

Cordex HP 48-12kW/480 Modular Switched Mode Three-Phase Rectifier

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Cordex HP 48-12kW/480


Modular Switched Mode Three-Phase Rectifier

 **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.

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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.

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



WARNING!

This system is designed to be installed in a restricted access location that is inaccessible to the general public.

1.3 Mechanical Safety

- Keep hands and tools clear of fans. Fans are thermostatically controlled and switch on automatically.
- Power supplies can reach extreme temperatures under load.
- Use caution around sheet metal components and sharp edges.

1.4 Electrical Safety

WARNING!

Hazardous voltages are present at the input of power systems. The DC output from rectifiers and batteries, though not dangerous in voltage, has a high short-circuit current capacity that may cause severe burns and electrical arcing.

- Before working with any live battery or power system, follow these precautions:
 - a. Remove all metallic jewelry, such as watches, rings, metal rimmed glasses, or necklaces.
 - b. Wear safety glasses with side shields at all times during the installation.
 - c. Use OSHA approved insulated hand tools.

WARNING!

Lethal voltages are present within the power system. Always assume that an electrical connection or conductor is energized. Check the circuit with a voltmeter with respect to the grounded portion of the enclosure (both AC and DC) before performing any installation or removal procedure.

- Do not work alone under hazardous conditions.
- A licensed electrician is required to install permanently wired equipment. Input voltages can range up to 480Vac. Ensure that the utility power is disconnected and locked out before performing any installation or removal procedure.
- Ensure that no liquids or wet clothes come into contact with internal components.
- Hazardous electrically live parts inside this unit are energized from the batteries even when the AC input power is disconnected.

1.5 Battery Safety

- Servicing and connection of batteries must be performed by, or under the direct supervision of, personnel knowledgeable of batteries and the required safety precautions.
- Always wear eye protection, rubber gloves, and a protective vest when working near batteries. Remove all metallic objects from your hands and neck.
- Use OSHA approved insulated hand tools. Do not rest tools on top of batteries.
- Batteries contain or emit chemicals known to cause cancer and birth defects or other reproductive harm. Battery post terminals and related accessories contain lead and lead compounds. Wash your hands after handling batteries.

WARNING!

Follow battery manufacturer's safety recommendations when working around battery systems. Do not smoke or introduce an open flame when batteries (especially vented batteries) are charging. When charging, batteries vent hydrogen gas, which can explode.

- Batteries are hazardous to the environment and should be disposed at a recycling facility. Consult the battery manufacturer for recommended local authorized recyclers.

2. Introduction

2.1 Scope of the Manual

This instruction manual explains the installation, interconnection, and operation of the Alpha Cordex HP 48-12kW/480 modular switched mode rectifier systems.

2.2 Product Overview

Cordex High-Performance rectifiers make a proven, reliable platform even better, with significant advancements in efficiency and performance. In a compact, fan-cooled design, Alpha's HP rectifiers open the possibility for immediate OPEX/CAPEX savings, reducing total cost of ownership and impact on the environment, and are usable under a wider range of applications.

The Cordex HP 48-12kW/480 is a perfect solution for various 48Vdc high capacity applications including Central Office, MTSOs and Data Centers.

Cordex HP 48-12kW/480 is a true three-phase, three wire, 480 VAC input rectifier which meets the critical requirements of current high density telecommunications environments. It combines the latest DSP controlled power conversion technology, to provide a flexible, efficient, and very highly reliable DC power source.

Local and remote setup, adjustment and control is a simple single-step process with CXC HP controllers. By utilizing TCP/IP technology, complete configuration and monitoring of power equipment is possible through a network web browser.

The CXC HP controller allows the user to configure, monitor and control the entire DC power system from its touch screen display including temperature compensation, auto equalization, remote access, dial out on alarm, battery diagnostics, as well as Web server and SNMP support for configuration and monitoring. Details of CXC HP controller operation are provided in the current version software manual.



Figure 1 — Cordex 48-12kW/480

2.3 Part Numbers and List Options

The product, options, and accessories can be ordered by using the part numbers in the following table.

Description	List Option
Cordex 48-12kW rectifier power module	0100020-001
Fan, spare for Cordex 48-12kW/480	5000064
MOV replacement assembly	7050308-001
Cordex 48-12kW/480V, 3 phase 23" shelf, flush or mid-mounting	0300167-XXX
Module blank	5900550-002

3. Specifications

Table A — 12kW Rectifier Specifications

Electrical	
Input voltage (3ϕ-3W + PE):	
Nominal:	480Vac
Operating:	375 to 530Vac
Extended:	375 to 430Vac (de-rated power)
	Note: Neutral is not required at rectifier or shelf
Maximum Input Voltage Phase Imbalance:	10%
Input Frequency:	47 to 63Hz
Input Current:	
Nominal:	15A
Max:	17A
Input Inrush Current (per ϕ at 480Vac, 25°C, excluding X-capacitor charging):	<17Apk
Input Leakage Current (per ϕ at 480Vac 60Hz):	<6mA
Power Factor (50%-100% load):	>0.96
THD (50-100% load):	<5%
Efficiency:	94.4% peak
Holdup Time:	>5ms
Output Voltage:	42 to 58Vdc
Maximum Output Current:	220A
Maximum Power:	
at 54.54V output:	12000W
at 48V output:	10560W
Static Load Regulation (under control of CXC HP controller):	<0.5%
Dynamic Load Regulation (40-90% load step, output shall recover to static limits within 30ms):	<4%
Static Line Regulation (under control of CXC HP controller):	<0.1%
Time Stability (per year, under control of CXC HP controller):	< 0.5%
Electrical Noise:	
Voice band:	<42dBrnC
Wide band:	<20mV RMS (10kHz to 10MHz)
	<150mV peak to peak (10kHz to 100MHz)
Psophometric noise:	<4mV RMS
Acoustic noise:	<65dBa

Mechanical	
Dimensions H x W x D:	160mm x 261mm x 326mm (6.25in x 10.3in x 11.8in) 175mm x 261mm x 364mm (7in x 10.3in x 14.38in) including front panel and handle
Weight:	12.8kg (28.2lbs)
Environmental	
Temperature:	
Operation:	-10 to 65°C (14 to 149°F); (see Figure 2 on page 11)
Full Nominal Output Power:	0 to 40°C
Storage:	-40 to 70°C (-40 to 158°F)
Humidity:	0 to 90% RH non-condensing
Heat Dissipation:	<2800 BTU per hour
Elevation:	-100m to 2000m (-330ft to 6500ft)

3.3.1 Cordex 48-12kW Rectifier Shelves

23in 4RU universal mount 24,000W shelf P/N 0300167-001	
Number of Rectifiers:	2 x CXRF HP 48-12kW
Nominal AC input current (one module per feed):	15Arms @ 480Vac 2 feeds per shelf
Recommended input feeder breakers:	30A per feed or 50A per shelf
Recommended AC input wire size:	12AWG (RW90) minimum
Shelf output power:	24kW maximum
Distribution:	Bulk power for external distribution
Dimensions, H x W x D:	177mm x 530mm x 388mm (7in x 21.1in x 15.3in)
Weight:	11.3kg (25lbs)
Communications ports:	CAN: interface to control rectifiers and smart peripherals Shelf ID RJ12 connection
Compliance	
Safety:	CSA 60950-1-07 UL 60950-1
EMC:	
Emissions:	CFR47 (FCC) Part 15 Class A EN 55022 (CISPR 22) Class A
Immunity:	EN 61000-4-2 EN 61000-4-3 EN 61000-4-4 EN 61000-4-5 EN 61000-4-6
NEBS:	GR-1089-Core GR-63

3.1 Power Derating vs Ambient Temperature

For ongoing reliability of the rectifier, the output power is reduced when the ambient temperature is very high or very low, see Figure 2.

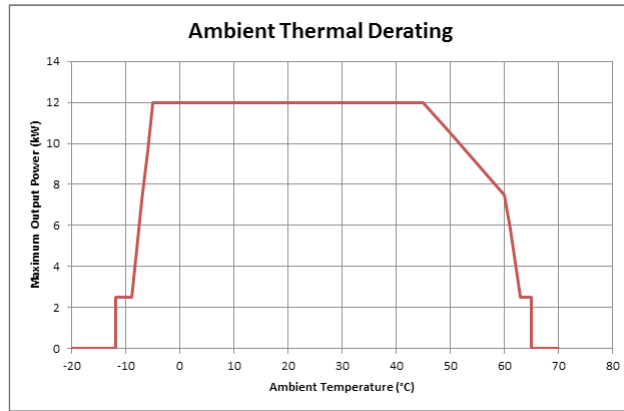


Figure 2 — Power Derating vs Ambient Temperature

3.2 Power Derating vs Input Voltage

The output power is reduced when the input voltage drops below 430Vac, see Figure 3.

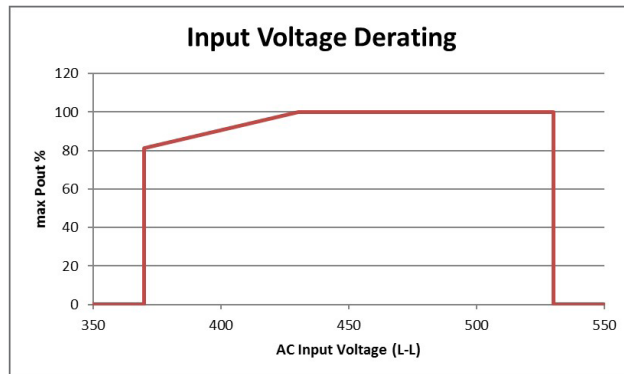


Figure 3 — Power Derating vs Input Voltage

4. Rectifier Features

4.1 Front Panel LEDs

The front panel LEDs indicate:

- Rectifier status summary
- Rectifier software upgrade in progress
- Patterned response to Locate Module command

The rectifier status summary shows the rectifier alarm status, communication fail status, and rectifier on/off status.

AC ON (1)

The green LED is illuminated when the AC input voltage is within its allowable range.

DC ON (2)

The green LED is illuminated when the rectifier is providing DC output voltage.



Figure 4 — 12kW Rectifier Front Panel LEDs

ALARM / FAULT (3)

The red LED is illuminated when a major alarm is detected and the module is unable to source power because of any of the following conditions:

AC Line Frequency High	Output Fuse Open
AC Line Frequency Low	Output Over Current Protection (OCP)
AC Line Over Current Protection	Output Over Voltage Protection (OVP)
AC Line Voltage Fail	Output Ramp Test Fail
Fan Failure Shutdown	PFC Failure
Internal Communication Lost	Thermal Shutdown
Module Insertion Fail	

The LED flashes (~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:

- AC Line Voltage Low
- Calibration Data Corrupted
- Output Current Limit
- Output Power Limit
- Temperature Foldback

The LED remains extinguished in the absence of an alarm.

LED Activity During Software Upload

When a rectifier software upload is in progress, the LEDs are turned off.

LED Activity During the 'Locate Module' Command from CXC HP

The 'Locate Module' command from the CXC HP, causes the target rectifier LEDs to flash in a ping-pong pattern that repeats every 2 seconds. Each LED illuminates sequentially and after the last LED illuminates, the sequence is reversed. When the first LED is illuminated, the pattern repeats. This effect makes it appear that the light bounces between the first and last LED.

Mechanical

Two thumbscrews are provided to secure the rectifier into the shelf. During normal operation, the rectifier must be locked into position. A handle or grip on the front panel helps to remove the rectifier from the shelf. No special tools are required.

4.2 Rectifier Rear Panel

The 12kW rectifier has three connectors for shelf power and communications on the rear panel. These three connectors align with corresponding connectors in the shelf when the rectifier is installed.

4.3 True Module Fail Alarm

The power modules have a “true” fail alarm that provides a true indication of the power module's ability to source current. When the module's output current drops below 2.5% of the rated output, a low output current condition is detected and the Module Fail detection circuit is activated. This circuit momentarily ramps up the output voltage to determine if the module will source current. If no increase in current is detected, the Module Fail alarm is activated. The module will test once every 60 seconds for the condition until a current is detected. The output voltage ramping ceases upon detection of current. A minimum 2.5% load is required to avoid the Ramp Test Fail alarm. This can 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 the rated output, the ramp test should be disabled to avoid nuisance alarms.

4.4 Heat Dissipation

Each rectifier module is equipped with two front-mounted variable speed fans. The air flow is front-to-rear with the exhaust air exiting at the back. The fan speed is determined by the heatsink temperature and the load.

4.5 Over Temperature Protection

Component failure or a cooling airflow blockage can result in an excessive increase in temperature. During over-temperature conditions, the rectifier limits the output power and the output current. If the temperature continues to increase, the rectifier is shutdown. The rectifier restarts automatically when the temperature returns to a safe level.

4.6 AC Inrush/Transient Suppression

To prevent a surge on the AC line, the inrush current of a rectifier module is limited to the full load steady state line current. Modules are also protected from input lightning and transient surges.

4.7 Soft Start

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

4.8 Start Delay

The rectifier modules are equipped with a delay timer to stagger-start a series of modules to prevent excessive loading of generators upon start up. The built-in timer delays the switching on of the module by an interval (up to 120 seconds), which is set in the CXC HP. A minimum one-second delay is preset to allow the input capacitors to charge.

4.9 Current Limit/Short Circuit Protection

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

The rectifier will sustain a short circuit at the output terminals indefinitely. The maximum short circuit current will not exceed 105% of the rated full load current.

4.10 Power Limiting

Each rectifier module is designed to limit the power output to the module specification.



NOTE:

The current limiting feature overrides the power-limiting feature.

4.11 Over Voltage Protection (OVP)

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

5. Cordex HP Controller (CXC HP)

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

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

The CXC HP supports to dual CAN ports to allow up to 256 power and/or ADIO modules to be controlled and monitored. The controller uses external analog and digital input and output (ADIO) peripherals to monitor electrical signals (temperature, voltage, temperature) and generate electrical signals through relays.

The most commonly used ADIO peripheral is the L-ADIO for low voltage systems which includes:

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

5.1 Controller Features

The CXC HP has the following features:

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

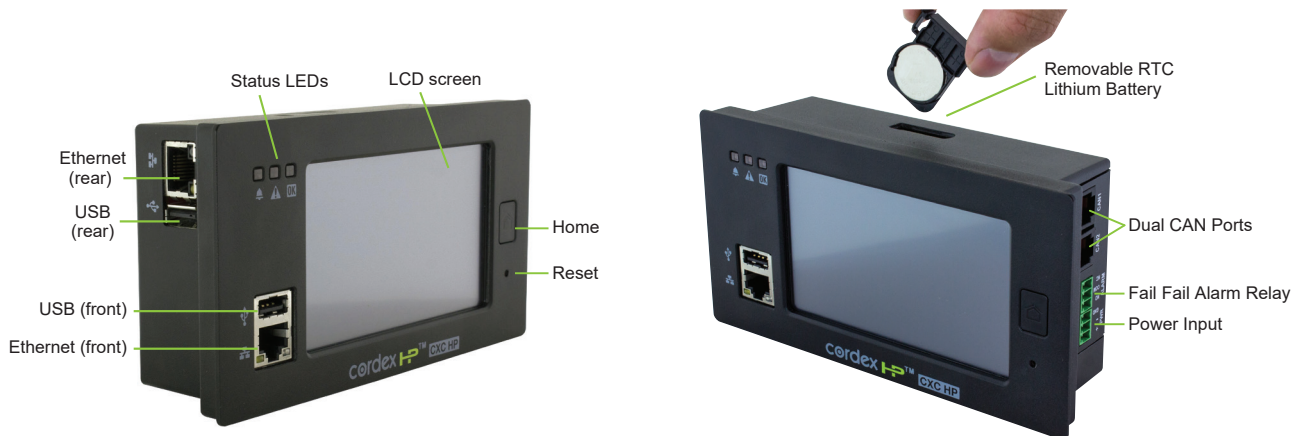


Figure 5 — Cordex CXC HP Controller

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

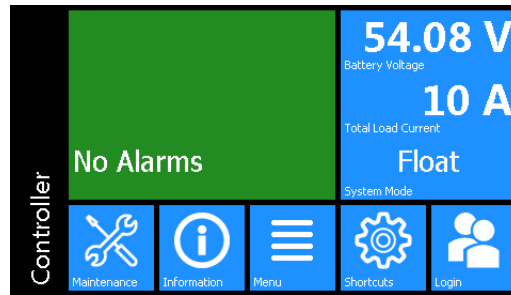


Figure 6 — LCD Color Touchscreen Display

5.2 External Peripherals

5.2.1 L-ADIO

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

Analog Inputs



Figure 7 — L-ADIO I/O Peripheral

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

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

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

Digital Inputs

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

Alarm and Control Output Relays

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

LED Indication

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

LVD – Yellow = LVD Override Engaged

Power – Blue = Power present to device

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

Front Panel Reset Button

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

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

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

LVD Override

An LVD Override button is provided to keep any relays assigned to LVD function in a static state. The override function should be used whenever performing controller maintenance such as test relay functions, or when replacing a CXC HP controller.

To engage the LVD override function, press and hold the button for three seconds. A yellow indicator LED will signal that the override is engaged. To restore back to normal LVD operation, press and hold the LVD button again for three seconds.

5.2.2 Shelf/Bay ID

The CXC HP Shelf/Bay ID peripheral enables users to identify individual 12kW/480 (3-phase) rectifier modules by their specific bay and shelf location within the system. This peripheral is an independent module which broadcasts information directly to the rectifier modules. 12kW/480 rectifiers can then communicate the specific bay, shelf, and slot identification back to the master CXC HP controller. The controller’s LCD screen and web interface provide details on the physical location via each module within the system.

The Shelf/Bay ID peripheral only requires the user to manually select the Bay ID from the front panel. Shelf location is determined by factory installed internal system wiring, and the 12kW/480 rectifiers determine their slot position automatically within a shelf.

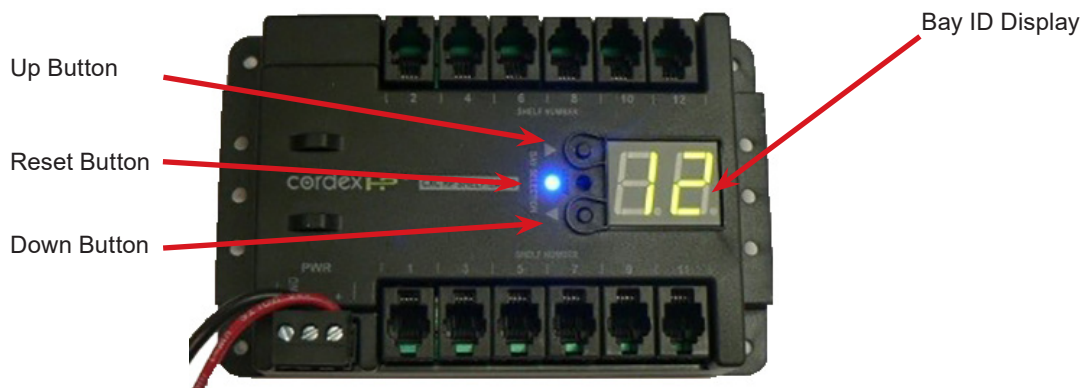









Figure 8 — Shelf/Bay ID

6. Inspection

6.1 Packing Materials

Alpha is committed to providing products and services that meet our customers' needs and expectations in a sustainable manner, while complying with all relevant regulatory requirements. As such Alpha strives to follow our quality and environmental objectives from product supply and development through to the packaging for our products. Packaging assemblies and methods are tested to International Safe Transit Association standards. Rectifiers and batteries are shipped on individual pallets and are packaged according to the manufacturer's guidelines.

Almost all of Alpha's packaging material is from sustainable resources and or is recyclable. See the following table for the material and its environmental codes.

 20 PAP/PCB	 01 PET	 04 PE-LD	 06 PS	 40 FE	 41 ALU	 50 NW
Cardboard	Polyethylene Terephthalate	Low Density Polyethylene	Polystyrene	Steel	Aluminum	Wood
Packing boxes Caps	Flexible film Packaging	Bubble wrap Shrink wrap Plastic bags	Foam	Strapping on pallets	Strapping on pallets	Pallets Lumber

6.1.1 Returns for Service

Save the original shipping container. If the product needs to be returned for service, it should be packaged in its original shipping container. If the original container is unavailable, make sure that the product is packed with at least three inches of shock-absorbing material to prevent shipping damage. Alpha Technologies is not responsible for damage caused by improper packaging of returned products.

6.2 Check for Damage

Prior to unpacking the product, note any damage to the shipping container. Unpack the product and inspect the exterior for damage. If any damage is observed contact the carrier immediately. Continue the inspection for any internal damage. In the unlikely event of internal damage, inform the carrier and contact Alpha Technologies for advice on the impact of any damage.

6.3 General Receipt of Shipment

The inventory included with your shipment is dependant upon the options you have ordered. The options are clearly marked on the shipping container labels and bill of materials.

6.3.1 Racks

Consult the packing slip and power system bill of materials to verify that you have the correct number of racks per your order.

6.3.2 Rectifiers (Purchased Separately)

Consult the packing slip to verify that you have received the correct number of rectifiers per your order.

6.3.3 Miscellaneous Small Parts

Review the packing slip and bill of materials to determine the part number of the "configuration kits" included with your system. Review the bill of materials to verify that all the small parts are included.

6.3.4 Batteries (Purchased Separately)

Verify that you have the correct number of batteries if applicable. Refer to the packing list. Verify that you have all the necessary parts per your order.

Call Alpha Technologies if you have any questions before you proceed: 1 888 462-7487.

7. Installation

The equipment is suitable for installation in Network Telecommunication Facilities.



WARNING!

This system is designed to be installed in a restricted access location that is inaccessible to the general public.

The following procedure is written for qualified personnel to install this product in a clean and dry environment.

7.1 Safety Precautions

Refer to the Safety section near the front of this manual before beginning this installation.

7.2 Tools Required

Various insulated tools are essential for the installation. Use this list as a guide:

- Battery lifting apparatus if required
- Various crimping tools and dies to match lugs used in installation
- Digital voltmeter equipped with test leads
- Cable cutters
- Torque wrench: 1/4" drive, 0 - 150 in-lb
- Torque wrench: 3/8" drive, 0 - 100 ft-lb
- Insulating canvases as required (2' x 2', 1' x 1', 3' x 3', etc.)
- Various insulated hand tools including:
 - Combination wrenches - Ratchet and socket set
 - Various screwdrivers. - Electricians knife
- Cutters and wire strippers (#14 to #22 AWG) [2.5 to 0.34 mm²]

7.3 Power System Assembly and Mounting

7.3.1 Shelf Preparation/Mounting

 **NOTE:**

Mount the shelf in a clean and dry environment. Allow at least 1.75" of free space in front of the unit for unrestricted cooling airflow. Sufficient free space must be provided at the front and rear of the power system. This is to meet the cooling requirements of the rectifiers and to allow easy access to the power system components.

The 23" shelf has been designed for flush mounting in a standard EIA relay rack. Option is also available for mid-mounting.

Mounting brackets accommodate either 1" or 1-3/4" rack spacing. Mount the shelf to the rack using at least two #12 – 24 x 1/2" screws in each bracket. Use Phillips-type screws and screwdriver to eliminate the possibility of slippage and scratching of the unit's exterior.

An electrical conducting path must exist between the shelf chassis and the metalwork of the enclosure in which it is mounted or a grounding conductor. This electrical continuity requirement can be met by the use of thread-forming type unit mounting screws and star washers that remove any paint or non-conductive coatings and establish metal-to-metal contact.

7.3.2 Rack Mounted Systems

Attach the power system to the customer-provided relay rack using the mounting screws and star washers. Ensure a proper electrical bond between the system chassis and the relay rack.

7.3.3 Floor Mounted Systems

Secure the system to a concrete floor using either heavy duty anchors (1/2" x 2-1/2"), or for wooden floors, heavy-duty lag bolts (5/8" x 2-1/2"). Use appropriately sized flat washers.

If required, use isolating kits to isolate the system from the floor.

Secure the relay rack to the overhead cable tray. Alpha does not supply the mechanical details necessary for overhead support.

8. Wiring

This chapter provides cabling details and notes on cable sizing for DC applications using the Cordex 48-12kW, modular switched mode rectifier systems.

Refer to the Safety section on page 5 for safety precautions.



WARNING!

Ensure that the power at the AC service panel is switched off. Remove battery line fuses or connections before attempting work on the wiring. Use a voltmeter to verify the absence of a voltage. Clearly mark the correct polarity of the battery leads before starting work on DC connections.

8.1 Grounding

This power system is suitable for installation as part of a Common Bonding Network (CBN) and is intended to be used in a DC-C configuration (common DC return).

Connect the isolated power system battery return bus (BRB) to the building master ground bus (MGB), or floor ground bus (FGB) in a larger building. This acts as a system reference and as a low impedance path to the ground for surges, transients, noise, etc. The MGB or FGB must have a direct low impedance path to the building grounding system.

The cable from the power system to the MGB or FGB must be sized to provide sufficient ampacity to clear the largest fuse or breaker on the power system, excluding the battery protection fuse or circuit breaker. 750 MCM is recommended. This is the minimum requirement. Other factors including the length of the cable and special grounding requirements of the load must also be factored in. The insulated cable must be equipped with two-hole crimp type lugs and must not have any tight bends or kinks.

Power system ampacity	Ground reference conductor size
< 30A	#10
30 – 100A	#6-2
100 – 400A	0000
400 – 800A	350 MCM
> 800A	750 MCM

The power system frame must also be connected to the MGB or FGB. This is done for personnel safety and to meet many telecom grounding requirements. Each bay must have its own frame or site ground connection. Refer also to the customer connections drawing at the rear of the manual.

8.2 AC Feeder Protection/Sizing

To maximize system reliability, feed each power module from a dedicated protection feeder breaker located at the AC distribution panel. The feeder breaker can also act as the disconnect device for the connected module.



CAUTION!

To minimize EMI disturbances, route the AC input wires in flexible or rigid conduit and located as far away as possible from the DC power wires.



WARNING!

Use care when removing or replacing the covers for the AC input connections. Never assume that an electrical connection or conductor is not energized.

8.3 AC Input Connections

1. Ensure that all modules are removed from the shelf.
2. Remove the covers (two places) from the rear of the shelf to expose the AC input terminal blocks, L1, L2 and L3 for each rectifier. (Refer to the customer connections drawing towards the end of the manual for AC terminal block location.) Each terminal block corresponds to an individual power module as marked.
3. The wire way is designed for two customer-supplied, 1" conduit fittings for the AC supplies located on each side of the shelf. Attach the conduit retainers to the wire way hole(s) and route the AC cables through them.
4. Secure the wires to the AC input and chassis ground terminals.
5. Tighten the cable connector to the AC cable (conduit similar).
6. Replace rear cover(s) once all connections have been completed.

8.4 DC Output Connections



WARNING!

Leave cables or bus bars disconnected at the battery and verify the output polarity using a voltmeter. Make battery connections only after all other wiring is completed.

The DC output wires must be UL approved XHHW or RHH/RHW (RW90 type for Canadian users). Control and sense wires must be UL approved Style 1015 (TEW type for Canadian users).

The common output leg of the rectifier system must be connected to the ground. This is typically done at the load common termination point.

8.4.1 Cables

Terminate cable leads with appropriate crimp lugs for 3/8" holes on 1" centers.

Secure the positive and negative to the shelf output post of the correct polarity. Ensure the washers are on the bolts in the same order in which they were shipped from the factory. Tighten the bolts as per the Customer Connections drawing at the rear of this manual.

8.4.2 Bus Bar

Do not complete the final live connections to the battery. Leave open and insulate the final connections or remove the battery fuses. Switch off the battery contacts if used. Refer to the system startup procedure before connecting the batteries online.

Bus bar adapters may be factory-installed, for the option selected, to easily accommodate direct connections to customers' vertical bus bars.

Secure the positive and negative to the shelf output post of the correct polarity. Ensure the washers are on the bolts in the same order in which they were shipped from the factory. Tighten the bolts as per Customer Connections drawing towards the end of this manual.

8.5 CAN Serial Ports (Rectifier Shelf)

Each module communicates with the CXC HP controller using CAN protocol. The modules report alarms, rectifier output voltages, and the location of the module within a cabinet.

8.5.1 Making CAN Bus Connections

Figure 9 shows an example of a controller and three shelves.

1. Daisy chain the CAN bus cables from the controller to shelf #1, shelf #2 and then to the last shelf #3.
2. Insert the CAN terminator in the last shelf, as shown in Figure 9.

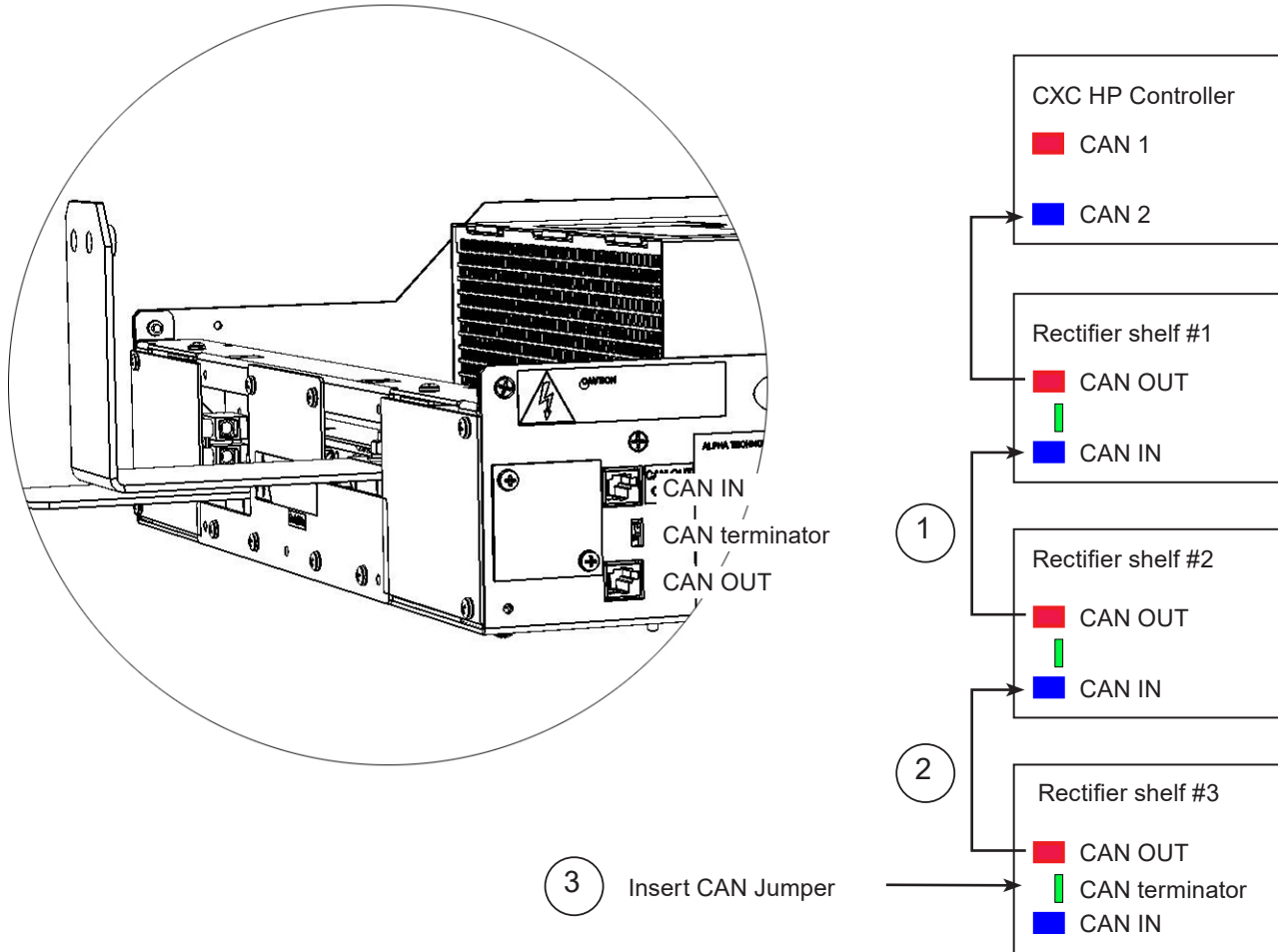


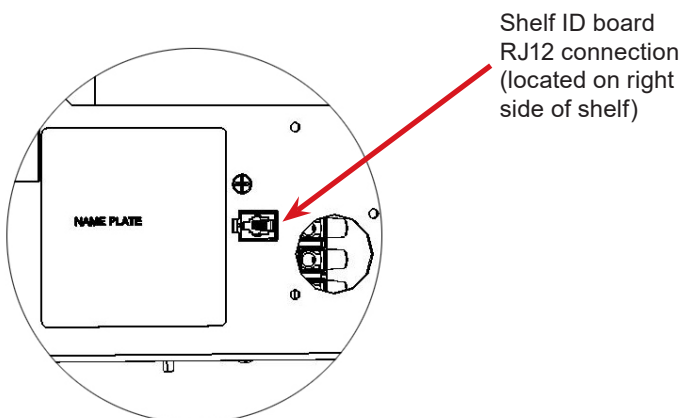
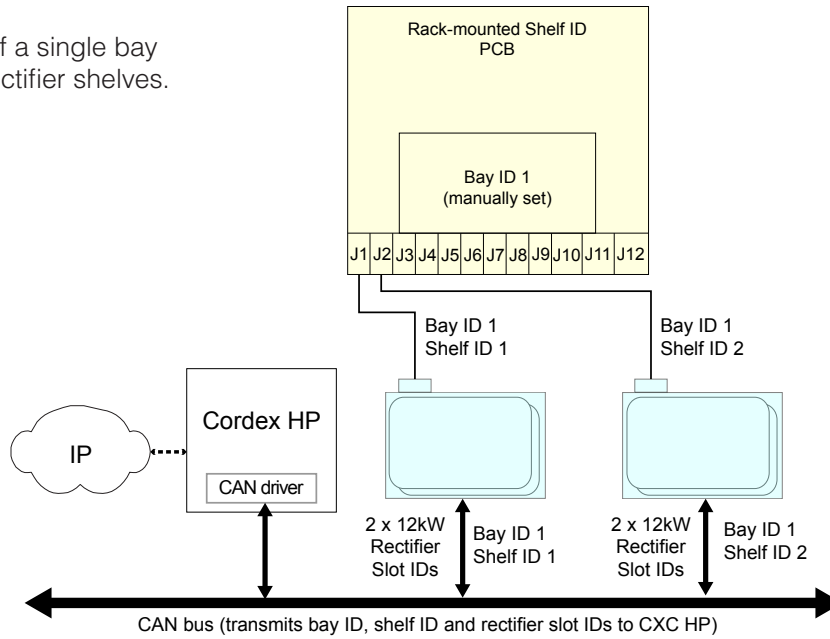
Figure 9 — CAN Port Connections

8.6 Shelf ID Connection

The shelf/bay ID/ comes factory installed.

If shelves are installed in more than one bay, then set the Bay ID sequentially on each Shelf ID board.

Example of a single bay with two rectifier shelves.



8.7 Signal Wiring Connections to L-ADIO Board

For terminal block connections, the recommended wire sizes are 0.823 to 0.129mm² (#18 to #26 AWG) for the temperature range of 0 to 50 deg. C (as per UL/CSA).



CAUTION!

To reduce risk of fire, use only 0.129 mm² (#26 AWG) or larger wire.

8.7.1 Relay Outputs

Terminals provide contacts for extending various alarm or control signals. Each relay output can be wired for NO or NC operation during an alarm or control condition (Figure 10).

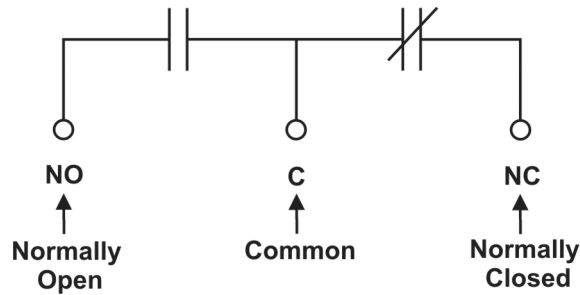


Figure 10 — Relay Connections in the De-energized State

Relays can be programmed to energize or de-energize during an alarm condition (see CXC-HP Software manual). When the CXC reset button is pressed or power is lost, all relays de-energize.

8.7.2 Digital Inputs

The digital input channels are used to monitor various alarm and control signals. All input channels are voltage activated and accept a bipolar (negative or positive) DC signal directly.

Connection Method

Typical Alpha systems use the “reset with Hot and trigger with Ground” connection. The digital input is wired in such a way that the Hot is wired directly into one of the input terminals. For example, the positive input for +24 V systems. The other input terminal is wired to the Ground (common) of the system through a dry contact relay usually located on the equipment requiring monitoring. This method allows the digital input to receive or not receive a Ground signal on an alarm.

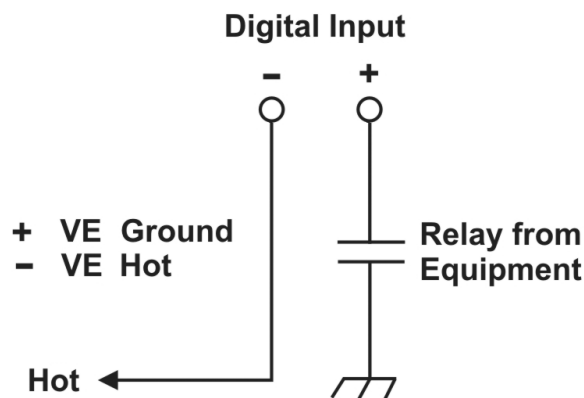


Figure 11 — Digital Input Connection Method

Voltage level definitions for digital inputs

The digital input channels can be programmed for “active high” or “active low.” Active high indicates “alarm on the presence of a ground signal” and active low indicates “alarm on the removal of a ground signal.” See CXC HP Software manual for detailed instruction on programming.

Voltage Range (Vdc)	Voltage Level (Vdc) Considered As “0” (Off)	Voltage Level (Vdc) Considered As “1” (On)
0 - 60 (system voltage setting)	0 - 1*	5 - 60

*NOTE: The range 1 – 5 is undefined.

8.7.3 Analog Inputs



CAUTION!

Ensure the correct polarity is used for all input cable terminations.

The analog input channels are used to monitor various types of electrical signals. Some of the analog channels are reserved for specific signals, while others are designated as general-purpose inputs, which accommodate various types of analog signals.

The Battery -48V should be connected at the battery system voltage terminal for CXC HP reference when a battery disconnect device is used. It is critical to CXC HP operation as it ensures a source of power to the CXC HP should the disconnect device open the circuit.

Voltage

Voltage Input #1 (load voltage per CXC HP software) terminals (V1) on the shelf provide connections to an optional secondary voltage input. For example, this can be terminated to the load side of an LVD contactor to monitor load voltage.

Voltage Input #2 (battery voltage per CXC HP software) is wired internally (V2) to the rectifier output voltage of the shelf. This is used as the reference for system alarming (such as high voltage) and control (such as low voltage disconnect).

Temperature Sensing

Temperature Probe input channels provide connections for temperature sensors. A voltage is supplied to these terminals for sensor measurements.

Current

Current Input #1 (discharge or load current per CXC HP software) terminals (I1) are available for customer connection as required.

Current Input #2 (charge or battery current per CXC HP software) terminals (I2) are available for customer connection as required.

9. System Startup

Visually inspect the installation thoroughly.

After completing the system installation and power system wiring, perform the following startup and test procedure to ensure proper operation:

9.1 Check System Connections

1. Make sure that the AC input power is switched off, the batteries are disconnected, and all the power modules are removed from the shelf.
2. Triple-check the polarity of all connections.

9.2 Verify AC and Power the Rectifier Shelf

NOTE:

Insert the first module into the front left most position using the side of the shelf (or the optional shelf-mounted controller) as a guide. Subsequent modules can be inserted using the previous module as a guide.

Do not force a module into position if it does not seat properly. All modules are keyed to ensure that the correct module (voltage/polarity) type is used.

1. Install one power module.
 - a. Place the rectifier module on the shelf bottom and slide the module into the rear connector (inside the shelf).
 - b. Apply pressure on the module handle to engage the rear connector in the shelf receptacle.
 - c. Tighten the screw on the bottom of the faceplate to secure the module to the shelf.
2. Verify that the AC input voltage is correct and switch on the corresponding feeder breaker. The power module **AC ON** LED illuminates after a preset start delay.
3. Using the CXC HP, test the functionality of various module alarms and controls.

9.3 Triple Check Battery Polarity and Connections

1. Use a voltmeter to verify that the battery polarity is correct. Ensure that no cells or batteries are reversed.
2. Connect the batteries to the output of the system.
3. Install the remaining power modules.
4. In the adjustments menu of the CXC HP, set the float and equalize voltages to the levels specified by the battery manufacturer.
5. Using the CXC HP, test the functionality of the various module alarms and controls. Perform a load test with the system using a resistive load box.
6. Enable the temperature compensation (temp comp) feature in the batteries menu. Program the settings for slope and breakpoints (upper and lower) according to the specific batteries used.

9.4 CXC HP Reset

Use the LCD on the front panel of the optional CXC HP to restart the microprocessor. Click **Settings** (Gear symbol) and then **Reset**. See Figure 5.

9.5 Rectifier Modes

There are two main rectifier modes: output voltage mode and the output current/power mode.

9.5.1 Output Voltage Modes

Voltage modes are under software control, and can be used to directly adjust the output voltage. The qualification of “under software control” is made because there are processes that occur in the rectifier that can change the output voltage that do not adjust the output voltage directly, for example, if the rectifier has reached the current limit.

Table C lists four output voltage modes and a description of when they are active. These modes can be set via the controller.

Output Voltage Modes	Active When...
Float	Output voltage is set to the float voltage setting.
Equalize	Output voltage is set to the equalize voltage setting.
Battery Test	Output voltage is set to the battery test voltage setting.
Safe	If the rectifier is not connected to a controller, the rectifiers will switch to safe mode (51.4V) after 5 minutes

9.5.2 Output Current/Power Modes

These modes directly affect the output current and power. Table D lists the four output current/power modes and a description of when they are active.

Output Voltage Modes	Active When...
Temperature foldback mode	Output current and power limit have been reduced because a high temperature has been detected on the heatsink or internal ambient temperature sensor.
AC foldback mode	Output current and power limits have been reduced because the AC input voltage is low. This will reduce the risk of tripping an AC breaker due to increased AC current draw as the AC voltage decreases.
Short circuit foldback mode	Output current limit has been reduced due to a short circuit at the output.
Internal fault foldback mode	Output current limit has been reduced due to an internal fault.
Constant power mode	If the output current exceeds max rated current, the rectifier puts out constant power within a specific voltage range. The rectifier is in constant power mode.
Overload	If the load current increases further, the output voltage and current will reduce. This mode is called fold back mode or Over Load.

9.6 Factory Ranges and Defaults

Table E shows the rectifier settings/ranges/defaults. Changes are made through the CXC HP interface

Table E — Rectifier factory ranges and defaults		
Setting	Range (minimum to maximum)	Default
Float (FL) Voltage	47.5 – 58.2V	54V
Equalize (EQ) Voltage	49.8 – 60.2V	55V
Battery Test (BT) Voltage	44 – 52V	46V
Over Voltage Protection (OVP)*	63V	60V
Current Limit (CL)	20 – 100%	100%
Power Limit (PL)	0 – 100%	100%
Module Start Delay	0 – 250s	1s
System Start Delay	0 – 600s	0s
Softstart Ramp-rate	1-8sec	8sec
CL/PL Alarm	Enabled / Disabled	Enabled
Remote Shutdown	Enabled / Disabled	Enabled
Ramp Test	Enabled / Disabled	Enabled
Safe Voltage	46-56V	51.4V

*The OVP cannot be set below the present system/FL/EQ/BT voltage setting or the safe mode voltage of 51.4V.

10. Maintenance

Although very little maintenance is required with Alpha systems, routine checks and adjustments are recommended to ensure optimum system performance. Qualified service personnel should do the repairs.

The following table lists a few maintenance procedures for this system. These procedures should be performed at least once a year.



WARNING!

Do not work inside the rectifier module while it is energized. If working on the system with battery connected, use insulated tools to prevent accidental contact and arc flash.

Circuit cards, including RAM chips, can be damaged by static electricity. Always wear a grounded wrist strap when handling or installing circuit cards.



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.

Table F — Sample maintenance log

Procedure	Date Completed
Clean ventilation openings.	
Inspect all system connections. Re-torque if necessary.	
Verify alarm/control settings.	
Verify alarm relay operation.	

10.2 Spares

Table G — Spare parts

Description	Part Number
Rectifier fan (single fan)	7400564-001
Replacement MOV module	7050308-001

10.3 Replacing a Rectifier Module

NOTE: When a rectifier fails and or is permanently removed, the system generates a Rectifier Comms Lost alarm. The alarm is cleared by removing the rectifier from the system inventory.

Replacing a Rectifier

To remove the rectifier from the system inventory do the following:

1. Remove the rectifier from the shelf.
2. In the web user interface go to **Power System > Inventory > Rectifiers > Status**.
3. Click the **Unassign** button on the rectifier to be removed, and then click **Forget All in Comms Lost**.

Alpha My Account US English Metric

OK No Alarms

DD System (DC System 48V/1630)

SYSTEM VOLTAGE 54.01 V BATTERY CURRENT 1 A

TOTAL LOAD CURRENT 4 A SYSTEM MODE Battery Conditioning

Inverter System/7270

TOTAL OUTPUT POWER 190 VA DC INPUT 0 %

AVERAGE OUTPUT LOADING 4 % SYSTEM MODE Line

Dashboard Controller Power System Modules Alarms and Events Shelf Layout

Power System / DD System (DC System 48V/1630) / Inventory / Rectifiers / Status

Status

Unassign All

Forget All in Comms Lost

Name	Device Name	Alerts	Output Current	Output Power	% Loading	Mode	Actions
N598126/0613	CXRF 48-3.6KW	0	0.0 A	1 W	0 %	Float	Locate Unassign
N598371/0913	CXRF 48-3.6KW	0	2.7 A	146 W	4 %	Float	Locate Unassign

4. Place the new rectifier in the shelf.
5. Rectifiers are plug-and-play, but you may still need to map the new rectifier to an AC phase.
6. By default the system is set to auto-assign. If not set to auto-assign, go to **Modules > Unassigned Modules > Assign All Rectifiers** to assign the new rectifier.
7. Click **Yes** on the **Confirmation** window to confirm the assignment.

10.4 Fan Replacement

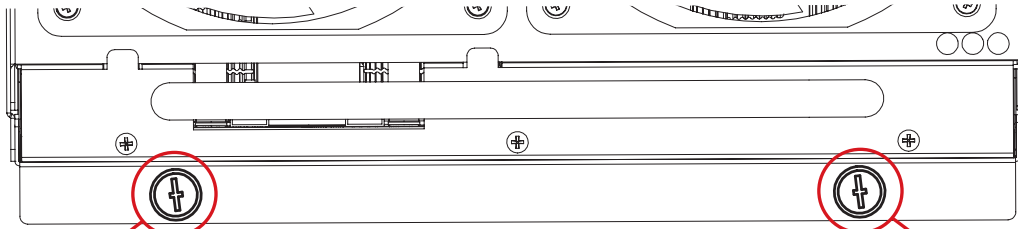


WARNING!

Do not work inside the rectifier module while it is energized. If working on the system with battery connected, use insulated tools to prevent accidental contact and arc flash

A recommended replacement period of six years is suggested for preventative maintenance.

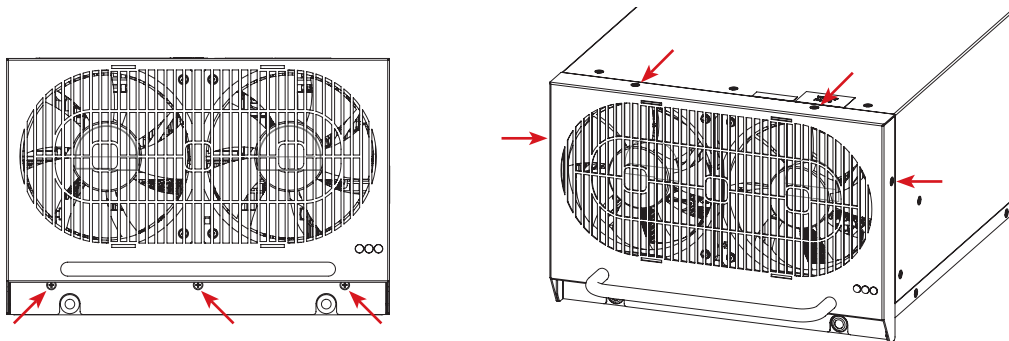
1. Unscrew the two front thumbscrews that secure the module and pull the unit out of the shelf.
2. Allow the module to sit for 10 minutes to dissipate internal stored energy.



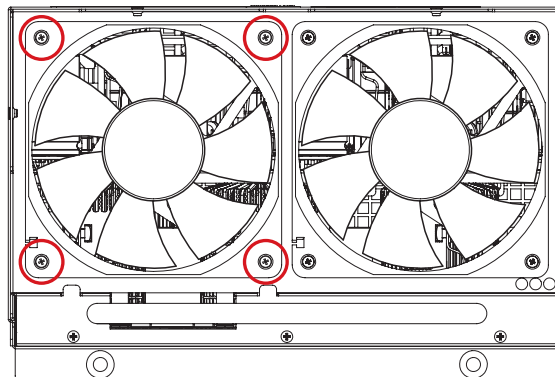
Thumb screws

Thumb screws

3. Remove the seven screws holding the fan cover in place. Remove the fan cover.



4. Disconnect the cable.
5. Remove the four screws that secure the failed fan to the panel.



6. Note the direction of the airflow, then remove the fan.
7. Install the replacement fans by following the preceding steps in reverse order.

10.5 MOV Replacement

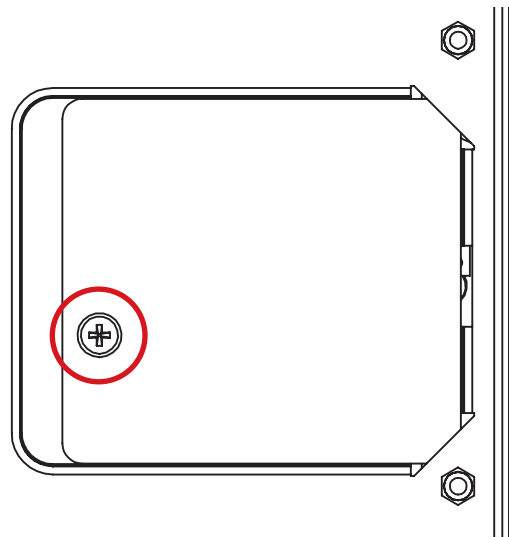


WARNING!

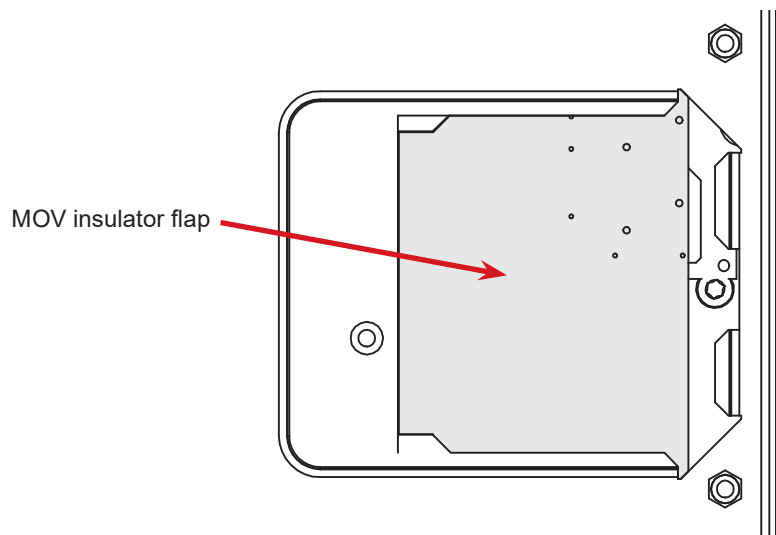
Do not work inside the rectifier module while it is energized. If working on the system with battery connected, use insulated tools to prevent accidental contact and arc flash

Lethal voltage persists inside the unit for several minutes after removal from the shelf. Allow 10 minutes before removing fan grill.

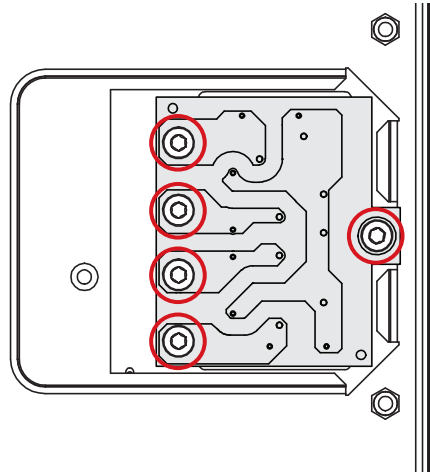
1. De-energize the rectifier.
2. Turn the rectifier so that you are looking at the bottom of the module.
3. Remove the screw from the MOV board cover.
4. Remove the MOV board cover from the chassis.



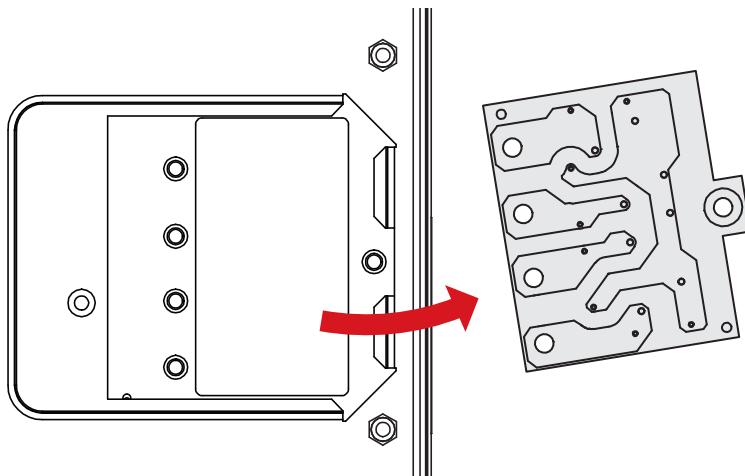
5. Pull the MOV insulator flap out of the chassis to expose the MOV board.



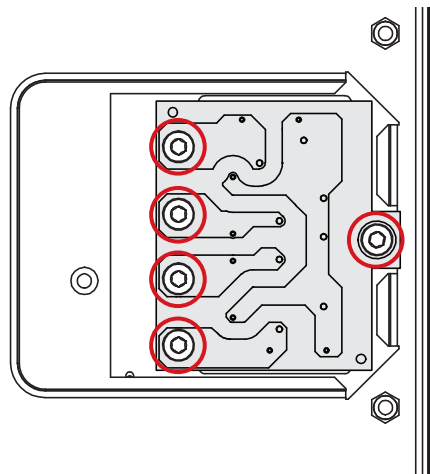
6. Remove the five screws from the module.



7. Carefully remove the old MOV board from the rectifier.



8. Place the new MOV board into location by inserting it through the bottom of the chassis and secure to module using five screws. Torque to 5in.lb.



9. Place the MOV Insulator flap back into the chassis so it sits securely inside the chassis.

10. Place the MOV board cover into the chassis as shown in step 4.

11. Screw the MOV board cover to the chassis, and torque the screw to 5in.lb.

11. Acronyms and Definitions

AC	Alternating current
ANSI	American National Standards Institute
AWG	American Wire Gauge
BTU	British thermal unit
CAN	Controller area network
CEC	Canadian Electrical Code
CSA	Canadian Standards Association
CX	Cordex™ series; e.g., CXC for Cordex System Controller
DC	Direct current
DHCP	Dynamic Host Configuration Protocol
EIA	Electronic Industries Alliance
EMC	Electromagnetic compatibility
EMI	Electromagnetic interference
ERM	Electromagnetic Compatibility and Radio Spectrum Matters
ESD	Electrostatic Discharge
FCC	Federal Communications Commission (for the USA)
HVSD	High voltage shutdown
IEC	International Electrotechnical Commission
IEEE	Institute of Electrical and Electronics Engineers
IP	Internet Protocol
LED	Light emitting diode
LVD	Low voltage disconnect
MIL	One thousandth of an inch; used in expressing wire cross sectional area
MTBF	Mean time between failures
NC	Normally closed
NEC	National Electrical Code (for the USA)
NO	Normally open
OSHA	Occupational Safety & Health Administration
OVP	Over voltage protection
RAM	Random access memory
RU	Rack unit (1.75")
TCP/IP	Transmission Control Protocol / Internet Protocol
THD	Total harmonic distortion
UL	Underwriters Laboratories
VRLA	Valve regulated lead acid

12. Warranty and Service Information

Technical Support

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

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

Warranty Statement

For full information details review Alpha's online Warranty Statement at <http://www.alpha.ca/warranty>.

Limited Hardware Warranty

Alpha warrants that for a period of two (2) years from the date of shipment its products shall be free from defects under normal authorized use consistent with the product specifications and Alpha's instructions, unless otherwise specified in the product manual, in which case, the terms of the manual will take precedence

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

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

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

Battery Warranty

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

Warranty Claims

Any claim under this Limited Warranty must be made in writing to Alpha BEFORE sending material back. Alpha will provide Product return instructions upon approval of return request. A Service Repair Order (SRO) and / or Return Authorization (RA) number will be issued ensuring that your service needs are handled promptly and efficiently. Claims must be made online at: <http://www.alpha.ca/web2/service-and-support>.

Service Centers

For a list of international service centers, refer to the Alpha website:

<http://www.alpha.ca/web2/services-and-support>

13. 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. 60950-1 (2nd Ed) and UL 60950-1 (2nd Ed). Alpha UPS products, bearing the aforementioned CSA marks, are certified to CSA C22.2 No. 107.3 and UL 1778.

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



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

NRTLs capabilities

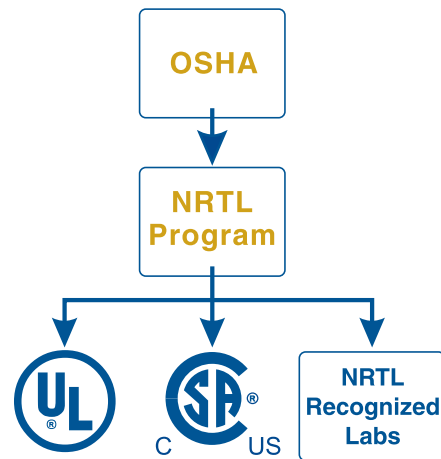
NRTLs are third party organizations recognized by OSHA, US Department of Labor, under the NRTL program.

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

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

Governance of NRTL

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



(1) www.csagroup.org

(2) www.scc.ca

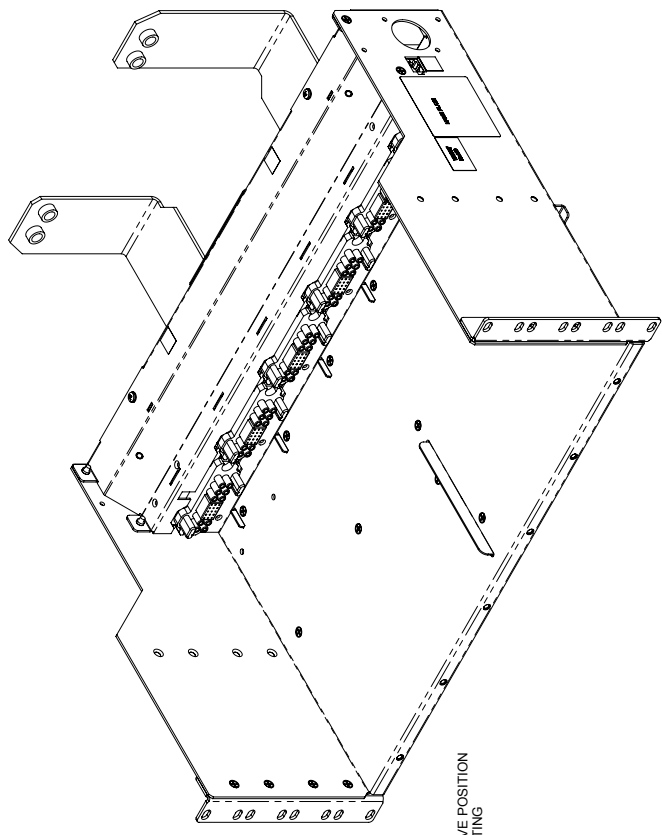
(3) www.ulc.ca

(4) www.osha.gov

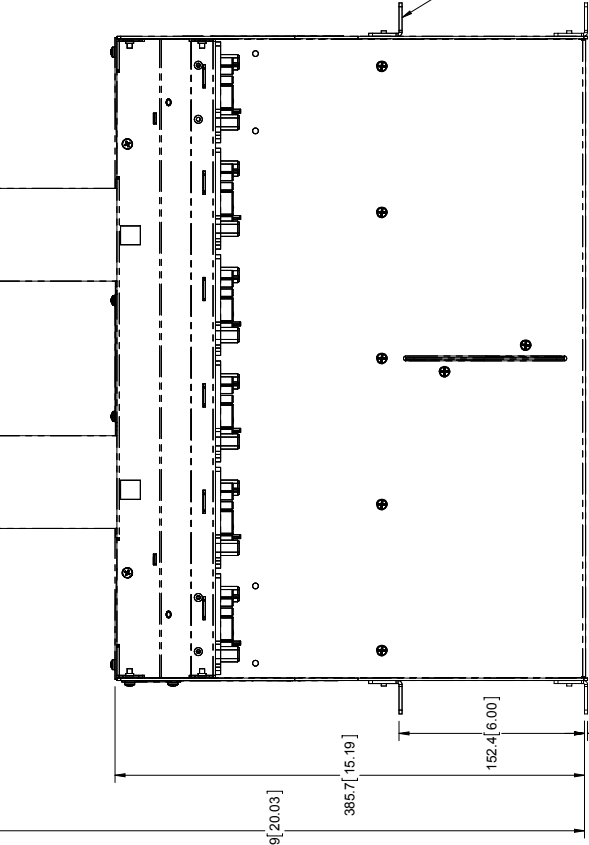
REVISIONS			
LTR	DESCRIPTION	DWN	DATE
A	INITIAL RELEASE	KLAU	Sep-02-15
			ZL

DO NOT SCALE DRAWING

1 2 3 4 5



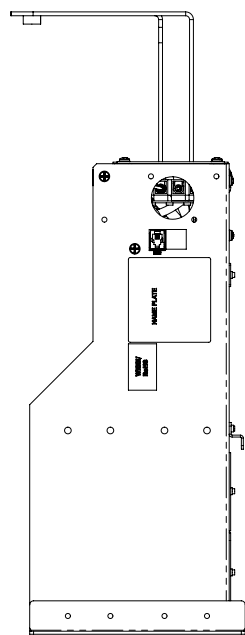
ALTERNATIVE POSITION FOR MOUNTING BRACKETS



16X Ø6.4 [0.25] X 10.9 [0.43] OBROUND

4X 3/8"-16 THREADED HOLE

0300167-001 - 20" DEEP CXPS-C OUTPUT BUS BAR ADAPTORS



E

D

C

B

A

E

D

C

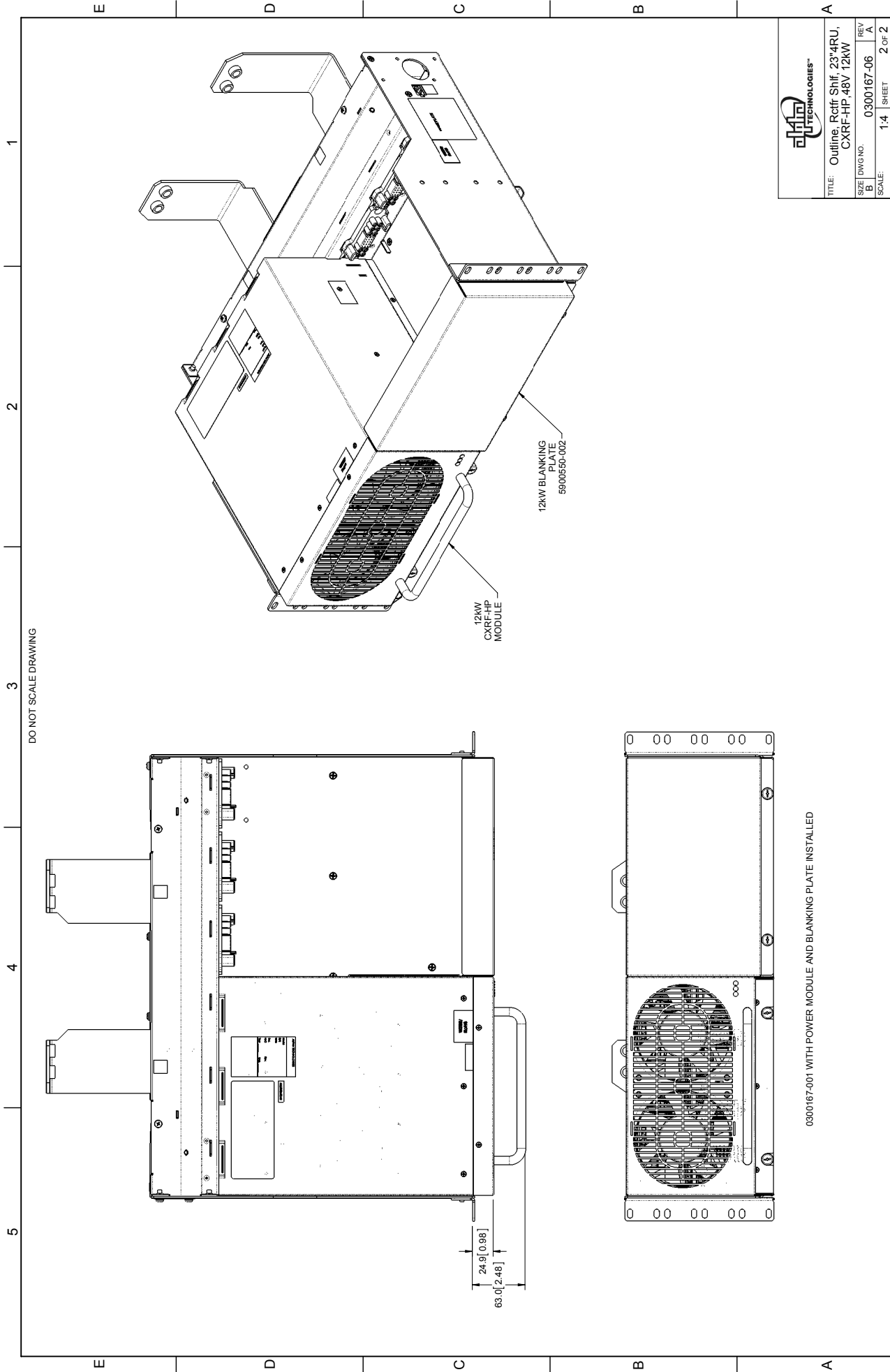
B

A

UNLESS OTHERWISE SPECIFIED DIM ARE IN MM			
X X	1.5	APPROVALS	DATE
X X	0.25	DRAWN	KLAU
X X	ANGULAR: ±3°	CHECKED	Z. LAMBER
INTERPRET DIM AND TOL PER ASME Y14.5M-1994		TITLE Outline, Rctfr Shif, 23*4RU, CXRF-HP, 48V 12KW	
THIRD ANGLE PROJECTION		SIZE B	
		DWG NO. 0300167-06	
© ALPHA TECHNOLOGIES LTD		SCALE: 1:4	
		SHEET 1 OF 2	

NOTES:
1. DIMENSIONS ARE IN MM [INCH].

1 2 3 4 5



DO NOT SCALE DRAWING

24.9 [0.98]
63.0 [2.48]

12kW
CXRF-HP
MODULE

12kW BLANKING
PLATE
59.00550-002

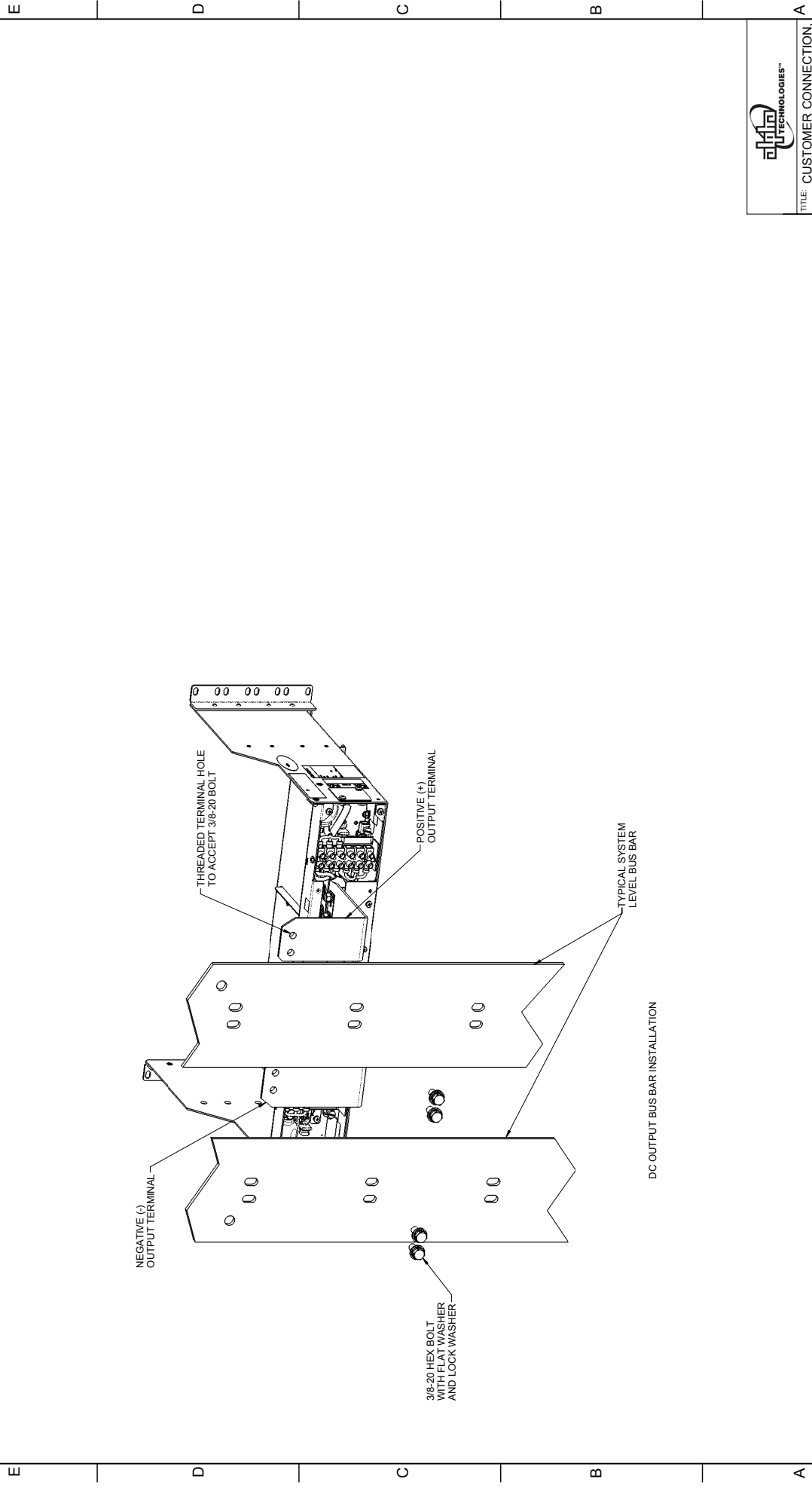
0300167-001 WITH POWER MODULE AND BLANKING PLATE INSTALLED



TITLE: Outline Refr. Shlf. 23'4RU, CXRF-HP, 48V 12kW	
SIZE DWG NO.	REV
0300167-06	A
SCALE: 1:4	SHEET 2 OF 2

1 2 3 4 5

DO NOT SCALE DRAWING



MTI TECHNOLOGIES™

TITLE: CUSTOMER CONNECTION, SHLF, CXRF-HP 12KW

SIZE	DWG NO.	REV
B	0300167-08	A
SCALE:	1:5	SHEET: 2 OF 2

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