW	20 kVA, 16 kW	20 kVA, 16 kW
	AC output voltage		120/208 V or 120/240 V	120/208 V or 120/240 V	120/208 V or 120/240 V	120/208 V or 120/240 V
	AC output poles & wiring		3 w + G	3 w + G	3 w + G	3 w + G
	Wiring		2-pole	2-pole	2-pole	2-pole
	AC output current per phase		83 A	83 A	83 A	83 A
	Installed inverter input & output circuit breaker		125 A	125 A	125 A	125 A
	Recommended AC output wire size 90ºC copper[1]	NEC 30ºC	#2	#2	#2	#2
		CEC 30ºC	#2	#2	#2	#2
		NEC 40ºC	#1	#1	#1	#1
		CEC 40ºC	#1	#1	#1	#1
AC input & output connection terminals	Box lugs are rated for both Aluminum and Copper wire, 350 kcmil to #6 AWG. Fasten clamping screw to 42 N-m (375 in-lbs) for #1 AWG to 350 kcmil wire or 23 N-m (200 in-lbs) for #6 to #2 AWG wire.					
Note 1	Inverter AC Input & AC Output connections: Calculations based on full load and charging current, 0.8 derating with 5 current carrying conductors, (L1,L2,L3,2XN) due to possible high harmonic content load. Temperature correction factor applied when needed.					
Note 2	Maximum AC utility service protection feeding the AMPS80 HP is 400 A. The actual supply circuit breaker must be sized appropriately for the supply wire used. Consult your local and national electrical codes. The AC source must be limited to 18 kA short circuit current. Double neutral is strongly recommended for AC output wiring (and AC input wiring to the MBS) for 3Φ systems with significant non-linear (ie rectified capacitive) loads. Because the AC input to the inverters is power factor corrected, AC wiring solely to the inverters does not require double neutral wiring.					

DC breaker and wire sizes

	Model		AMPS80-3-75 AMPS80-3-75-H2	AMPS80-3-30 AMPS80-3-30-H2	AMPS80-2-40 AMPS80-2-40-H2	AMPS80-2-20 AMPS80-2-20-H2
DC input	Maximum DC Input wattage		67 kW	27 kW	36 kW	18 kW
	Maximum DC Input Current @ 48 Vdc, full load		1396 A	563 A	750 A	375 A
	DC input current @ 40 V 110% load		1843 A	743 A	990 A	495 A
	Maximum DC input breaker		2500 A, maximum 50 kA SCC			
	Recommended minimum DC breaker rating (100% rated, per feed)	Single DC feed	2000 A	800 A	1200 A	600 A
		Dual DC feed	1200 A	400 A	600 A	300 A
		Quad DC feed	600 A	200 A	300 A	150 A
Note 1	Lower breaker ratings can be used if the system is sized with redundancy or the system will not be fully loaded.					
Note 2	Ground bonding wire must be sized for the DC current					
Note 3	DC input breaker recommendation based on 110% load current at 40 Vdc for a fully populated system.					
Note 4	DC source must be limited to 50 kA SCC					

DC wire size versus breaker size

Breaker size		2000 A	1200 A	800 A	600 A	400 A	300 A	200 A	150 A
Recommended DC Wire size, 90ºC copper single feed	NEC (USA)	4 x 750 kcmil	3 x 500 kcmil	700 kcmil or 2 x 350 kcmil	400 kcmil	OOOO	OO	#1	#3
	CEC (Canada)	4 x 750 kcmil	3 x 500 kcmil	700 kcmil or 2 x 500 kcmil	500 kcmil	250 kcmil	OOO	#1	#3

3.7 Converting from Single to Dual AC Feed (Optional)

WARNING!

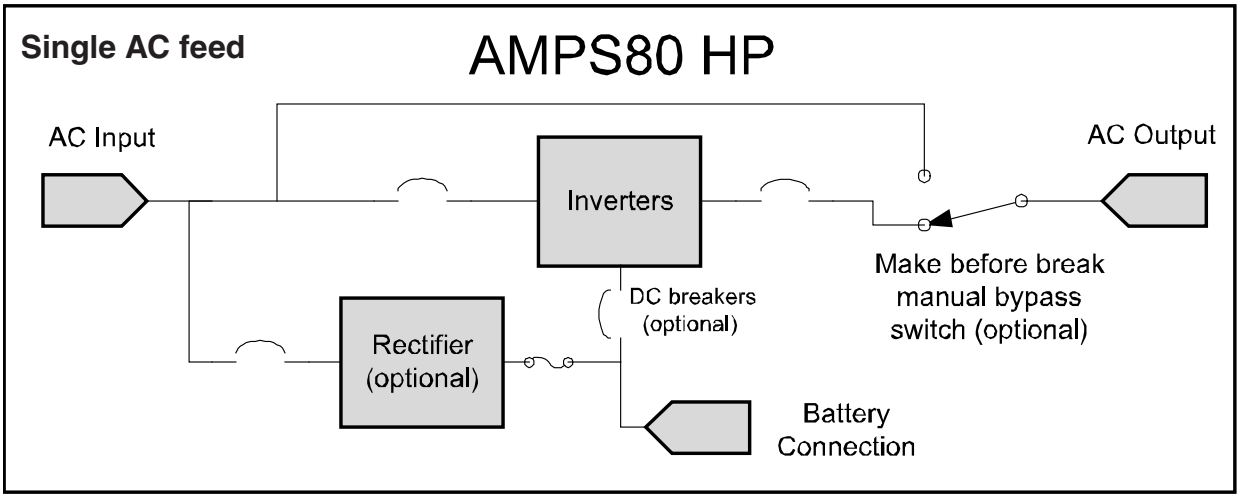
To prevent electrical hazards, switch off all AC and DC sources.

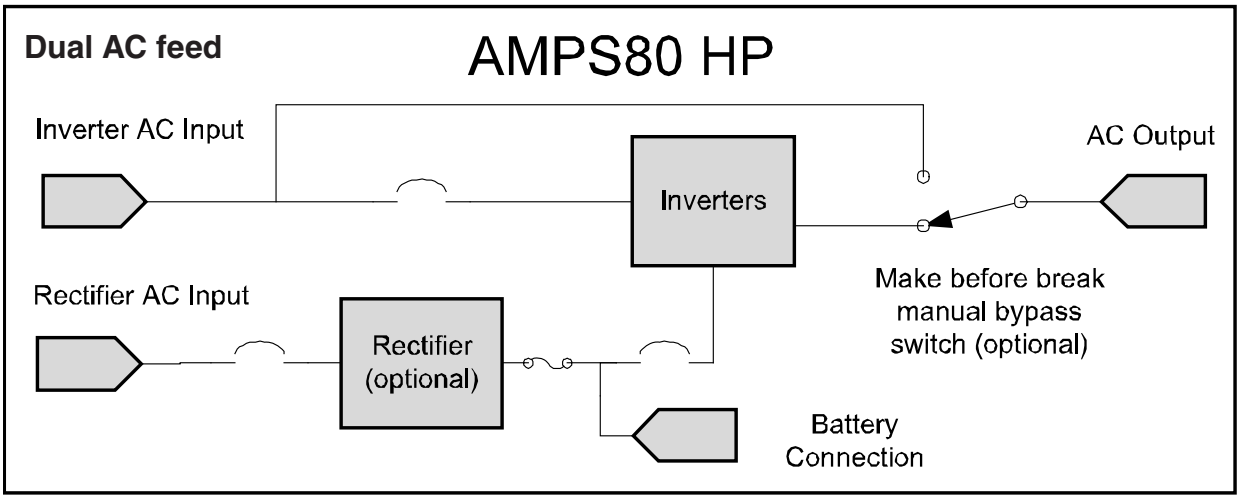
3.7.1 Tools Required

- Phillips screw driver
- 3/8” wrench or socket
- 3/16” hex key

3.7.2 Wiring Diagrams

To convert the AMPS80 HP from single AC feed to dual AC feed, first remove the internal rectifier powering wiring. Once this wiring is removed, install the inverter and the rectifier power wiring according to the diagrams below.





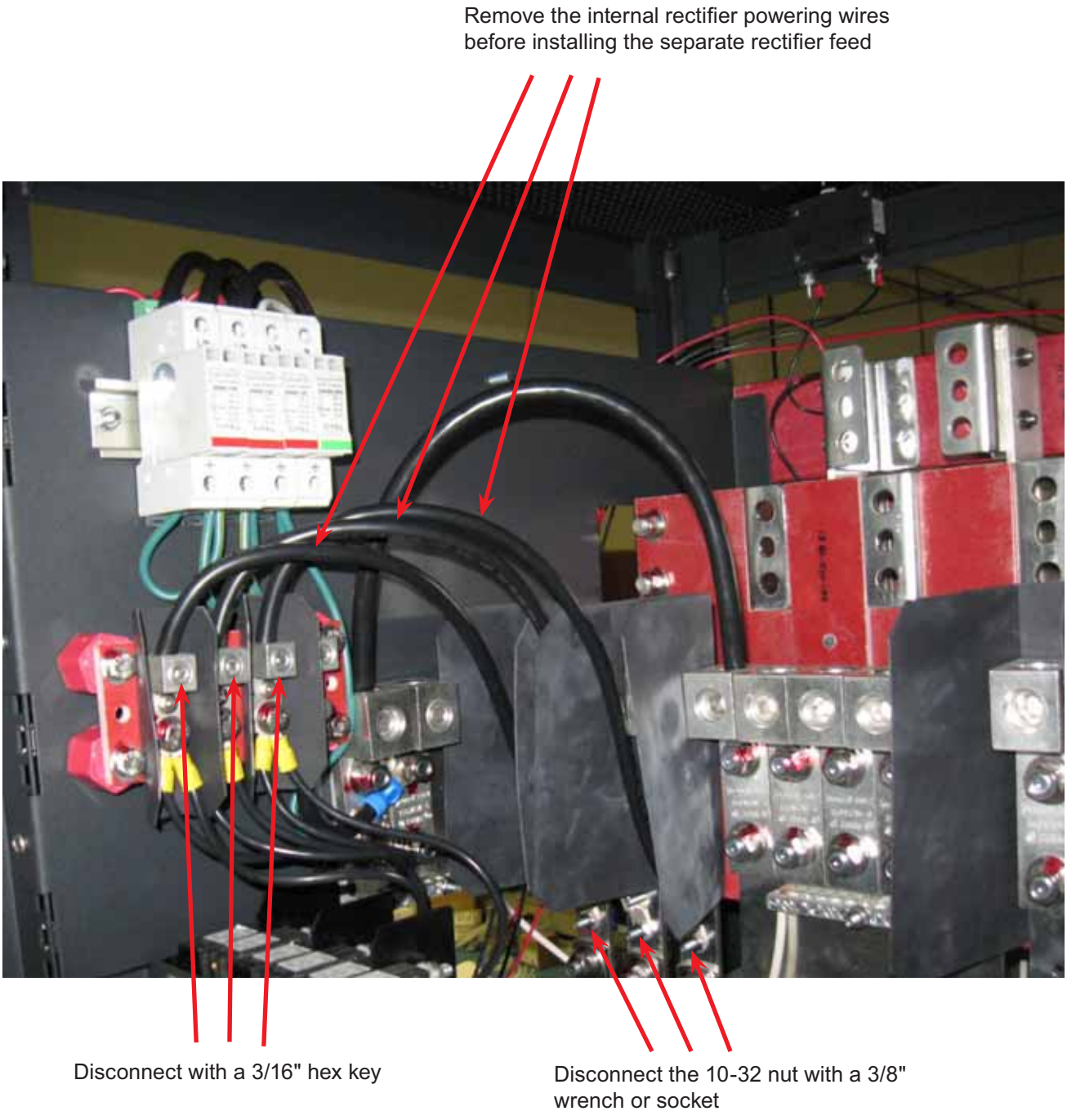
3.7.3 Remove Rectifier Wiring

WARNING!

Before removing the wiring access panel, make sure all power to the unit is switched off.

Remove the wiring access panel to gain access to the wiring compartment

Rectifier terminal block



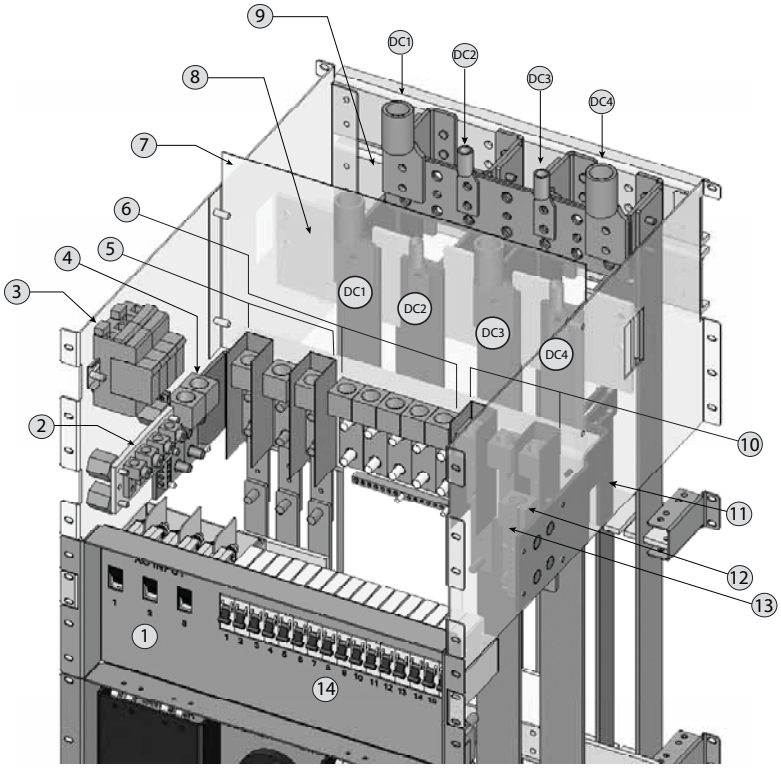
Once the internal rectifier powering wires have been removed, the external rectifier powering wires can be installed in the rectifier terminal block.

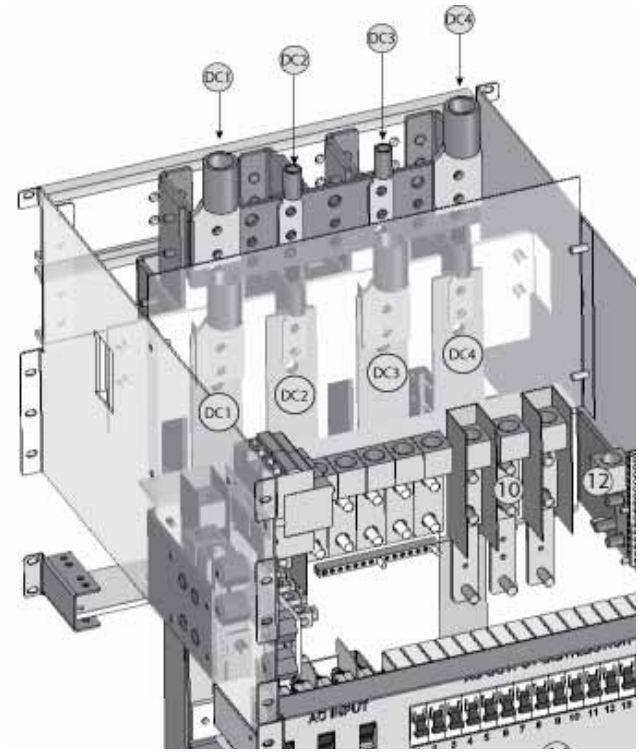
3.8 Input/Output Cabling

The illustrations below show the locations of the AC input, DC output, and AC output connection points:

1. Rectifier AC input circuit breakers
2. Rectifier AC input terminals
3. Industrial grade surge suppression modules.
4. AC input ground
5. AC input termination points for L1, L2, L3
6. AC neutral connection points
7. Protective panel between AC & DC connections
8. DC- bus, DC1, DC2, DC3, DC4
9. DC+ bus, DC1, DC2, DC3, DC4 input connectors shown with one 4DC shorting bar
10. AC output connection points; L1, L2, L3
11. Ground bus
12. AC output ground
13. Secondary AC output ground

AC input and AC output wires are connected to box lugs rated for 350 kcmil to #6 AWG.





The illustrations below show the dimensions and spacing for DC connections and the supplied joining plates.

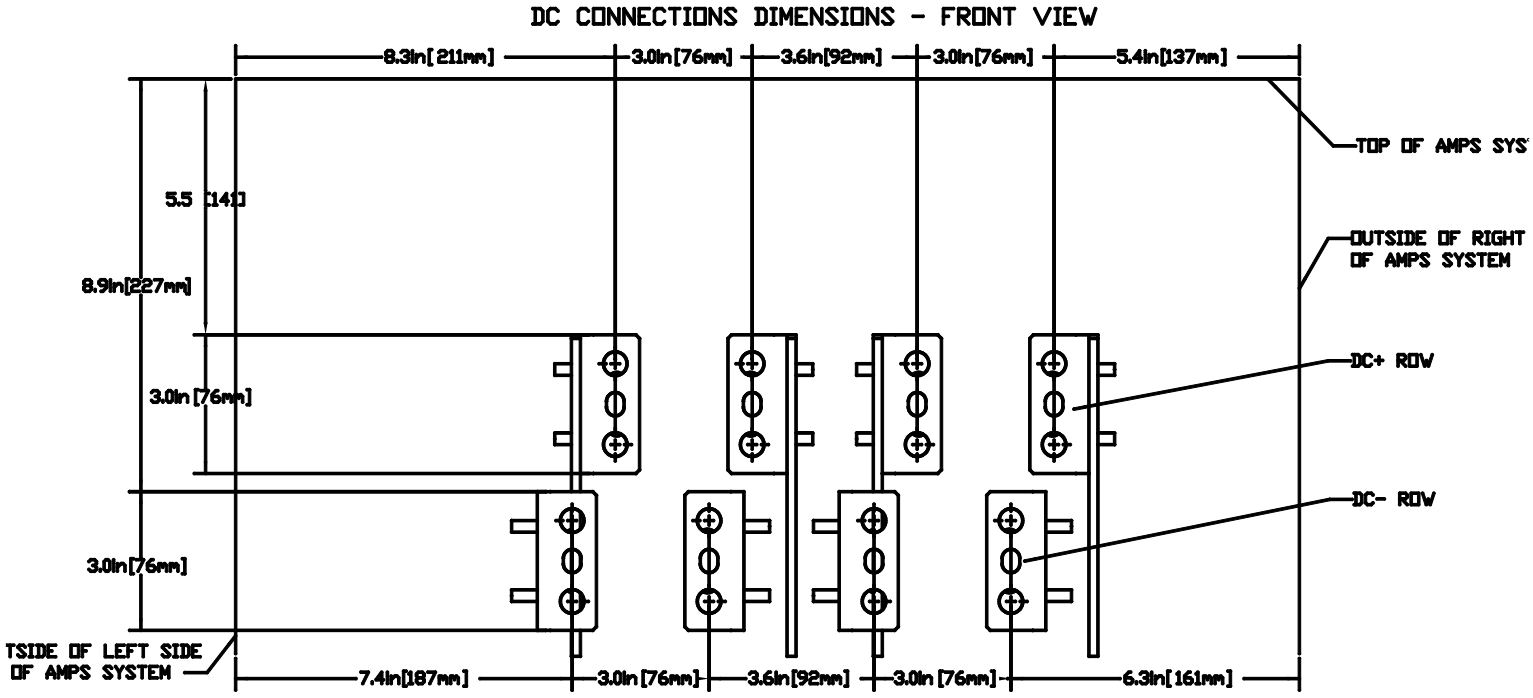


Fig. 3.4 Front view, DC connections

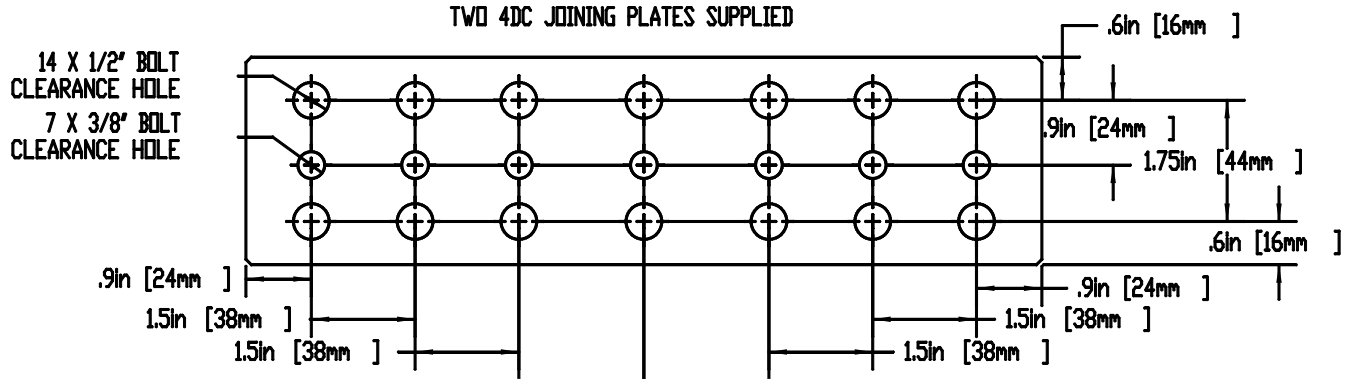


Fig. 3.5 Layout, Two 4DC joining plates

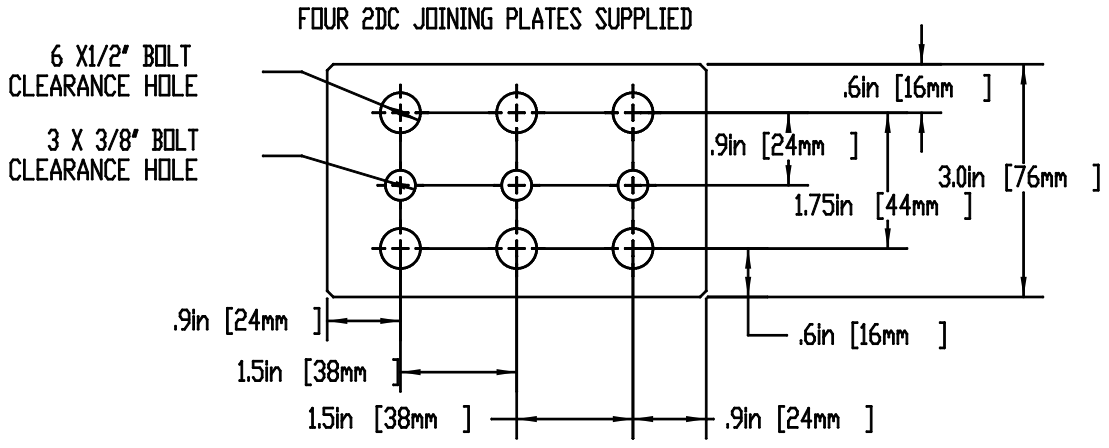


Fig. 3.6 Layout, four 2DC joining plates

3.9 DC Battery Cabling

DC battery cable terminations are designed for two-hole spade lugs crimped to the cabling, then attached to the bus bars with 3" hardware. Depending upon the gauge of the input wiring used, the connections may be made either singly or with two back-to-back lugs per mounting hole. Each bar (DC+, DC-) can accept seven 2-hole ½" mounting lugs on 1-3/4" centers or seven 2-hole 3/8" lugs on 1" centers.

Bus bar tie kits for DC+ and DC- are included to allow the installer the option to make a single battery connection or up to 4 separate battery connection (A/B feeds or A/B/C/D feeds).

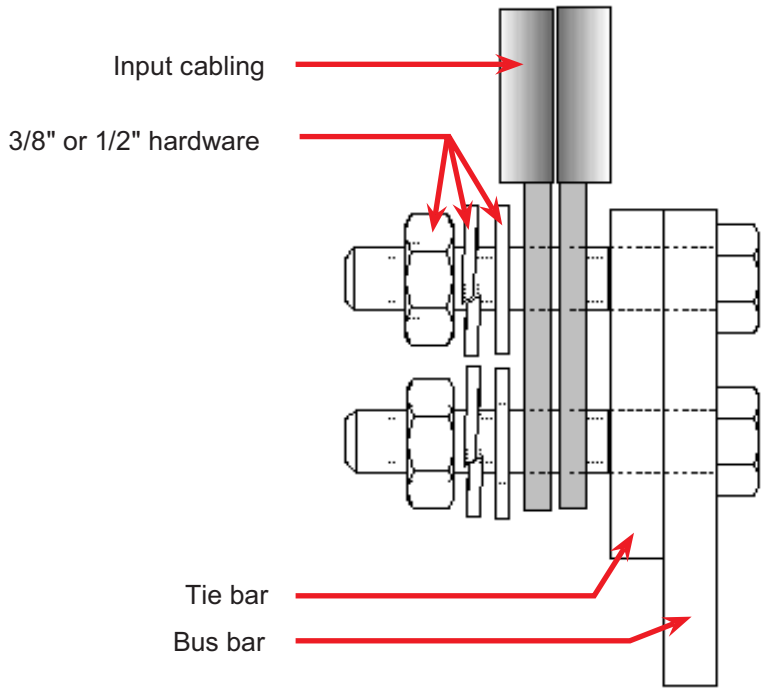


Fig. 3.7 Cabling and hardware arrangement

3.10 AMPS80 HP Inverter or Hybrid System with MBS; Single and Dual AC Input Feed

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

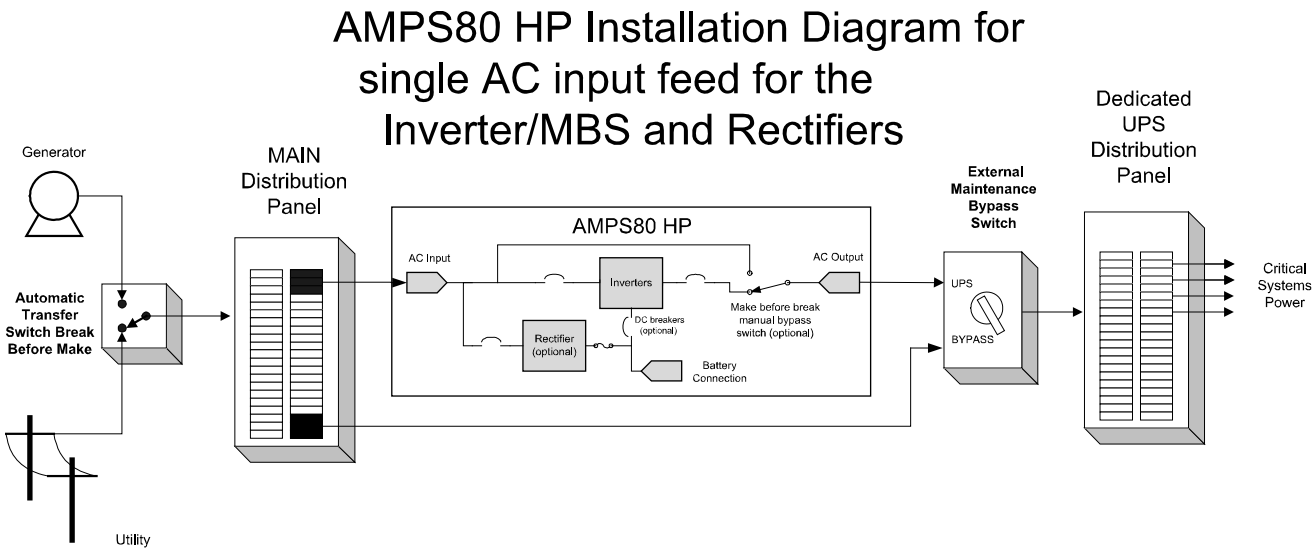


Fig. 3.8 Representative system wiring for AMPS inverter or hybrid system with MBS with single AC input feed.

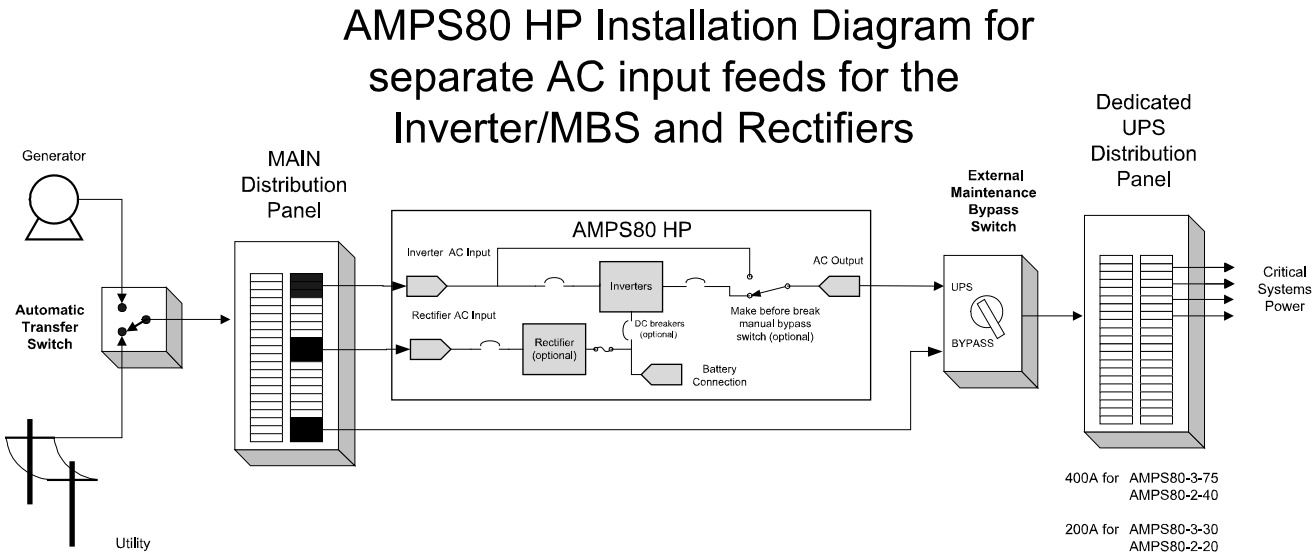


Fig. 3.9 Representative system wiring for AMPS inverter system with independent AC input feed for MBS

Reference Notes:

The AMPS80 HP system is preconfigured from the factory for a single AC feed per phase for inverters, a maintenance bypass switch, and rectifiers if present.

- If the AC input neutral is connected, remove the neutral to ground bonding wire. The neutral to ground wire is provided for systems without AC Input connections in which case the inverter output is considered a separately derived source and the AC output neutral must be connected to earth ground.
- In a 3-phase system equipped with an internal maintenance bypass switch and a load with a significant distortion power factor, it is strongly recommended to provide the AC input and AC output connection with a double neutral feed. Non-power factor corrected IT power supplies with rectified-capacitive loads can contain high levels of 3rd harmonics that are created in such 3-phase systems. The current in the neutral line can easily be twice the current in the line currents.
- DC tie bars are supplied to allow dual A/B battery feed (DC1 shorted to DC2 and DC3 shorted to DC4) or single battery feed (DC1 - 4 are shorted)
- 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 AMPS80 HP rectifiers. When using two independent A/B feeds, DC1 should be shorted to DC2 and DC3 shorted to DC4 at the AMPS80 HP DC connection points. Shorting bars are provided.

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

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

3.11 Starting System For the First Time

3.11.1 Tools Required

The following tools are required to commission the AMPS80 HP system for the first time:

- Medium flat screwdriver with approximately 3/8” (5 mm) blade width.
- True RMS digital multimeter.
- Computer with Ethernet port and Internet Explorer 8 or later.
- Crossover Ethernet cable if a computer is directly connected to the CXC controller.
- Straight through Ethernet cable if the network connections are made through a router or hub.
- Torque wrench.
- 3/8” hex driver.

3.11.2 Start up Procedure

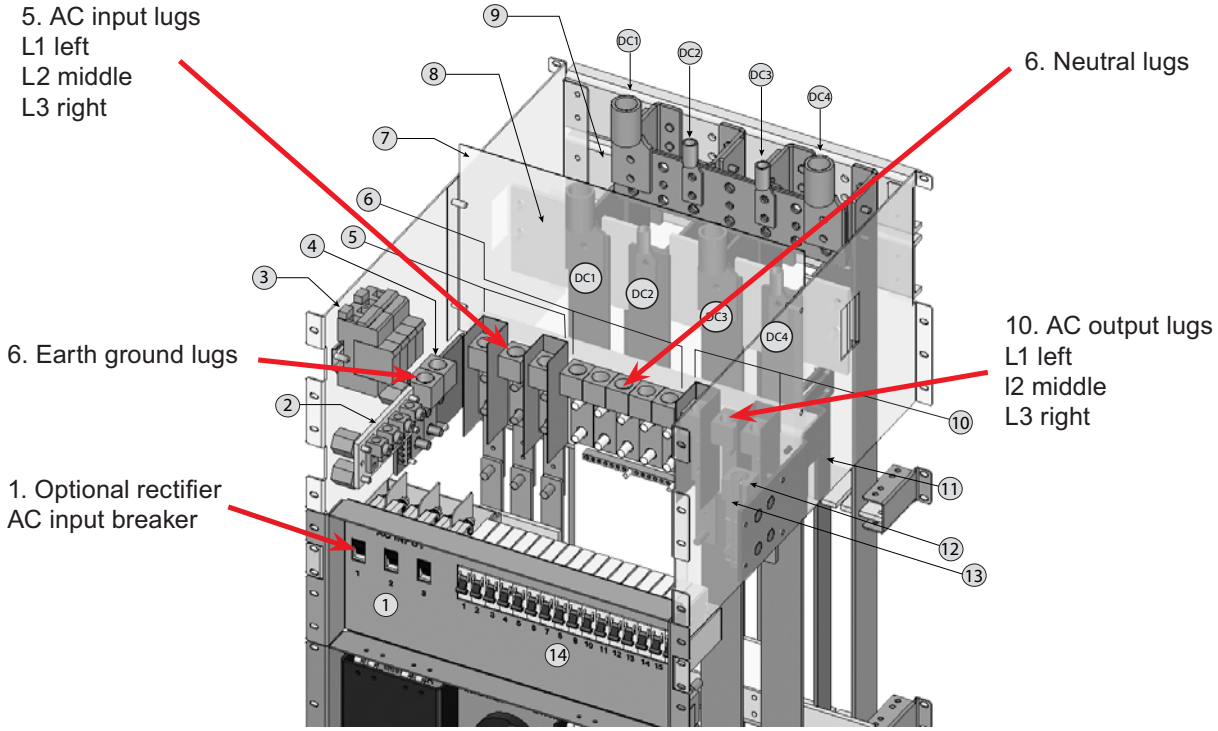
If your system does not have an AC input supply, i.e. there is no bypass function and the system always operates from DC input, ignore the instructions related to the AC input.

WARNING!

The AMPS80 HP must have no power and no modules installed.

1. Verify that the AMPS80 HP system is mechanically secured to the floor or other structure.
2. Verify that the AMPS80 HP system is correctly and securely connected to the utility and batteries:
   a. For the battery connections, follow the manufacturers recommendations and record the torques.
   b. For the AC connections, torque #1 AWG - 350 kcmil wire to 375 in-lbs (42 N-m), and #6 - #2 AWG wire to 200 in-lbs (23 N-m).
   c. If rectifier wiring is installed, torque the connections to 120 in-lbs (14 N-m).
3. Verify that the AMPS80 HP system is correctly and securely grounded to the building grounding system.
4. Verify that all load distribution breakers are switched off.
5. Verify that the inverter AC input circuit breaker of the AMPS80 HP system is in the OFF position.
6. If the rectifier option is installed, verify that the rectifier AC input circuit breakers of the AMPS80 HP system are in the OFF position.
7. Verify that the inverter AC output circuit breaker of the AMPS80 HP system is in the OFF position.

8. If equipped with a maintenance bypass switch (MBS), place this switch in the INVERTER mode.
9. Switch on the AC mains/utility power. Verify the AMPS80 HP system AC input and output voltages at the AC wiring terminals:
    a. The voltage from Neutral to L1 / L2 / L3 must be approximately 120 V.
    b. The voltage from L1 to L2, L2 to L3, L3 to L1 must be approximately 208 V for a 3 phase system, or the voltage from L1 to L2 must be approximately 240 V for a split phase system.
    c. The voltage from Neutral to Earth Ground must be near zero volts.



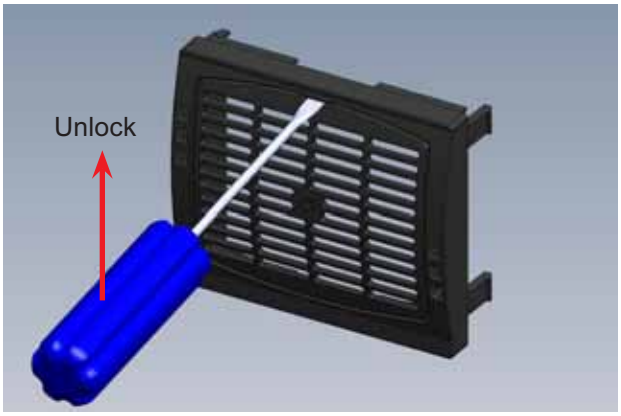
10. Ensure that all the batteries are disconnected, all rectifier modules are removed, all fuses are pulled, and all circuit breakers are switched off. Triple check the polarity of the battery connections.
11. If the system includes the rectifier option, install one rectifier module. Switch on the AC power to the rectifier and allow it to start up. Verify that the system starts up OK and that the controller switches on.
12. Check that the battery polarity is correct and then switch on the breakers, fuses, or circuit breakers for the batteries. If there is no means to disconnect the batteries, reduce the rectifier output voltage using the controller. To avoid sparks, match the rectifier voltage to the battery voltage to within 0.5 V.
    a. The DC+ (positive) terminal voltage on the AMPS80 HP is near the earth ground. The battery positive ground connection should be made near the battery.
    b. The DC- (negative) terminal voltage is approximately 48 Vdc relative to the chassis ground.
    c. The CXCR controller display initializes with three LEDs blinking for a few seconds. The LCD will show the correct DC voltage.
13. If the system includes the rectifier option, install one rectifier module.
14. Switch on all the rectifier AC input breakers. Verify that the AC LED on the rectifier front panel illuminates after a few seconds.
15. Connect a computer to the CXCR controller. See the Connections section in this manual or Section 9.1 “Establishing a network Connection via a Crossover Cable” in the Cordex Controller Software manual. The 48 V DC power must be switched on before the CXCR controller can operate. Provide either DC power on the main DC1 or DC4 connections, or switch on at least one rectifier if it is available.

WARNING!

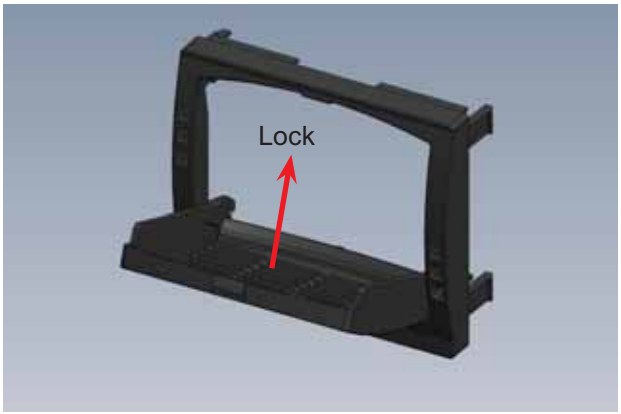
Do not install all inverter modules at once but load one inverter module into an open slot for each AC phase. This allow the initial set-up of the AC phases. All remaining modules will automatically take on the configurations of these “seed” modules. See diagrams under Section 8.1: Module Location Relative to System Wiring for AC phase locations. See below for detailed module insertion/removal instructions. You may not want to close/lock the grill at this time because the module may have to be removed at a later stage.

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.

Fig. 3.10 Unlocking and locking an inverter module for removal or insertion

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.

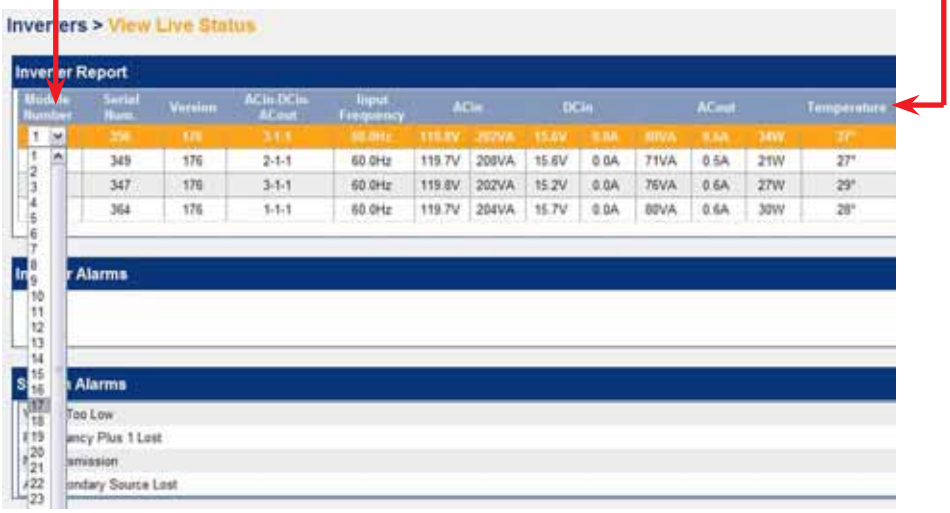
Fig. 3.11 Inserting and removing an inverter module

16. Switch on the inverter AC input breaker on the AMPS80 HP front panel. Verify that the AC input LEDs turn on for each module. The LEDs may flash in different colors but this behavior should not be a cause for concern.
17. Using the CXC web interface, verify that the modules are recognized and the voltages and currents of the modules are displayed. Ignore any alarms at this point. The current readings at no load are not very precise. Select: Inverters -> View Live Status
18. Select the first module listed in the Live View Status. The corresponding LEDs for that inverter will flash for a few seconds. Using the pull down box in the Module number column, set the number to the corresponding AC phase. Repeat this for the second module (for split and 3 phase systems) and the third module (for 3 phase systems).

19. Select Inverters > View Live Status

A pull-down menu allows the user to re-assign the inverter's module number in the report; for example, to correspond with their physical location on the shelf. Selecting a module number that is already used will swap the two modules.

Select a row to send a Locate command; the inverter module's LEDs will then blink momentarily.



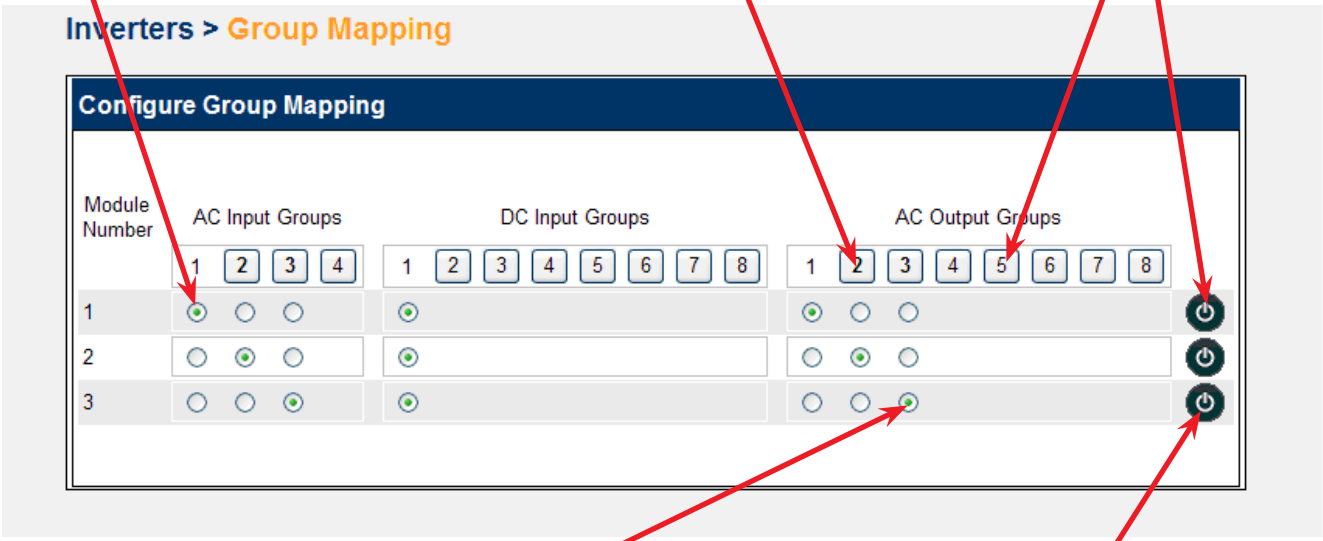
20. Select the first module listed in the Live View Status. The corresponding LEDs for that inverter will flash for a few seconds. Using the pull down box in the Module number column, set the number to the corresponding AC phase. Repeat this for the second module (for split and 3 phase systems) and the third module (for 3 phase systems)

21. Select Inverters > Group Mapping

Match the AC input group to the AC output group

For a split phase 120/240 V system, click on heading button 2
For a 3-phase 120/208 V system, click on heading button 3

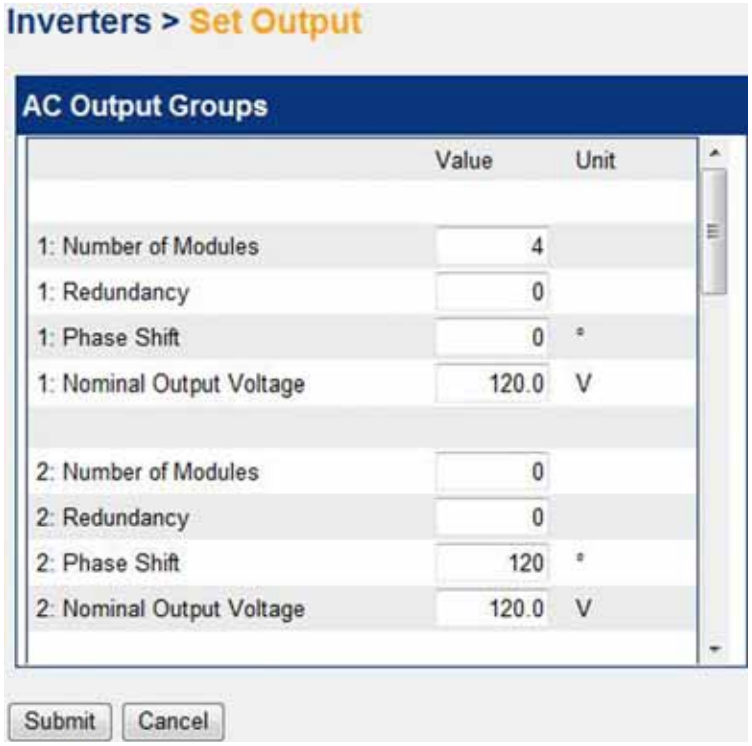
Turn off all inverters before changing the number of AC phase groups



Switch off the inverter before changing the inverter's AC output group.

Click this button to switch the inverter ON/OFF. Use with caution.
Green = inverter is ON
Black = inverter is OFF
Red = inverter ALARM

22. Press the power icon to turn the inverters off. The icon should turn black within a few seconds.
23. Configure the AC input and output phases (groups).
    a. For a split phase configuration (120/240 V), click on the #2 button under both the AC Input Groups and AC Output Groups.
    b. For a 3-phase configuration (120/208 V), click on the #3 button under both the AC Input Groups and AC Output Groups.
    c. Set the round button for Module Number 1 under AC Input Group 1 and AC Output Group 1. Similarly, set Module Number 2 under AC Input and Output Group 2, and for 3 phase systems, set Module Number 3 under AC Input and Output Group 3.
    d. Select Inverters -> Set Output menu and set the values for each phase of your system. The leftmost number on each line corresponds to the AC phase (group). The AC Input phase will always be in phase with the corresponding AC output phase.



    e. **Number of Modules:** Enter the total number of modules installed for that phase.
    f. **Redundancy:** Enter the number of modules that provide redundant power for that phase. This information is used to provide system warnings.
    g. **Phase Shift**: Enter 0 (zero) for phase 1. For a split phase (120/240 V) system, enter 180 for group 2. For a 3-phase (120/208 V) system, enter 120 for phase 2 and 24 0 for group 3. If the actual phase rotation of the AC Input is not 1 – 2 – 3 (i.e. it may be 1 – 3 – 2) then enter 240 for group 2 and 120 for group 3. The inverters will not start until the phase and rotation is correct.
    h. **Nominal Output Voltage**: Enter 120 for all phases. Caution, this value can change the actual AC. output voltage of the inverters. Changing this value will render the UL/CSA approval invalid.
24. Switch on the AC output breaker in the AMPS80 HP.
25. Check the actual Inverter AC Output by measuring voltages on the AC Output terminal block in the AMPS80 HP wiring compartment:
    a. The voltage from Neutral to L1 / L2 / L3 is approximately 124 V. At no load, the inverter output voltage is slightly higher than nominal.
    b. The voltage from L1 to L2 is approximately 240 V for a split phase system or the voltage from L1 to L2, L2 to L3, L3 to L1 is approximately 208 V for a 3 phase system.
    c. The voltage from AC Input L1 to AC Output L1 is less than 20 V. Similarly, the voltage between L2 input and output and L3 input and output should be less than 20 V.

26. Install the remaining inverters, rectifiers, and blank modules, if applicable. Slot without modules must be filled with blank housings. The newly installed inverter modules will clone themselves to be identical to the initial modules that where installed and set up.

WARNING!

Use blanks to cover any open module slots. Do not leave any module slots open.

Safe solution. Blanks must be used to cover any open module slots.

Unsafe solution. Do not leave any module slots open.

Fig. 3.12 Inserting blanks in open slots

a. Using the CXC web interface, select: Inverters -> View Live Status and verify that all inverters are recognized.

b. Change the inverter numbers as desired. The largest inverter number that can be used is 32. A typical naming convention would be to use 1 – 10 for phase 1, 11 – 20 for phase 2, and 21 – 30 for phase 3 inverters.

c. We recommend that you identify each physical inverter model with its corresponding inverter number. To help identify a specific Inverter, click on the inverter row in the View Live Status screen and the LEDs of that inverter will flash for a few seconds.

d. Select: Inverters > Group Mapping and verify that all inverters are mapped to the correct AC input and AC output group. If the AC input group does not match the AC output, match the AC input group with the output group as shown in step 21.

e. Select: Rectifiers -> View Live Status and verify that all rectifiers are recognized.

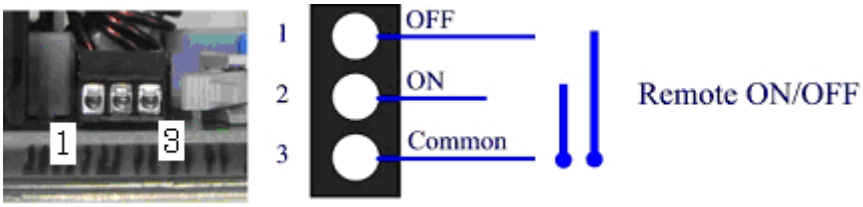
27. Using the CXC controller web interface, configure any other parameter as required. Typical changes may include battery and charging values for the rectifiers in a hybrid AMPS80 HP system, changing the low and high voltage AC and DC warning and cutout limits, or creating more than one DC group if independent battery settings are desired.

Alarm tests	
Test	**Expected result**
Turn the bypass switch to the BYPASS position	“Bypass mode active” alarm
Turn off the Inverter AC Input breaker	Inverter AC input breaker off alarm, no change in AC output voltage
Turn off the Inverter AC Output breaker	Inverter AC output breaker off alarm, power to loads is off
Pull out one inverter module	Assuming the number of modules is set correctly in the Inverters -> Set Output web page, the communication lost alarm should appear

28. At this point there should be no alarms present. Investigate and correct any alarm issues.
    a. You will see a “communication” alarm if the number of installed inverters do not match the number of modules set in the Inverters -> Set Output menu.
    b. You will also get an alarm if the inverter input breaker is OFF, the inverter AC output breaker is OFF, or the MBS is in the BYPASS position.
29. Test the functionality of various module alarms and controls.
30. Perform a system load test. Power up the equipment, one at a time. If possible, add heater or light bulb loads to increase the load temporarily.
31. Turn off the inverter AC input breaker to perform a full load test from DC power.

3.12 Inverter Remote On/Off (Optional)

The AMPS80 HP inverters can be remotely activated or stopped (stand-by mode).



- In a typical multi-shelf system, the remote ON/OFF can be connected on any shelf.
- The voltage present on Terminal 1 and 3 is +5 V (galvanically insulated).
- Do NOT connect an external voltage on terminal 1, 2, or 3. Maximum wire size is 16 AWG (1 mm^2)
- Use 3 wires, from a C NO/NC relay contact to control this function.

Functional table for remote ON/OFF function

State	Pin 1 - 3	Pin 2 - 3	Comment
1	Open	Open	System working normally
2	Close	Open	Inverter module output switched off AC output LED off DC input LED illuminated green AC input LED illuminated green
3	Open	Close	System working normally
4	Close	Close	System working normally

- The inverter does not change its operating status if both transitions are not detected.
- State 3 should be implemented by default.
- Changing the status of these inputs from (State 3 -> State 2 -> State 3) forces the inverter modules to start running without the T2S.

4. System Operation

4.1 Inverter Module Indicators

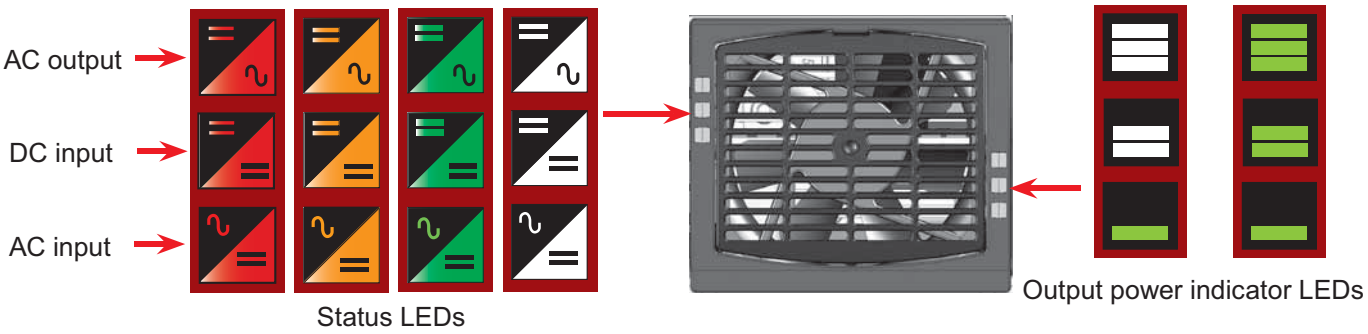


Fig. 4.1 Inverter module status, power LEDs

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 control card
Flashing red	Recoverable fault	Wait or attempt to clear fault condition by removing and reinserting the module
Permanent red	Non recoverable fault	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.

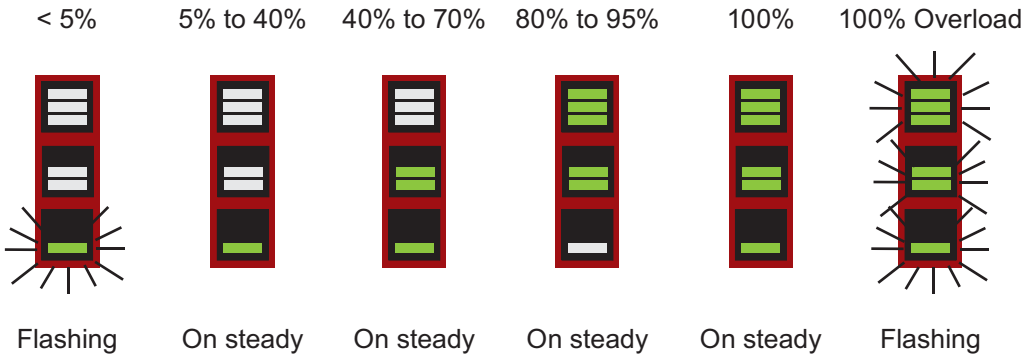


Fig. 4.2 Output power indicator LEDs

4.2 T2S Inverter Control Card

The CXC 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
- User-selectable Alarm (with T2S)

All alarms are qualified in Minor Alarm except those configurable by T2S.

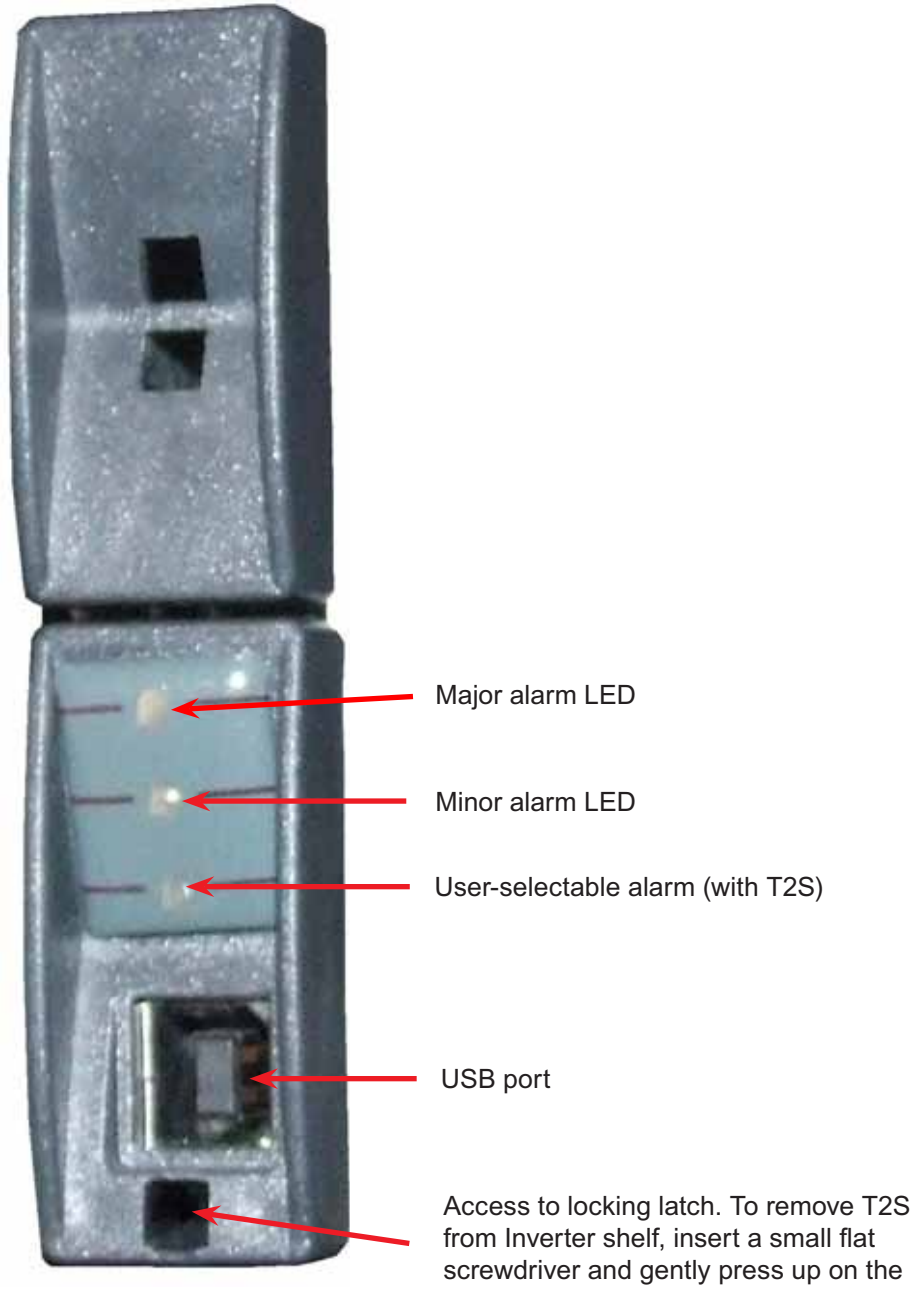


Fig. 4.3 T2S front panel

4.3 Using the CXC Unified System Controller

The CXC controls the AMPS80 HP system and allows the user to set wide variety of parameters regarding the alarms and operational functionality of the rectifier and inverter modules.

The following guide provides a brief overview of the controller; in-depth information can be found in the Technical Manual for the Cordex Controller Software.

Note: Section numbers referenced in this section correspond to the sections in the Technical Manual containing additional information on the referenced topic.

4.4 Software Overview

The CXC software enables control of an entire DC + AC power system via the CXC central touch screen user interface or web based monitoring and control interface. The software also allows the user to control temperature compensation, auto equalization, remote access, and battery diagnostics.

Fig. 4.4 CXC system controller

User interface

Located on the front panel of each model is a 160-x-160-pixel touch screen liquid crystal display. This graphical user interface (GUI) enables a person to interact with screen selectable items.

LED lights

Each CXC has three LEDs located on the front panel. These are used to display the alarm status of the power system, CXC progress and status during startup, and file transfers.

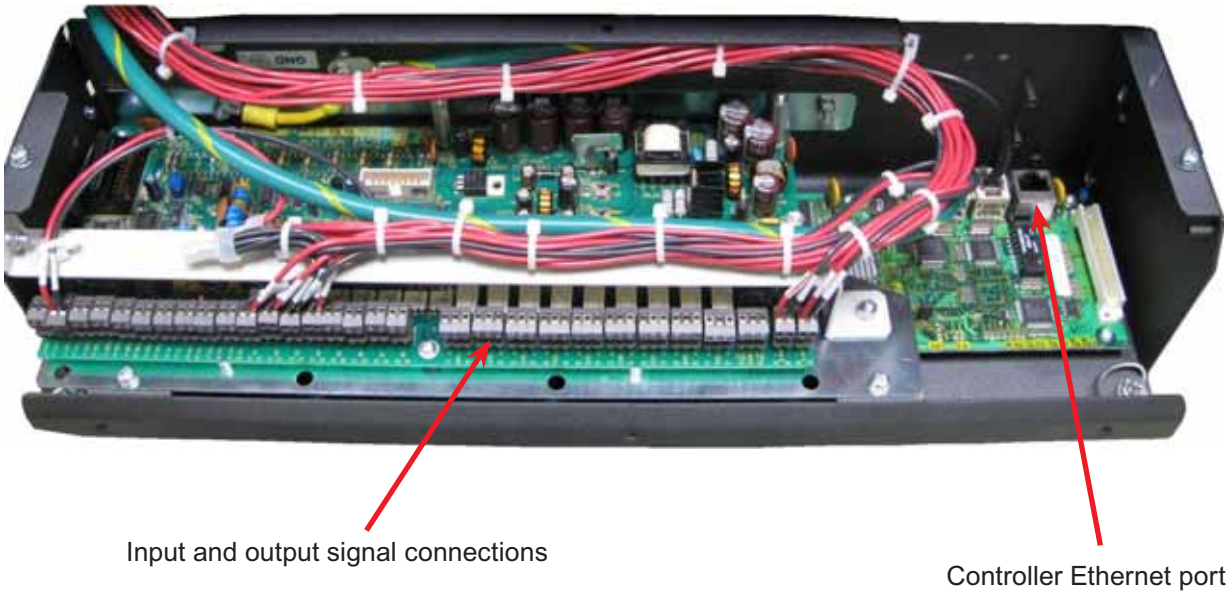
Alarm conditions

The CXC illuminates the LED that corresponds to the system alarm status. The following show the corresponding alarm status for each LED color:

- Green – OK, no alarms present
- Yellow – Minor alarm is present (no major alarms)
- Red – Major alarm is present.
- Only one LED is illuminated at a time during alarm conditions.

4.5 Connections

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



4.6 Quick Start

1. Initiate a startup routine by switching on the power to the controller. This may be done by closing the battery breaker. The controller will perform a short self-test as it boots up. Alarm alerts are normal. The LEDs perform a scrolling pattern to indicate there is activity. Wait for the startup routine to finish.
2. Check and adjust alarms and control levels in the CXC's submenus.
3. Check and adjust group settings in the INVERTERS and RECTIFIERS submenus; e.g. float, equalize voltage, etc.
4. Verify COMMUNICATIONS settings as needed.
5. Program the CXC's TEMP COMP and AUTO EQUALIZE settings as needed.
6. Test relay OUTPUT ALARM\CONTROLS as needed; e.g. Major Alarm, CEMF, etc.

4.7 Controller Operation

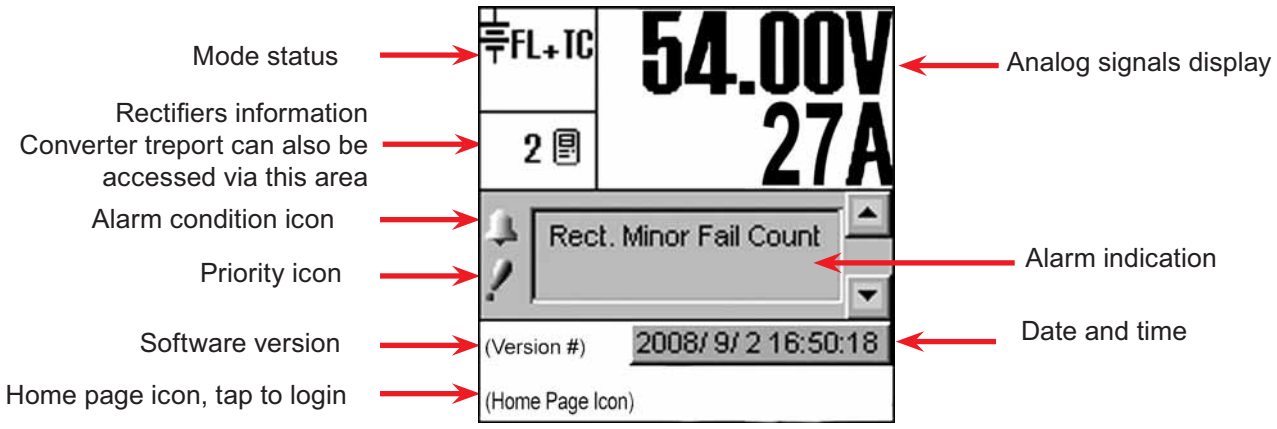
4.7.1 Startup and Reset Procedure

When the CXC is powered-up or reset, it will first perform a 15-second self-test before displaying the Cordex logo and various identification messages. The three front-panel LED's will illuminate temporarily, but will extinguish after the system has finished its self-test. Next, the GUI will display the power system's parameters during Normal operating mode.

4.7.2 Normal Operation

This is the default-operating mode or "home page." The GUI displays system status information and monitors all input channels.

Active areas to tap and activate are noted below:



Activation/Tapping: Each active area is touch sensitive and responds better to a stylus suited for this purpose; i.e. PDA type.

The Analog Signals Display on the home page will show two lines of text for system voltage and current by default. Tap this active area to decrease the font size for four lines of text showing the system values and the corresponding labels. The large font reappears after 20 minutes of inactivity (no user input); otherwise tap again to enter a new window of operation or select a different active area as required.

4.7.3 Menu Navigation and Sample Programming

Menu Navigation The sample screen shown below is presented upon login. From here, the user may navigate (e.g. browse – as on a personal computer) each of the CXC's menu items, including alarms, controls and configuration items.

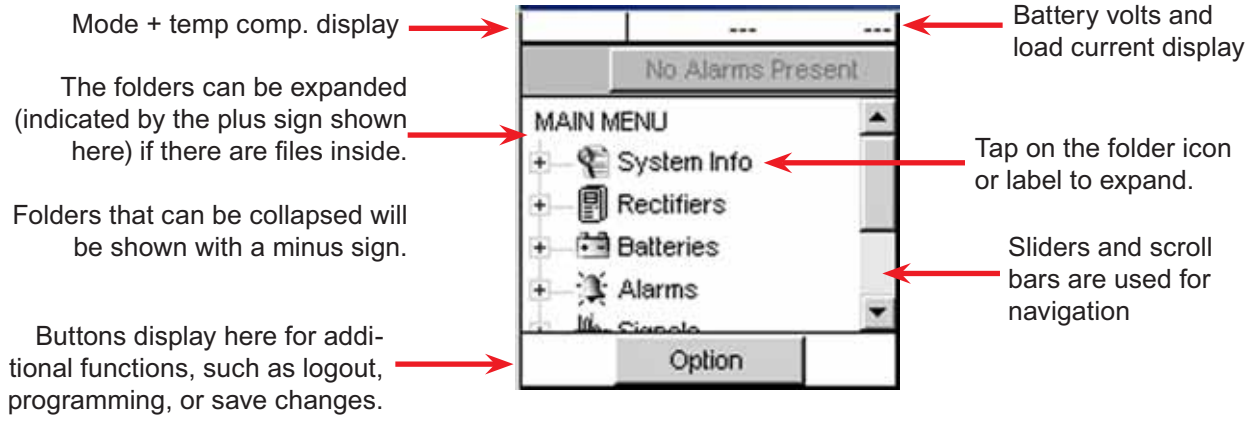


Fig. 4.5 Navigation screen

Option to Logout

Via the Option button, a pop-up window enables the user to logout of the menu navigation screen and return to the home page. Follow the on-screen prompts to log out

Option to save

Saving in menu navigation (Supervisor only) will result in a prompt (pop-up window) to appear; e.g., "Save Complete" when the settings are downloaded. Follow the on-screen prompts to save or discard changes.

Auto-logout time out

After 20 minutes of inactivity (no user input), the CXC will automatically logoff the user. The CXC will discard any unsaved changes made by the user while logged in the system and return to Normal Operation mode.

Backlight time out

After one minute of inactivity (no user input), the CXC will automatically turn off the LCD backlight.

4.7.4 Web-accessed Features

This section describes the additional web page features for Inverter system. See the CXC Software manual for a complete description of the Cordex functionality.

Scope

These instructions explain the interconnection and operation of Alpha Technologies' Cordex Controller with Inverter Support. To aid the user with operation, frequent reference is made to the Cordex Software manual (current revision).

The functionality of the CXCU is the same as the existing Alpha CXC system controller. A basic understanding of Ethernet, TCP/IP, SNMP, RS-485, and CAN bus functionality is required.

Product overview

The CXC is an integrated Alpha Cordex Controller designed to provide universal control for Alpha Group products; in particular, AMPS80 HP systems using inverters and Alpha Cordex rectifiers.

The CXC has Ethernet capability that supports a web interface and SNMP for customer access to the equipment it is monitoring.

The CXC also has a CAN bus for communication with the Cordex rectifiers and other peripheral equipment.

Refer to the Cordex Software manual for details.

Inverter monitoring and control

Refer to the Cordex Software manual Chapter 6: Menu Structure, Programming and Adjustments.

The Inverter menu category consists of inverter alarms, signals and settings. Parameters can be accessed such as the number of acquired inverters, output voltage/power, and source position.

Other features include: Input source, Inventory update,Inverter locate, Group assignment, Inverter firmware upgrade, Major and minor alarms.

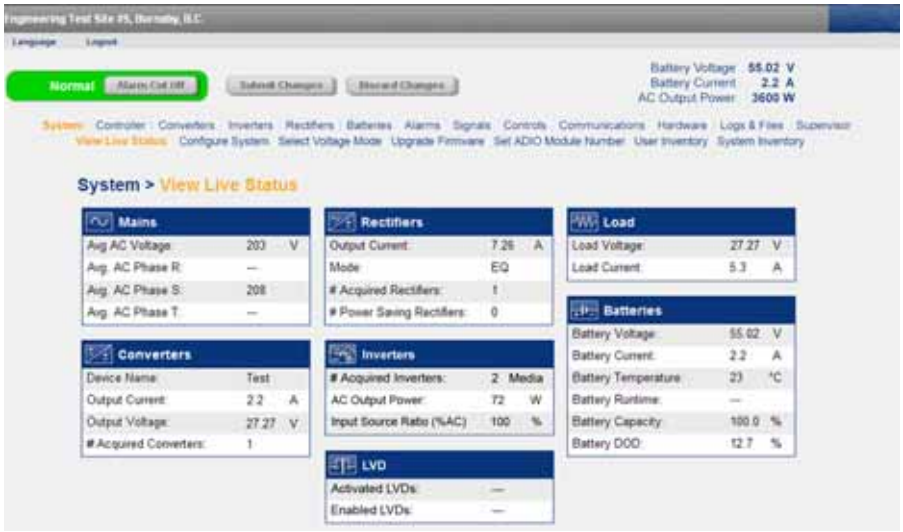


Fig. 4.6 Illustration of web interface window (sample home page)

4.7.5 Features

View live status inverter report

This submenu of Inverters will enable the user to view, in a list report, all of the acquired inverters in the system. The first column lists the module numbers (ID) of the inverters; which may be re-assigned. The report then displays the unique serial number and module version, followed by the corresponding AC In, DC In, and AC Out group mapping values. The input frequency and temperature of each inverter completes the top portion of the report table. The bottom portion of the report lists all the currently active inverter module specific and system alarms.

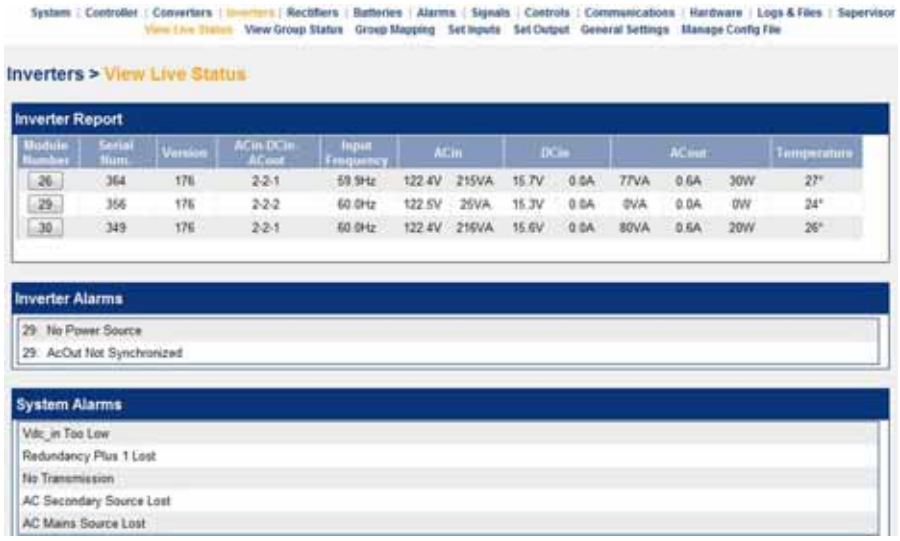


Fig. 4.7 View live status page

A pull down menu allows the user to re-assign the inverter module number in the report, for example, to correspond with its physical location on the shelf.

Selecting a module number that is already used will swap the two modules.

Select a row to send a locate command. The inverter module's LEDs will blink momentarily

Fig. 4.8 View live status — inverters page

4.7.6 View Group Status

This submenu of Inverters will enable the user to view the grouping of input sources and inverter output that share unique operating parameters per group – see Group Mapping.

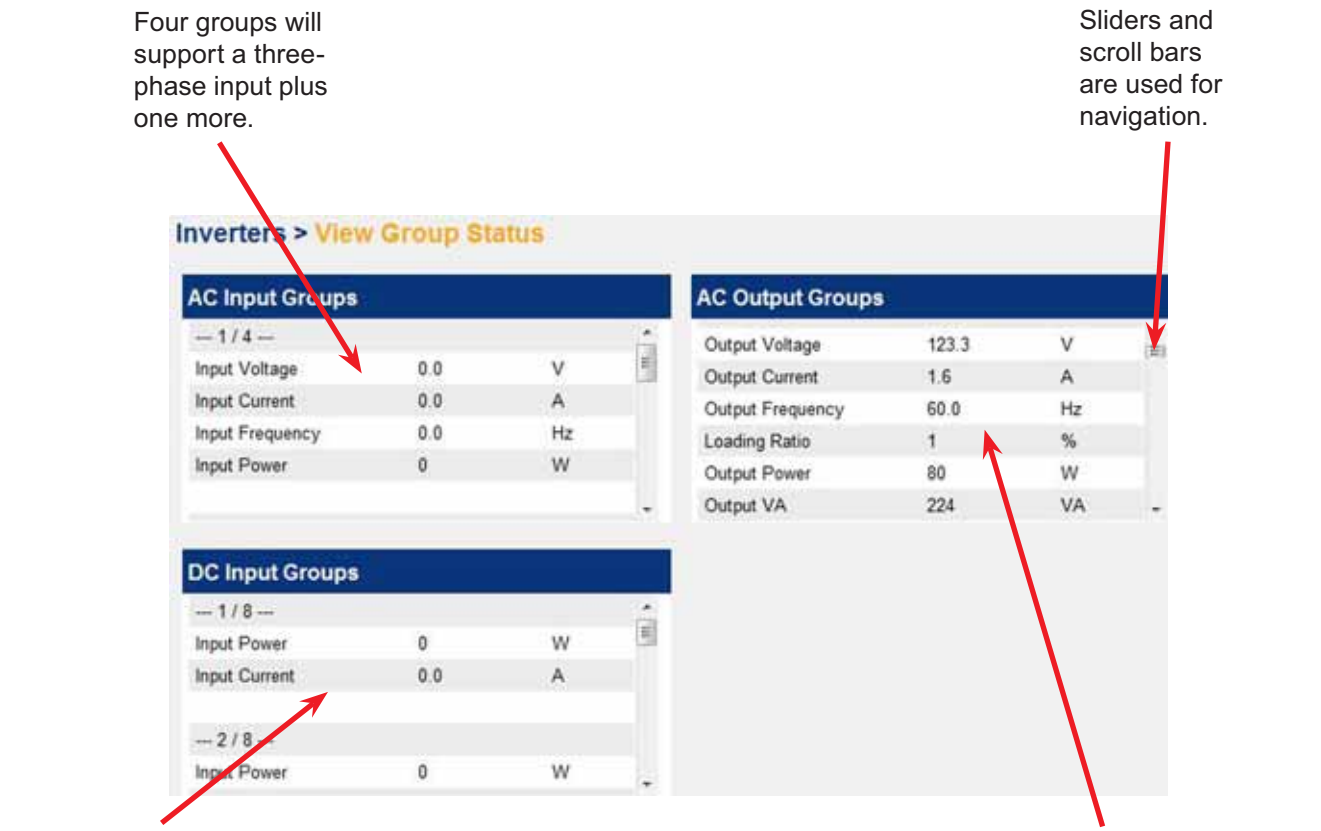
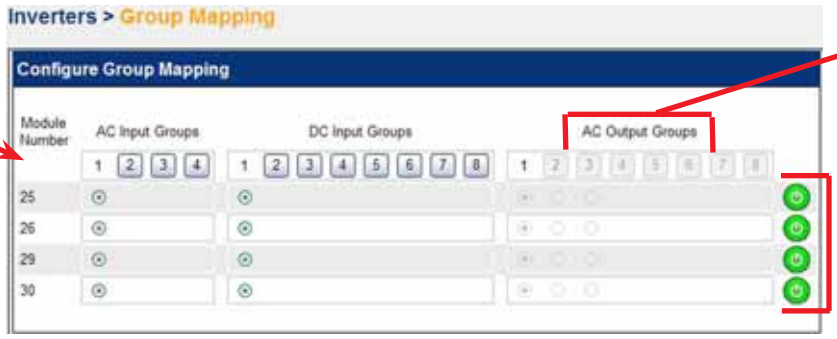


Fig. 4.9 View group status window — inverters page

4.7.7 Group Mapping

This submenu of Inverters will enable the supervisor to configure settings (via menu items) for all of the acquired inverters in the system.

A matrix of buttons allow the supervisor to map (enable/disable) the inverter's assignment per group.



Ensure phases are configured correctly before mapping inverters in the new groups and turning them on.

"Power Buttons" Use with caution

Fig. 4.10 Group mapping window

Power buttons – Green indicates an inverter is turned ON. An amber/orange/yellow color will indicate the inverter is in a recoverable error. The user can attempt to turn on the unit. The red color will indicate the inverter is in an irrecoverable error and there is nothing the user can do to turn on the unit. Black indicates an inverter is manually OFF. Adding/removing groups (columns) may take a few seconds to incorporate the change. Changing the radio style buttons (rows) will also take time to apply changes; for example, approximately two seconds for one inverter and up to ten seconds for the maximum number of inverters (32).

If there are inverters mapped to a column, disabling a column will be prevented and a warning message will be displayed.

All inverters must be turned OFF to enable the AC Output Groups column buttons. The AC Output Groups of an inverter in the ON state cannot be changed. The radio buttons for that inverter AC output group will remain disabled until the inverter is turned OFF.

4.7.8 Set Inputs

This submenu of Inverters will enable the supervisor to set the parameters shown below:

See general settings.

For inverters, changes apply on a page by page basis; select Submit.

Select Cancel to discard all changes made (including invalid settings).

Fig. 4.11..Set input window

4.7.9 Set Output

This submenu of Inverters will enable the supervisor to modify the following parameters:

CAUTION!

Modifying the AC output voltage or frequency will void the regulatory approval of the system.

Number of modules – The value is the number to be acquired by the CXCU. An invalid setting will result in an alarm condition: Inverter Comms Lost; i.e., the number of modules must agree with the actual number of inverters mapped to that particular group.

- Redundancy – Defines the number of inverters to consider redundant.
- Phase shift – Assigns a phase shift (in degrees) to the AC output group.
- Nominal Output Voltage – Sets the target output AC voltage and must be used with caution; the devices connected to the inverters could sustain damage due to irregular AC voltage.

Ensure that the Phase Shift is set correctly before mapping inverters in the new groups and turning them on.

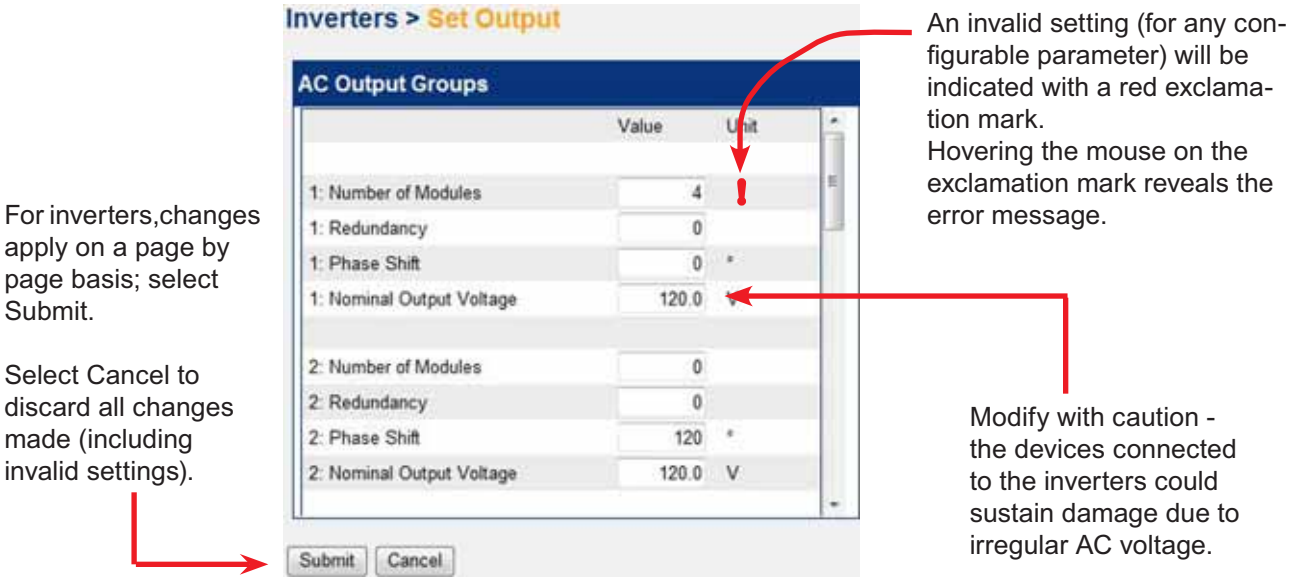


Fig. 4.12 Set output window

4.7.10 General Settings

This submenu of Inverters will enable the supervisor to set the parameters shown below:

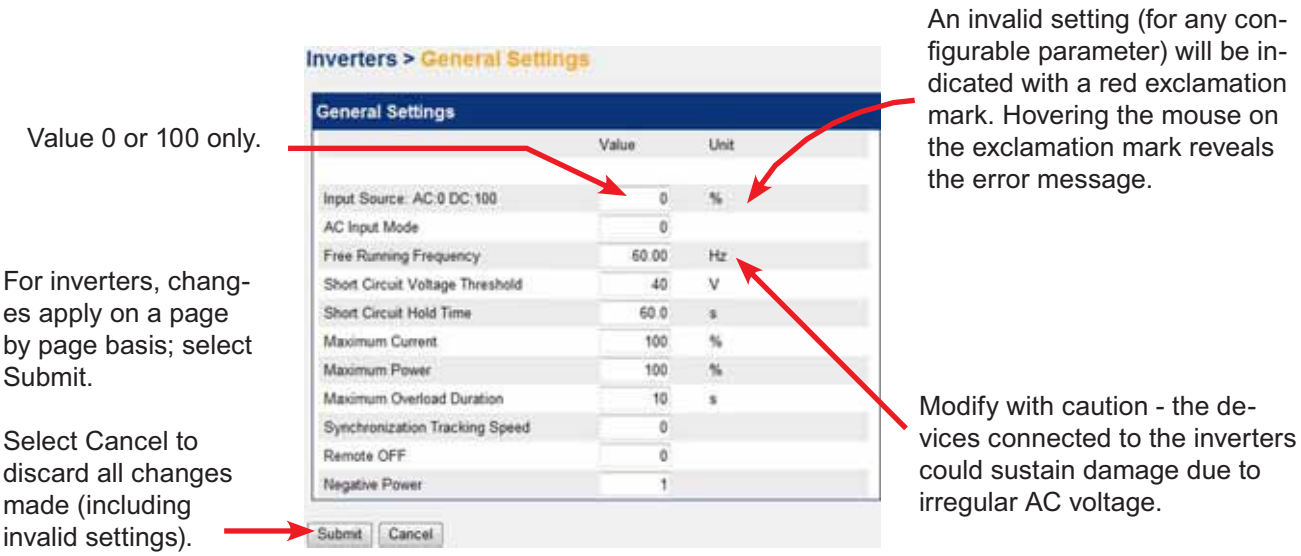


Fig. 4.13 General settings window

The Free Running Frequency min./max setting is determined by the General Settings value. If AC input is present, the AC output will synchronize; however an irregular AC voltage could damage the inverters.

4.7.11 Manage Config File

This submenu of Inverters will allow the user to upload an inverter configuration file.

Fig. 4.14 Manage config file window

4.7.12 Alarms

The Inverter submenu will enable the user to configure the following alarms:

Major fail count – The controller activates this alarm when the number of failed inverters equals or exceeds the user-configured threshold and clears when the number of failed inverters falls below the threshold.

Minor fail count – The controller activates this alarm when the number of failed inverters equals or exceeds the user-configured threshold and clears when the number of failed inverters falls below the threshold.

Communications lost – The controller activates this alarm when the controller loses communications with any one inverter and clears when communications resume. The number of inverters must be correctly identified in the Set Output menu.

AC input fail – The controller activates this alarm when the main AC input of the inverter is lost.

(Inverter) alarm – The controller activates this alarm when any individual or system alarm condition is detected.

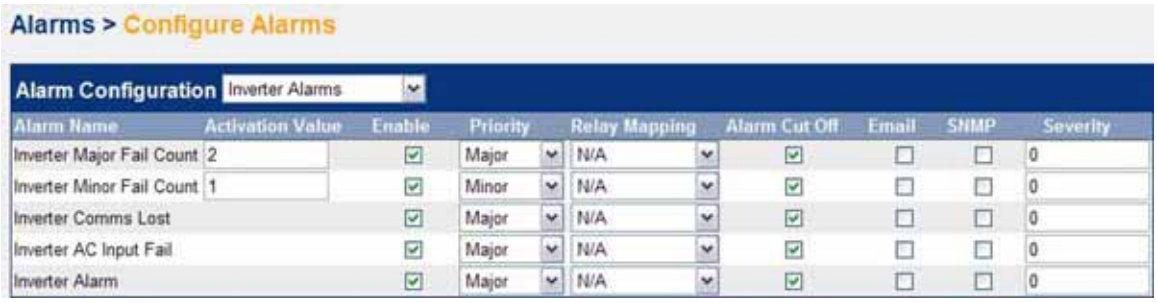


Fig. 4.15 Configure alarms window

4.7.13 Signals

The Signals submenu will enable the user to access inverter signals for all of the acquired inverters in the system. The following signals can be used for logging and equation building.

Fig. 4.16 Signals (inverters) window

4.8 Rectifier Features

4.8.1 Rectifier Front Panel Lights

Refer to the Cordex CXRF 48-1.8 kW manual for further details.

AC LED light

The top LED (green) is on when AC is within valid range. AC voltage is invalid if the AC Mains Low or AC Mains High alarm is active. The LED turns off when AC has failed.

DC LED light

The middle LED (green) is on when the rectifier is delivering power to the load. The LED will flash when communication is lost. The LED turns off when the rectifier is off; e.g., when commanded via the controller.

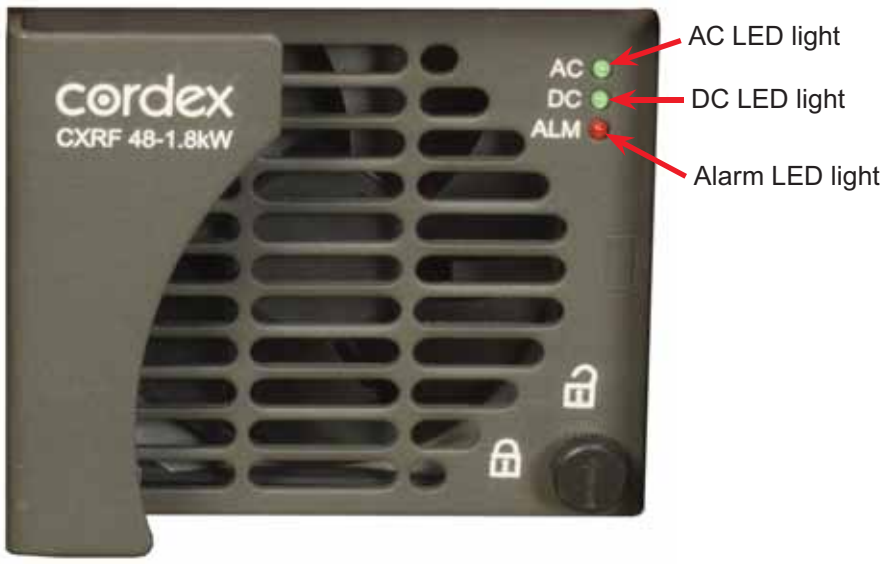


Fig. 4.17 Cordex CXRF 48 V rectifier

ALM LED light

The bottom LED (red) is on continuously in the event of an active Module Fail alarm; if the module is unable to source power as a result of any of the following conditions:

- Output fuse blown
- AC Mains Input Fail
- Module fail (ramp test fail)
- High voltage (OVP) shutdown
- Thermal shutdown
- Local shutdown
- UPF fail
- No output power
- Fan fail.

The LED will flash (~2Hz) when a minor alarm is detected; if the modules output capability has been reduced or a minor component failure is detected during the following conditions:

- VAC meter fail
- AC foldback
- Remote equalize
- Fan fail
- Low output voltage
- High output voltage
- Current limit (programmable option)
- Power limit (programmable option)
- High temperature foldback
- Temperature sense fail
- Soft start operation
- Communications lost.

The LED remains off in the absence of an alarm. If the unit output is not connected to a battery or parallel rectifier, the LED will extinguish if no AC power is present.

4.8.2 LED Activity During Rectifier Software Upload

When a rectifier software upload is in progress, the LEDs will behave in a distinctly different way to indicate new rectifier software is being transferred from the CXC.

When a rectifier data transfer is in progress, all three LEDs will flash in a sequence lasting 1.5 seconds. When the last LED is lit, the sequence is repeated beginning at the first LED.

4.8.3 LED Activity During Rectifier 'Locate Module' Command from Controller

When the 'locate module' command has been received from the CXC, the LEDs will behave in another distinct fashion so that the rectifier is easier to visually identify among adjacent rectifiers.

This state is entered when commanded via the CXC. The LEDs will flash in a ping-pong pattern repeating every 2 seconds.

The ping-pong pattern lights each LED sequentially. After the last LED is lit, each LED is lit in reverse sequence. When the first LED is lit, the pattern repeats. The effect makes it appear as if the light is bouncing between the first and last LED.

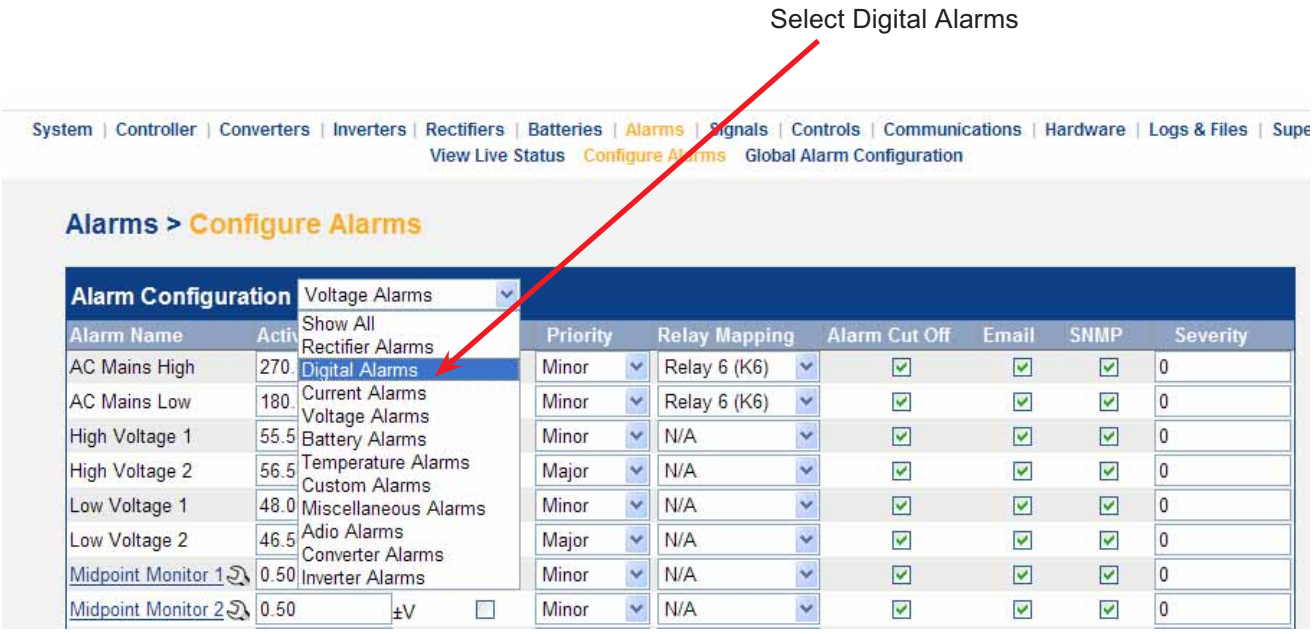
4.8.4 True Rectifier Module Fail Alarm

The power modules have a "true" fail alarm. This 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 current is detected. Output voltage ramping will cease upon detection of Current1. A minimum 2.5% load is required to avoid the Ramp Test Fail alarm; this can typically be provided with the parallel system battery. Activation of this alarm could indicate a failed module or a failed load.

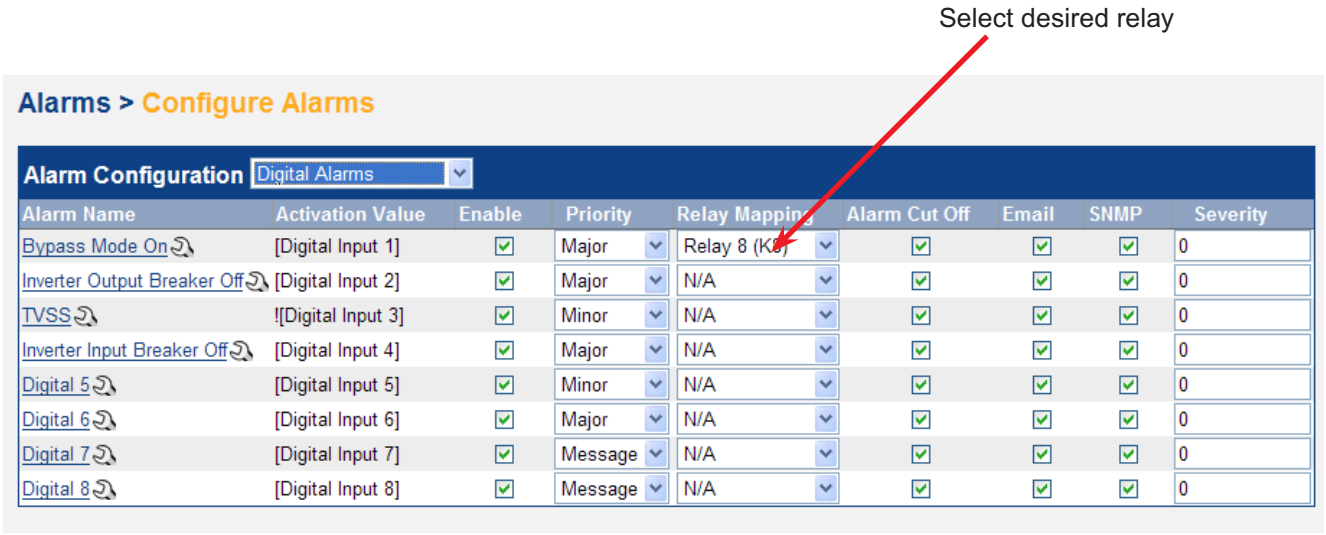
For Cordex rectifier systems without batteries (or with a very light load; below 2.5% of rated output) it is recommended that the ramp test be disabled to avoid nuisance alarms. The Ramp Test feature is enabled/disabled via the CXC menu item: Rectifiers, Configure Settings.

4.8.5 Mapping Alarms to Relays

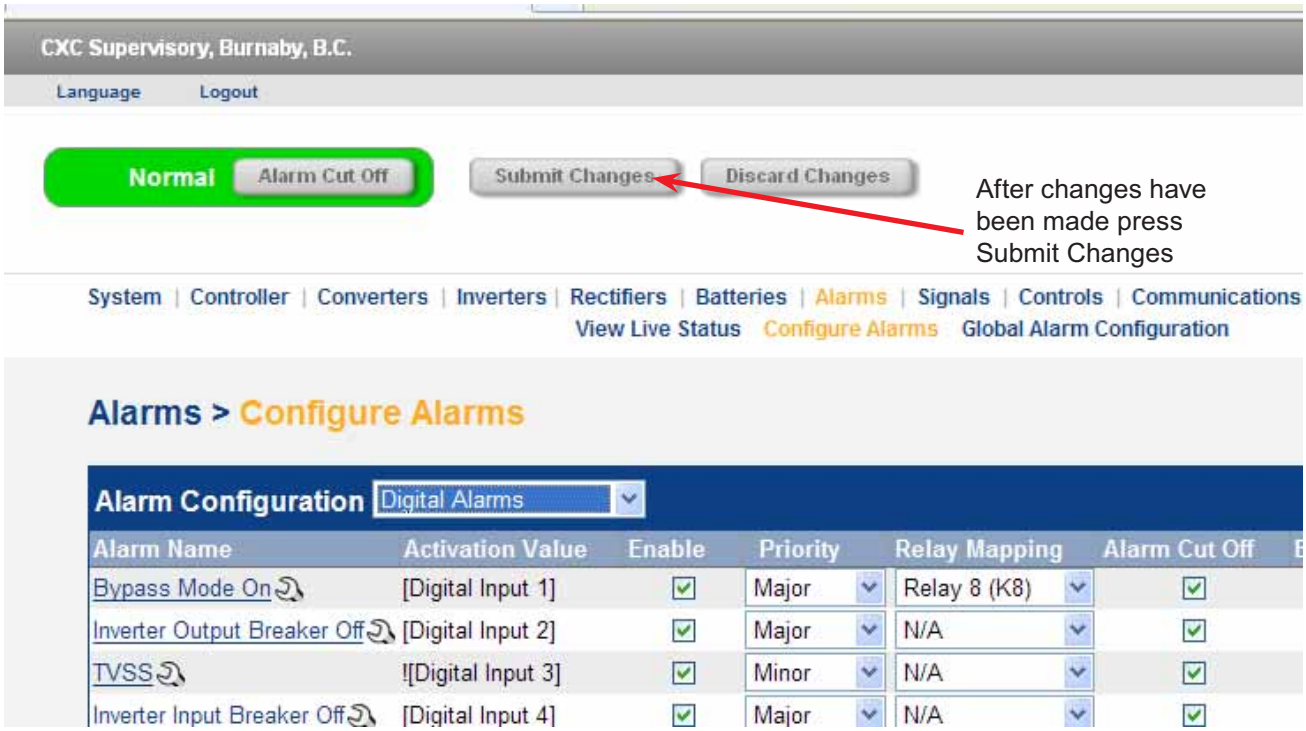
1. Connect a computer to the controller. Refer to the controller software manual. The 48 V DC power must be switched on before the controller can operate. Provide either DC power on the main DC1 or DC4 connections or switch on at least one rectifier.
2. Navigate to Alarms > Configure Alarms.
3. Select Digital Inputs.



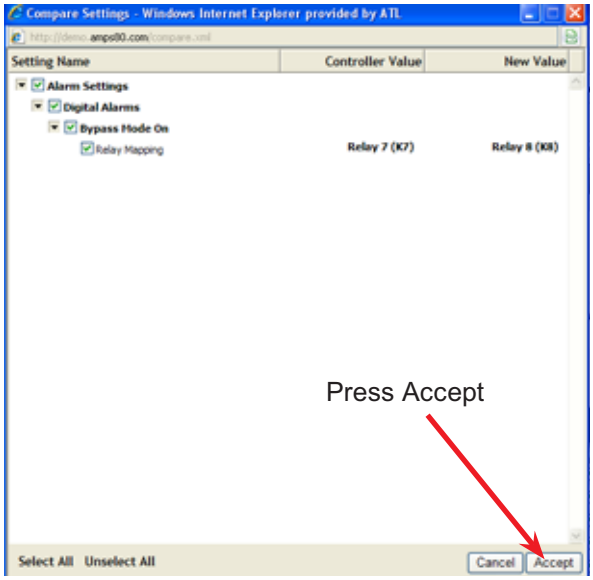
4. Select the desired relay. In this example K7 and K8 are available.



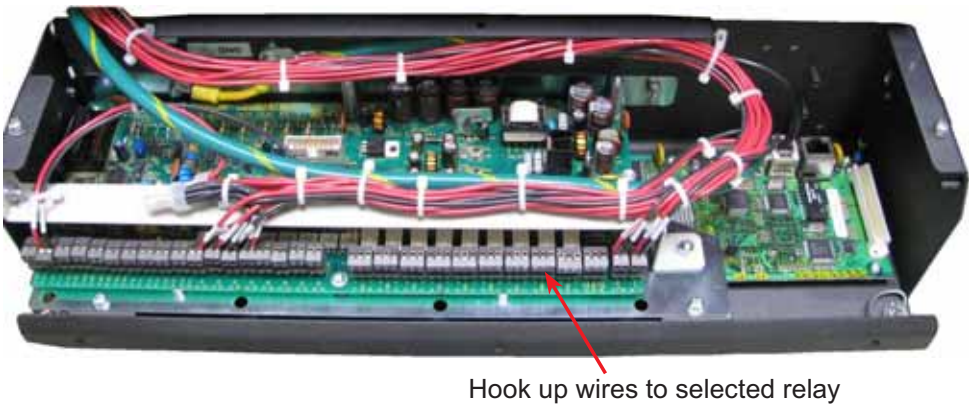
5. Submit changes after selection is made.



6. Accept changes.



7. Hook up control wires to the selected relay.



5. Tools Required

Required Tools	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	
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 Internet Explorer 8 or later	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	

6. Maintenance

6.1 Preventive 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..

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

6.2 Fan Replacement

1. Shut off the unit and unlock the power module.
2. Slide the module out of the shelf and wait two minutes for the module capacitors to discharge.
3. Disconnect the fan power wires from the module.
4. Note the direction of the airflow and remove the fan from the front panel.
5. Install the replacement fan following the preceding steps in reverse order.

6.3 Removing T2S Inverter Control Card

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..

Insert screwdriver
and lift up

6.4 Surge Suppression Replacement

1. Turn off the inverter input breaker.

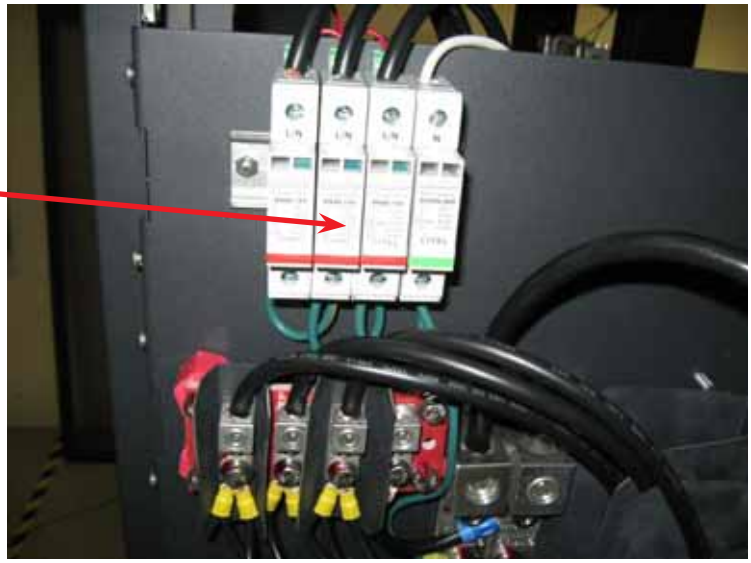
WARNING!

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

2. Remove the wiring access panel.
3. Pull out the surge suppression module.
4. Replace the module with one of the same type.

Replaceable parts	
Alpha part number	Description
162-600-19	Surge suppression replacement module, red stripe, Line-Ground, 40 kA rating
162-601-19	Surge suppression replacement module, green stripe, Neutral-Ground, 40 kA rating

Surge suppression
Red stripe = L-G
Green stripe = N-G



6.4.1 Service Entrance Grade Surge Suppression Replacement

Front and left side access may be required to properly service the service entrance grade TVSS located behind the CXCR control panel.

WARNING!

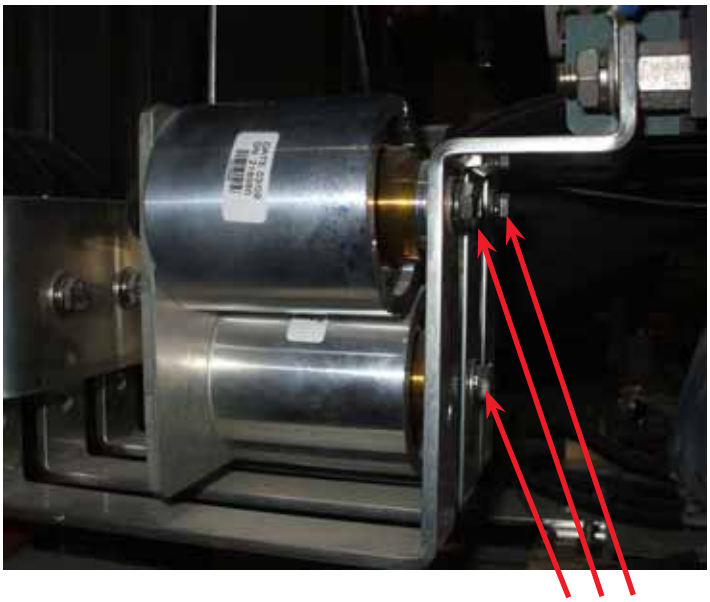
There may still be live parts inside the system and shock hazards may be present throughout this procedure.

Make sure the spare parts are available on site.

Replaceable parts	
Alpha part number	Description
741-021-31	AMPS80, TVSS 3-ph, 140kA rating per phase (TVSS option only)
741-021-21	AMPS80, TVSS 2-ph, 140kA rating per phase (TVSS option only)
741-021-41	AMPS80, TVSS 1-ph, 140kA rating (TVSS option only)

Side Access Replacement

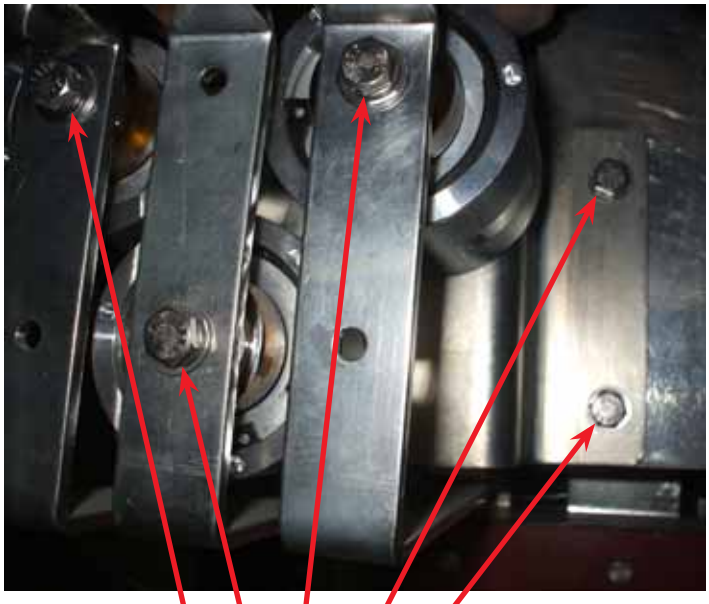
1. Turn off the inverter input breaker.
2. Remove the side access panel.
3. With the proper tools, reach in and remove the screws holding the surge suppression assembly.
4. Replace the module with an Alpha service entrance grade surge suppression assembly.



Bolts holding surge suppression assembly

Front Access Replacement

1. Turn off the inverter input breaker.
2. Remove the screw securing the CXCR unit.
3. Remove the 4 mounting screws that hold the CXCR to the chassis.
4. Pull the CXCR out and to the left. Do not remove any of the wires from the CXCR
5. Dangle CXCR unit gently.
6. With the proper tools, reach in and remove the bolts holding the surge suppression assembly.
7. Replace the module with an Alpha service entrance grade surge suppression assembly.



Bolts holding surge suppression assembly

6.5 Fuse Replacement

For hybrid systems equipped with rectifiers, there are two fuses located behind the rectifier shelves (see photo below). These fuses are sized to blow only if there is a wiring fault in the system. These fuses must only be replaced by a qualified service person.

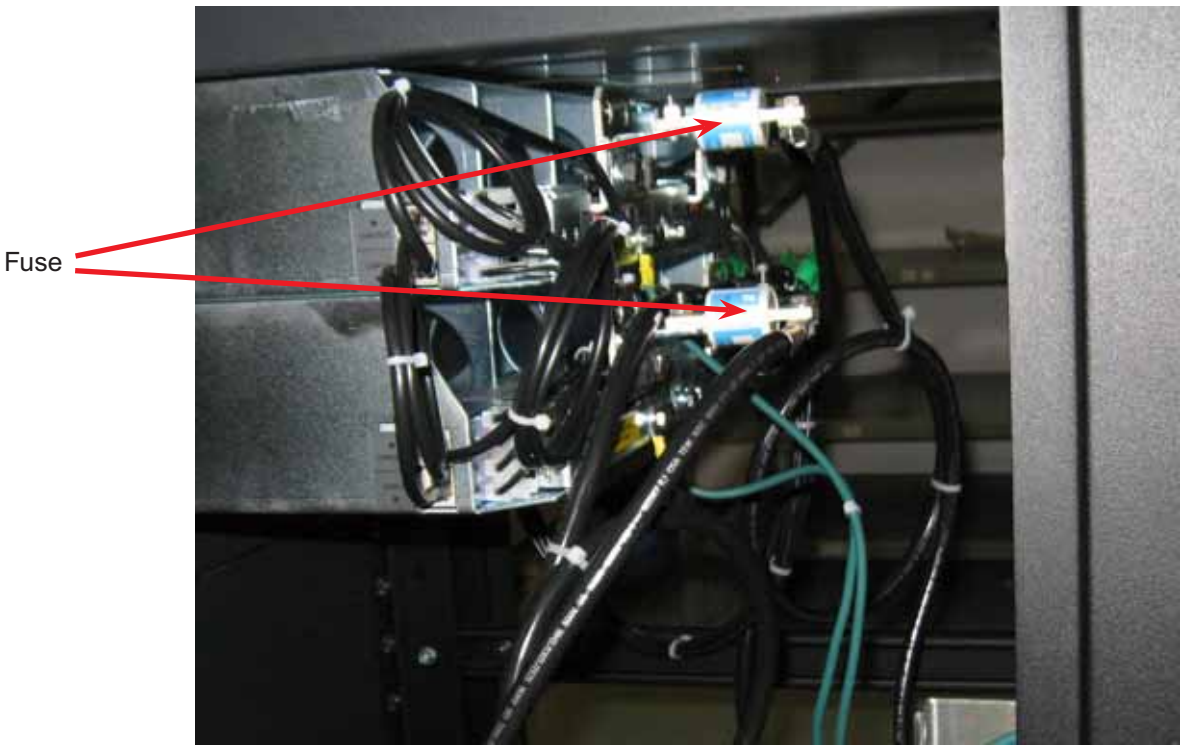
1. Turn the rectifier breakers off
2. Disconnect the battery feeds to the AMPS unit.

WARNING!

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

3. For a 75 kVA AMPS unit: Remove the Left Side panel. For any other system: Remove all the 2U blanking plates below the Rectifier shelves.
4. Remove the ¼-20 nut holding the fuse to the fuse holder/bracket (594-110-13). Use a 7/16 socket or wrench.
5. Remove the ¼-20 screw and ¼-20 nut holding the wire to the fuse. Use a 7/16 socket or wrench.
6. Replace the fuse with a fuse of the same rating and type:

Replaceable parts	
Alpha part number	Description
460-421-19	Fuse
162-601-19	Fuse



6.6 Synchronization After Maintenance or Repair

Implement the following sequence before switching the unit from bypass mode to inverter mode.

1. Switch on the inverter input breaker. Wait for the inverters to synchronize to the line, and for all status LEDs to turn green.
2. Switch on the inverter output breaker.
3. If present, switch the internal bypass switch to AMPS80 HP system. If present, switch the external bypass switch to AMPS80 HP system.

7. Troubleshooting

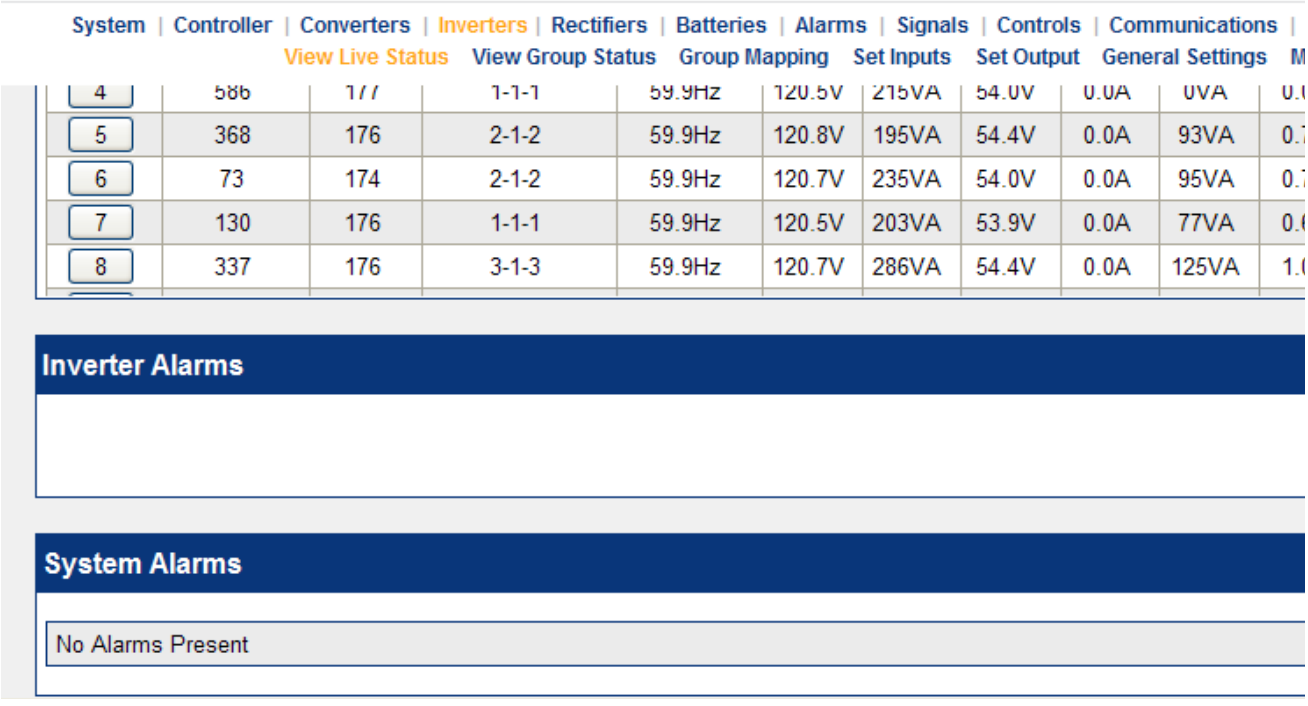
7.1 Non Recoverable Error

The status LEDs illuminate permanently red when a non recoverable error occurs. Thanks to its double input port, the AMPS80 HP inverter module will actually stop when either the output stage is non recoverable or when both input stages are faulty. Generally, a non-recoverable error cannot be erased and the module must be returned for repair.

7.2 Recoverable Error

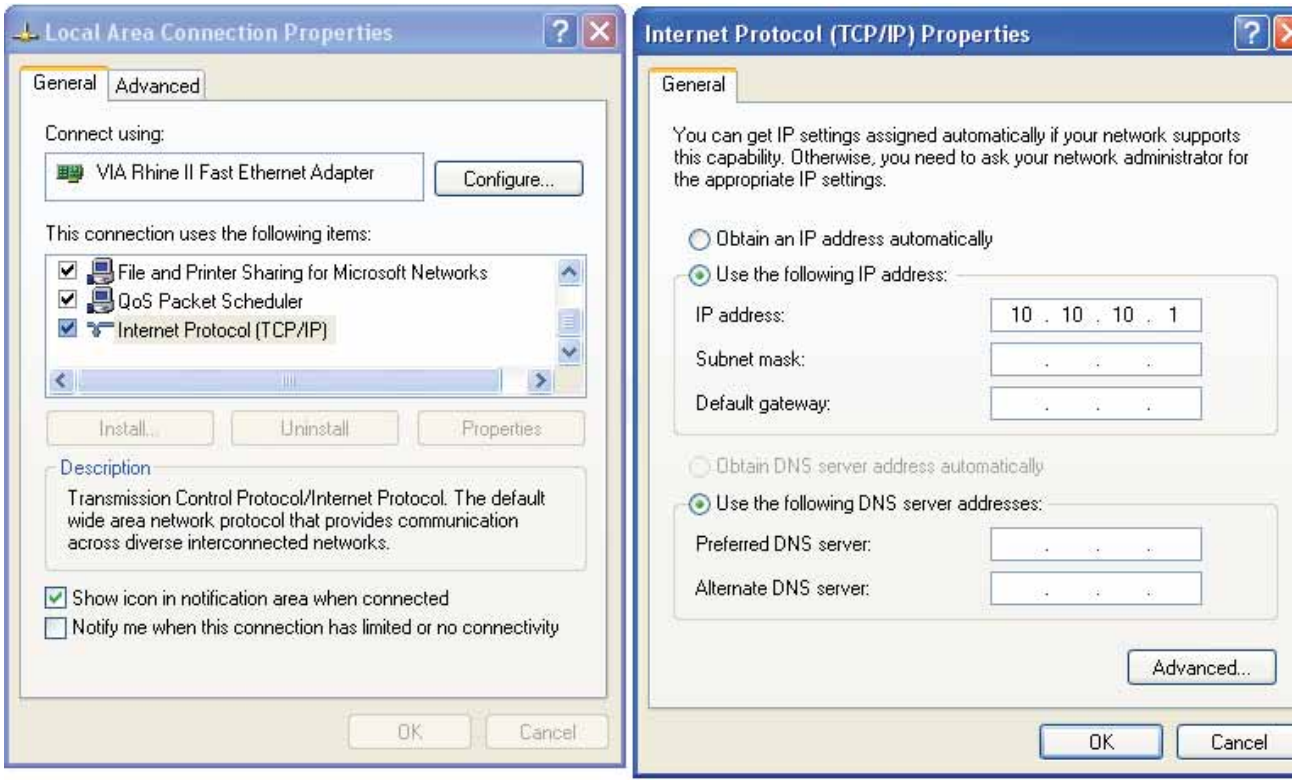
A recoverable error is a kind of protection that acts when, some parameters exit temporarily from their proper limit range. Stopping the module or removing it from its slot and plugging it back in may solve the problem.

For more detailed diagnostics, use the Ethernet port of the CXCR to view the alarm description. See Alarm descriptions below. The inverter alarms can be found in Inverters > View Live Status.

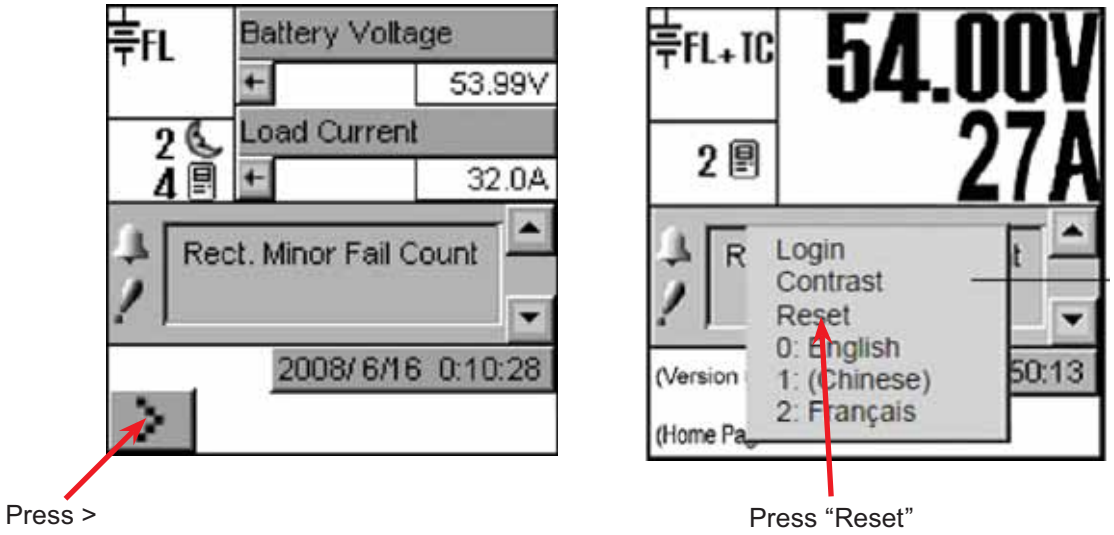


7.3 No Ethernet Communication

For a direct connection to the CXCR, verify that you are using a cross over cable, that your wireless connection is turned off, and that your local area network connection is set up as shown below.



Reset the CXCR by using the LCD touch screen as shown below:



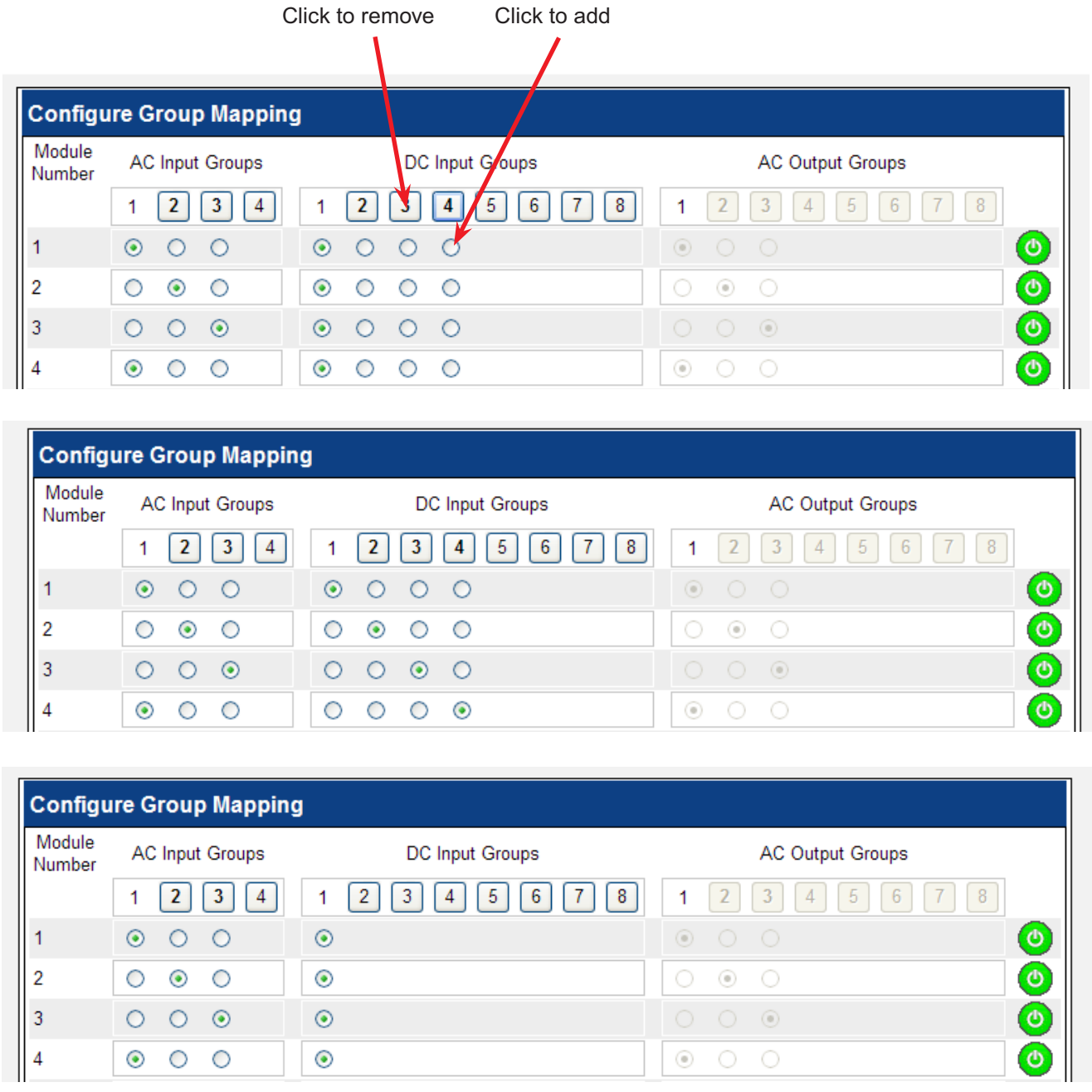
Press the "reset now" pop up when it appears. To reset the T2S, remove it from the system, then hook it back up.

7.4 System Saturated

The system saturated alarm defaults to 80% load on the non redundant inverters. To remove this alarm, add more inverters or reduce the amount of redundant units.

7.5 AC Secondary Source Lost

The AC Secondary alarm happens when the DC is removed from the system and when settings in the group mapping screen are incorrect.



7.6 AC Out Not Synchronized

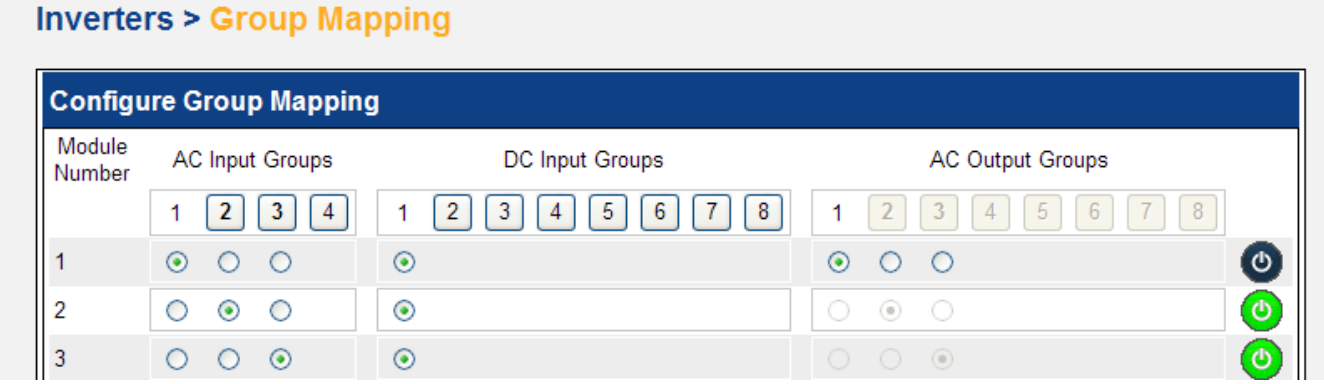
AC out not synchronized alarm happens when the input phase or frequency does not match the output phase or frequency when AC input is present.

7.7 AC Mains Lost

The AC mains lost happens when the AC input does not meet the correct voltage, phase, or frequency. When the AC main is lost the UPS goes into inverter mode. This alarm sometimes is accompanied by other alarms.

7.8 Manual Off

The Manual off alarm happens when one or more inverters have been turned off in the group mapping screen.



7.9 Overload Current

The overload current alarm is an alarm that is triggered when the UPS provides more than 100% current.

7.10 Overload Too Long

The Overload too long alarm is an alarm that happens when the UPS provides overload current up to its maximum period of time and shuts the inverter down to avoid damage.

7.11 Phase Not Ready

Phase not ready alarm happens when the inverter thinks it should be in a certain phase and the input to it is another phase. This can be correct either by changing the input wiring to the AMPS80 HP or by changing the phase in the group mapping settings screen.

8. System Specifications

Model	AMPS80-3-75	AMPS80-3-30	AMPS80-2-40	AMPS80-2-20
Input & Output Phase	120/208 V 3-ph	120/208 V 3-ph	120/240 V or 120/208 V 2-pole	120/240 V or 120/208 V 2-pole
Nominal Output Power (max)	7,500 to 75,000 VA	7,500 to 30,000 VA	5,000 to 40,000 VA	5,000 to 20,000 VA
Output Power (resistive load)	6,000 to 60,000 W	6,000 to 24,000 W	4,000 to 32,000 W	4,000 to 16,000 W
Maximum Output Current	208 Arms / phase	83 Arms / phase	167 Arms / phase	83 Arms / phase
Max. no. of 2,500 VA/2,000 W inverter modules	30	12	16	8
Min. no. of 2,500 VA/2,000 W inverter modules	3	3	2	2
Technology	Twin Sine Inverter (TSI); each module has DC input & AC input			
Static Switch	Not required; each module has own static switch			
Efficiency	94% AC-to-AC; 90% DC-to-AC (from 50% to 100% full load resistive)			
Waveform	Pure sine wave			
Output Power Factor	0.8			
Transfer time	0 ms			
Warranty	2 years			

Inverter Module AC Output	
Nominal Voltage (AC)	120 V
Voltage Accuracy	± 2%
Frequency	60 Hz, Same as input frequency
Inverter frequency accuracy	0.03%
THD (resistive load)	<1.5%
Transient load recovery time	0.4 ms
Soft start time	20 s
Max. crest factor at nominal power	3.5
Short circuit overload capacity	10 x In for 20 msec in EPC mode (AC input)
Short term overload capacity	150% for 5 seconds
Permanent overload capacity	110%

Inverter Module AC Input	
Nominal Voltage (AC)	120 V
Voltage Range	90-140 (user adjustable)
Input Power Factor	>99%
Frequency	60 Hz
Synchronization Range	57-63 Hz

Inverter Module DC Input	
Nominal Voltage	48 Vdc
Voltage Range (max)	40-60 Vdc (user adjustable)
Max DC input current @ 48 Vdc	1400 A / 560 A / 750 A / 375 A
Max DC input current @ 40 Vdc	1700 A / 680 A / 900 A / 450 A
Voltage Ripple	<2 mV / <38 dbrnc

Unified System Controller with SNMP	
Control & Monitoring	Configure, control and monitor Inverter & Rectifier modules via Internet Explorer 7 and onwards
Display	LCD Touchscreen display (160 x 160 pixels) OK / Major / Minor 3-color LED display Web-based GUI via Ethernet
Communication Ports	RJ45 Ethernet Port RS232 Craft Port RS232 Modem Port (optional)
Controller I/O	
Voltage Inputs	2
Temperature Inputs	2
Current Inputs	4
Bivoltage Inputs	2
Digital Inputs	8
Relay Outputs	8

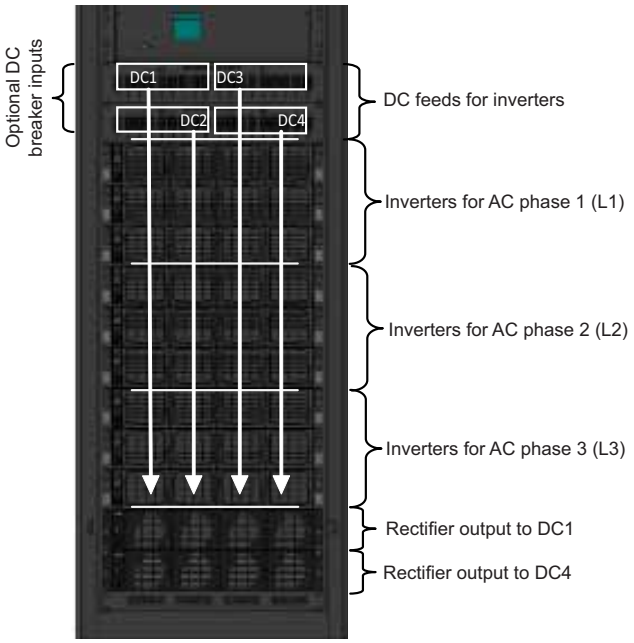
Environmental Specifications	
Operating Temperature (full load)	-20° to 40°C (-4° to 104°F)
Storage Temperature	-40° to 70°C (-40° to 158°F)
Relative Humidity	Up to 95%, non-condensing
Operating Altitude	Up to 1,500 m (4,900 ft) above sea level
Thermal Dissipation Per Module	437 BTU/hr in AC-to-AC mode & 758 BTU/hr in DC-to-AC mode

Mechanical Specifications	
System Dimensions D x W x H (mm/in)	680 mm x 600 mm x 2134 mm (26.75" x 23.6" x 84")
System Weight -- without modules (kg/lb)	270 kg/595 lb
Total Weight with modules (kg/lb)	420 kg/925 lb
Inverter Module Dimensions D x W x H (mm/in)	435 mm x 102 mm x 88.9 mm (17.13" x 4" x 3.5")
Inverter Module Weight (kg/lb)	5 kg / 11 lb

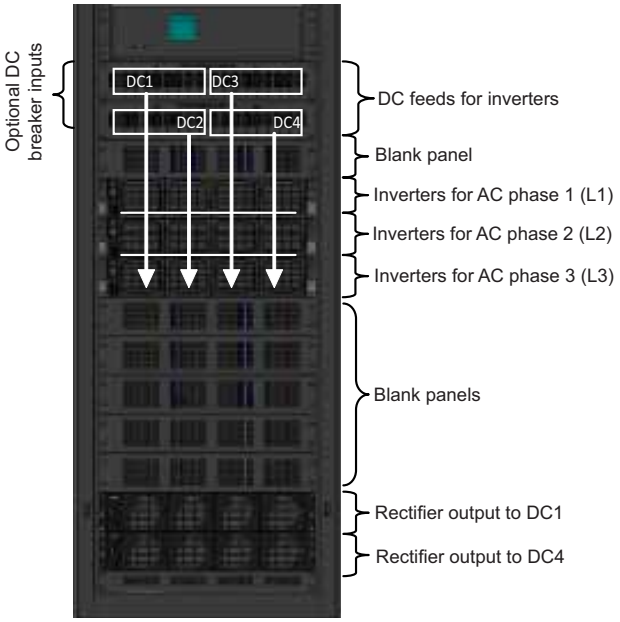
Agency Compliance	
CSA UL	C22.2 107.3-05 UL1778; Issue 4 (shelves and modules)

8.1 Module Location Relative to System Wiring

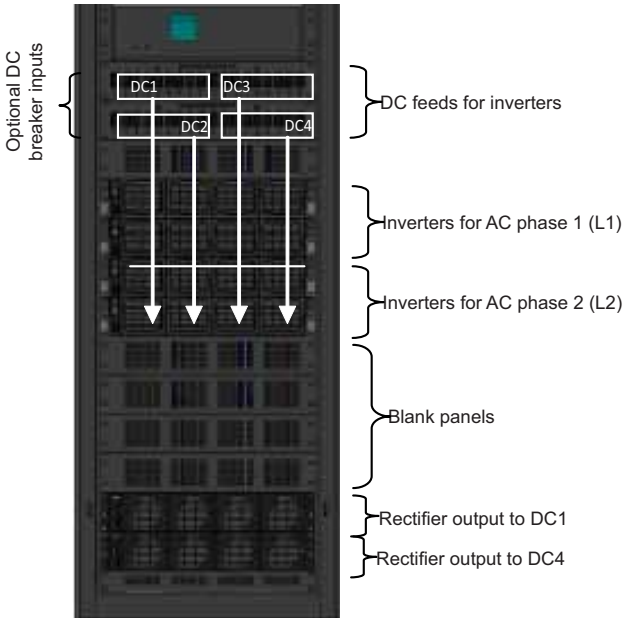
75 kVA, 3-phase systems.



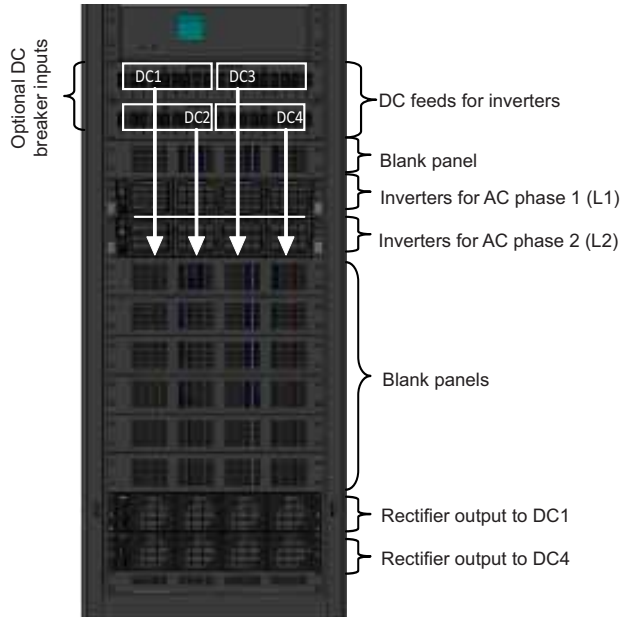
30 kVA, 3-phase systems



40 kVA, split-phase systems



20 kVA, split-phase systems



8.2 Specifications for 48/120 Inverter Module

General specifications:	
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	240000 hrs
Efficiency (typical)	
Enhanced Power Conversion	94%
On Line	89%
AC Output Power	
Nominal	2500 VA
Resistive Load	2000 W
Overload Capacity (short)	150% @ 5 s
Overload Capacity (permanent)	110%
Nominal	48 V
Range (V dc)	40 to 60 V
Nominal Current (@40 Vdc)	56 A
Max input current (5 s)	84 A
Voltage Ripple	2 mV
AC Input Specifications	
Nominal voltage (AC)	120 Vac
Voltage range (AC)	90 to 140 Vac (adjustable)
Power factor	> 99%
Frequency range (selectable)	60 Hz
Frequency Tolerance	± 3 Hz (Adjustable)
AC Output	
Nominal (AC)*	120 Vac Accuracy 2%
Frequency	60 Hz (Same as input frequency in EPC mode)
Frequency accuracy	0.03%
Transient load recovery time	0.4 ms
Transfer Performance	
Maximum Voltage interruption	0 s
Total Transient voltage duration	0 s
Environmental	
Operating Temperature:	-20 to +40°C
Storage Temperature:	-40 to +70°C
Humidity:	Up to 95% non-condensing
Elevation:	<1500M
Miscellaneous	
Dimensions:	2 RU H x 102 mm W x 435 mm D
Weight:	5 kg (11 lb.)

8.3 Specifications for 48-1.8 kW Rectifier

Rectifier Module Input Voltage, Output Current, Power			
AC Input Voltage	Rectifier shelves	Max # of Rectifier Modules	Max DC output VA Current (Adc)
120	2	8	192 Adc
120/240 Vac	2	8	300 Adc

Power Module Output	
Voltage	42 to 60 Vdc within rated limits
Current	37.5 A maximum @ 48 Vdc (nominal input)
	~24 A @ 48 Vdc (115 Vac input)
Power	1800 W maximum @ nominal input
	~1150 W @ 115 Vac input (de-rated linearly to 900 W @ 90 Vac)
Static Load Regulation	Better than ±0.5% for any load change within rated limits
Dynamic Load Regulation	Better than ±2% for 40% – 90% – 40% (50% load step) [output shall recover to static limits within 10 ms]
Static Line Regulation	Better than ±0.1% for any change in input voltage within rated limits
Dynamic Line Regulation	Better than ±1% for any change in input voltage within rated limits (output voltage shall recover to static limits within 2 ms)
Hold-up Time:	>10 ms
Time Stability:	=0.2% per year
Temperature Stability:	<170 ppm/°C over the operating range
Heat Dissipation:	<607 BTU per hour (per rectifier module)
Electrical Noise:	<32 dBrnC (voice band)
	<30 mVrms 10 kHz to 10 MHz (wideband)
	<150 mVp-p 10 kHz to 100 MHz
	<1 mV (psophometric)
Acoustic Noise:	<60 dBa @ 1 m (3 ft.) @ 30°C (86°F)
EMI:	FCC Part 15, Class B:

9. Spare Parts

Recommended spare parts	
Part number	**Description**
014-201-20	AIM2500 inverter module, 2.5 kVA, 2.0 kW
741-032-21	Inverter blanking module
571-005-10	Inverter black plastic front assembly
740-0026	Inverter fan
018-570-20-051	Cordex CXCR controller
018-045-20	T2S inverter controller card, black
162-600-19	Surge suppression replacement module, red stripe, Line-Ground, 40 kA rating
162-601-19	Surge suppression replacement module, green stripe, Neutral-Ground, 40 kA rating
613-707-W3	Rectifier blanking plate
010-580-20-40	Cordex 1.8 kW rectifier module (hybrid option only)
460-421-19	Fuse, 200 A, in-line (hybrid option only)
747-272-20	Rectifier fan (hybrid option only)
741-021-31	AMPS80, TVSS 3-ph, 140 kA rating per phase (TVSS option only)
741-021-21	AMPS80, TVSS 2-ph, 140 kA rating per phase (TVSS option only)
741-021-41	AMPS80, TVSS 1-ph, 140 kA rating (TVSS option only)

10. 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.

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

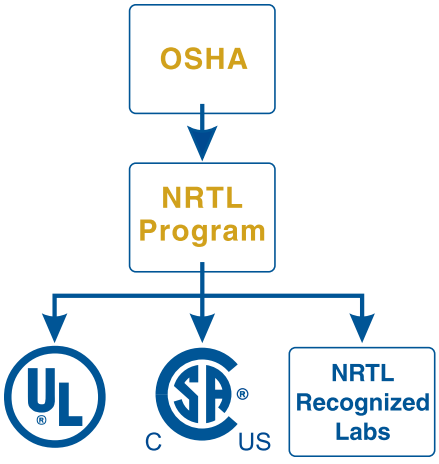
NRTLs are third party organizations recognized by OSHA, US Department of Labor, under the NRTL program.

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.



11. Warranty

Alpha Technologies Limited (ATL) warrants its products to be free from defects in material and workmanship for a period of two (2) years from the date of purchase. ATL obligation under this warranty is limited to the repair or replacement, at its sole discretion, at the ATL factory or ATL Authorized Service Center, of any defective product. This warranty does not cover any failure of the unit caused in whole or in part by any cause or causes external to the unit. Repair or replacement does not extend the original warranty period. Parts furnished under this warranty may be new or factory-remanufactured.

Registration

This warranty is only available to the original end user of the product. Registering the product will automatically increase the length of the original warranty by 3 months at no additional cost. Please register your product online at www.alpha.com/productregistration.

Extended Warranty

Registered purchasers may extend the warranty period for up to 3 additional years at any time during the original warranty period at the then prevailing rate of ATL for such warranty extension. Registered purchasers may be eligible to purchase other units, accessories, parts or services at discounted rates, including battery upgrade or replacement, during the coverage period. Please contact us at 1-888-462-7487 to discuss your service needs.

Limitation of Liability

This warranty is the purchaser's sole remedy and is expressly in lieu of any other warranty, expressed or implied, including any implied warranty of merchantability or fitness for purpose.

In no event shall ATL be liable for any indirect, incidental, special or consequential damages. In no case will the liability of ATL under this warranty exceed the value of the unit provided.

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