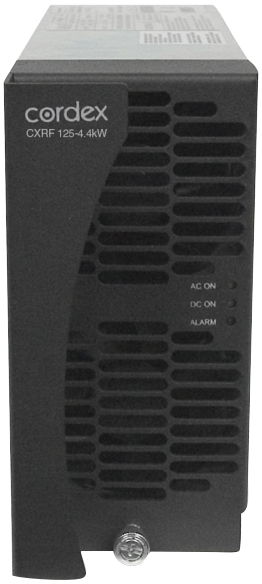
Cordex 125-4.4kW
Modular Switched Mode Rectifier

Installation & Operation Manual

Part # 010-589-B2

Effective: 01/2013



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Cordex 125-4.4kW
Modular Switched Mode Rectifier

010-589-B2 Rev B

The following documents and drawings are included in this manual to provide the necessary information required for installation, operation and fault diagnosis of the unit:

- **Installation and Operation Instructions: 010-589-B2**
- **Specifications, Cordex 125-4.4kW: 010-589-B1**
- **CSA/NRTL Equivalence: 048-554-10**
- **Outline Drawing, 19" Shelf: 030-769-06**
- **Customer Connections, 19" Shelf: 030-769-08**

IMPORTANT SAFETY INSTRUCTIONS

SAVE THESE INSTRUCTIONS

1. Please read this manual prior to use to become familiar with the product's numerous features and operating procedures. To obtain a maximum degree of safety, follow the sequences as outlined.

2. This manual provides warnings and special notes for the user:
    a. Points that are vital to the proper operation of the product or the safety of the operator are indicated by the heading: **WARNING**.

    b. A notation that is in **Bold *or Italic*** typeface covers points that are important to the performance or ease of use of the product.

3. Before using the product, read all instructions and cautionary markings on the product and any equipment connected to the product.

4. Do not expose the product to rain or snow; install only in a clean, dry environment.

5. **CAUTION** – Unless otherwise noted, use of an attachment not recommended or sold by the product manufacturer may result in a risk of fire, electric shock, or injury to persons.

6. **CAUTION** – Do not operate the product if it has received a sharp blow, it has been dropped, or otherwise damaged in any way – return it to a qualified service center for repair.

7. **CAUTION** – Do not disassemble the product – call our qualified service centers for servicing. Incorrect reassembling may result in a risk of electrical shock or fire.

8. **WARNING** – The output voltages of the product are hazardous. Extreme caution should be maintained when servicing or touching conductive components connected to the product's output.

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FIGURES

1 Introduction

1.1 Scope of the Manual

This instruction manual explains the installation, interconnection, and operation of Alpha Technologies' Cordex 125-4.4kW modular switched mode rectifiers.

NOTE: *To aid the user with installation, frequent reference is made to drawings located at the rear of the manual.*

1.2 Product Overview

A complete Cordex rectifier system consists of one or more power modules in a common shelf enclosure. The shelf has connections for AC inputs, DC output, and system communications.

Cordex rectifier modules use a high frequency, switched mode conversion technique to provide a fully regulated and isolated DC output from the AC mains. The rectifier input is wide range to allow use on 208/220/240Vac 50/60Hz electrical service.

Rectifier power modules are "hot swappable" meaning they can be inserted or removed from the shelf without cutting power to or from the system or the load.

Additional power modules can be included with the system at the time of ordering or added after the shelf has been installed.

The shelf rectifier system is designed to operate with the Alpha Cordex System Controller (CXC).

The CXC allows the user to configure, monitor and control the entire DC power system from its touch screen display similar to that used in a Personal Digital Assistant (PDA). Other features of the unit include temperature compensation, auto equalization, remote access, dial out on alarm, battery diagnostics, as well as Web server and Simple Network Management Protocol (SNMP) support for configuration and monitoring.
Details of controller operation are provided in the current version software manual.

There are two external CXC models of the system controller that communicate with the shelf via offset RJ-12 shelf connectors. The CXCR is mounted in a rack and the CXCP is (factory) mounted in a panel.
See manual #018-570-B2.

1.3 Part Numbers and List Options

This product is available to order under the following part numbers and list options:

Description	Part Number/List Option
Cordex 125-4.4kW rectifier power module	010-589-20
Basic module	*List 0
Charcoal finish with white (contrasting) silkscreen	*List 56
Cordex 125-4.4kW 19" shelf, flush mounting, single phase ac input	030-769-20
Basic shelf, may be equipped with up to five Cordex 125-4.4kW modules**	*List 0
19" mid-mount	List 19
23" mid-mount	List 23
DC output, bus bar adapters, 16" deep	List 82
Kydex rear cover	List 89
Module blank	List 90

* Default option
** See drawings at the rear of this manual.

The above information is valid at the time of publication. Consult factory for up-to-date ordering information.

2 Rectifier Features

2.1 Front Panel

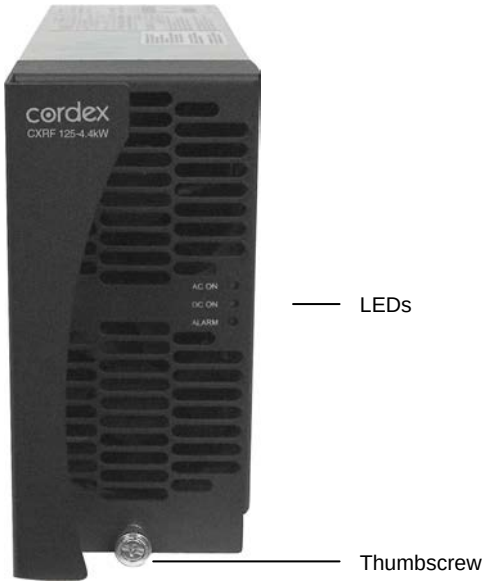


Figure 1–Cordex 125-4.4kW rectifier front panel

2.1.1 LEDs

The front panel LEDs provide:

- Rectifier status summary,
- Rectifier software upgrade in progress indication,
- Locate module pattern.

Rectifier status summary will show the rectifier alarm status, communication fail status and rectifier on/off status.

2.1.1.1 AC ON

The top LED (green) is on when AC is within valid range. The LED will flash (~2Hz) when AC is outside the nominal 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.

2.1.1.2 DC ON

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 CXC.

2.1.1.3 ALARM

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 (1 and 2) 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 (1 or 2) 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.

2.1.1.4 LED Activity During 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.

2.1.1.5 LED Activity During 'Locate Module' Command from CXC

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.

2.1.2 Mechanical

A thumbscrew is provided to secure the rectifier into the shelf. During normal operation the rectifier shall be locked into position. A handle (or grip) is incorporated into the front panel to facilitate the removal of the rectifier from the shelf. No special tools are required.

2.2 Rear Panel

Located on the rear panel of the rectifier is a single connector for shelf power and communications.

2.3 True 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 current[1]. 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.

NOTE: *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.*

2.4 Heat Dissipation

Each rectifier module is equipped with at least one front-mounted fan. The fan operates at temperatures above 0°C (32°F). Cooling of the module is front-to-rear with the exhaust air exiting at the back. The fan is variable speed; which is determined by heatsink temperature and load.

[1] Under normal conditions, a battery connected to the output of the rectifier will draw current when the voltage ramp occurs. Therefore the rectifier fail alarm will not be generated with a battery connected.

2.5 Over Temperature Protection

Each rectifier module is protected in the event of an excessive increase in temperature due to component failure or cooling airflow blockage. During over temperature conditions, the rectifier limits the output power as well as the output current. If temperature continues to increase, a shutdown of the rectifier is initiated. The rectifier shall restart automatically if the temperature has returned to a safe level.

2.6 Wide AC Range

A minor alarm is generated when the AC input voltage drops below specification. Rectifier output power is reduced linearly between 187Vac and 90Vac to 40% of the rated output power (the unit will deliver derated output power down to 80Vac).

At 80Vac, the module will shut down and will not restart until the AC is greater than or equal to 90Vac; however, the restart voltage depends on the load current. At reduced load current the unit may restart with the input voltage as low as 100Vac.

For voltages above 265Vac, power factor and total harmonic distortion may be derated. Up to 312Vac, the rectifier will be operational and shall not suffer any damage.

2.7 AC Inrush/Transient Suppression

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

2.8 Soft Start

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

2.9 Start Delay

The rectifier modules are equipped with a delay timer in order to stagger start a series of modules to prevent excessive loading of generators upon start up. The built-in timer delays the turn on of the module depending on the value selected (up to 120 seconds) via the CXC. A minimum one-second delay is preset to allow charging of the input capacitors.

2.10 Current Limit/Short Circuit Protection

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

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

2.11 Power Limiting

Each rectifier module is designed to limit power output to the module specification. This enables more current to be supplied at lower output voltages, and allows matching of output to the demand of constant power loads, normally seen with telecom equipment.

This feature may also be used for a faster recharge of flooded batteries paralleled with the load.

NOTE: *Current limiting overrides the power-limiting feature.*

2.12 High Voltage Shutdown (HVSD)

This feature provides protection to the load from over voltage conditions originating from the rectifiers. It operates by shutting down the offending rectifier module when a high output voltage condition occurs. Indication is through the red Alarm (Module Fail) LED. Modules will restart automatically; however, if more than three over voltage conditions occur in one minute, the module will latch off and remain shut down until it is reset via the CXC.

2.13 Battery Eliminator Operation

Rectifier modules maintain all specifications (except where indicated) with or without a battery attached in parallel to the output; however, if a battery or another module supplying DC voltage in parallel is not present, there will be no monitoring or control activity if there is an AC power failure or input fuse failure.

3 Inspection

3.1 Packing Materials

All Alpha products are shipped in rugged, double walled boxes and suspended via solid inserts to minimize shock that may occur during transportation. Packaging assemblies and methods are tested to International Safe Transit Association standards.

Products are also packaged with Cortex. This plastic wrap contains a corrosive-inhibitor that protects the product from corrosion for up to two years.

3.1.1 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 the product is packed with at least three inches of shock-absorbing material to prevent shipping damage.

NOTE: *Alpha Technologies is not responsible for damage caused by the improper packaging of returned products.*

3.2 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, please inform the carrier and contact Alpha Technologies for advice on the impact of any damage.

Verify that you have all the necessary parts per your order for proper assembly.

4 Installation

WARNING
This product must be installed in a restricted access location. Only qualified or trained personnel are allowed access to the equipment. Failure to do so may result in electric shock.

This chapter is provided for qualified personnel to install the product, which shall be mounted in a clean and dry environment.

NOTE: *To aid the user with installation, frequent reference is made to drawings located at the rear of the manual.*

4.1 Safety Precautions

WARNING
Hazardous voltages are present at the input of power systems. The DC output from the rectifiers is classified as hazardous voltage and has a high short circuit current capacity that may cause severe burns and electrical arcing.

Before working with any live battery or power system/distribution center, the following precautions should be followed:

- Remove all metallic jewelry; e.g., watches, rings, eyeglasses, necklaces.
- Wear safety glasses with side shields at all times during installation.

Metallic tools must be insulated.

The installer should follow all applicable local rules and regulations for electrical and battery installations; e.g., CSA, UL, CEC, NEC, OSHA, and local fire codes.

4.2 Shelf Preparation/Mounting

The 19" shelf has been designed for flush mounting in a standard 19" relay rack. Universal mounting brackets allow for mid-mounting in a 19" or 23" rack. The configuration depends on the options chosen.
See drawing 030-769-06.

NOTE: *The shelf shall be mounted in a clean and dry environment. Allow at least 1.75" of free space in front of the unit for unrestricted cooling airflow.*

Mounting brackets accommodate either 1" or 1-3/4" rack spacing. The shelf should be mounted to the rack using at least two #12 – 24 x 1/2" screws in each bracket. Philips-type screws and screwdriver should be used to eliminate the possibility of slippage and scratching of the unit's exterior. Washers (such as internal tooth) or special screws that are designed to cut through the painted surface should be used to ensure a good chassis ground.

4.3 Rectifier Module Insertion/Removal

Insert by placing the rectifier module on the shelf bottom and sliding the module into the rear connector (inside of the shelf). Apply pressure on the module handle to engage the rear connector in the shelf receptacle.

NOTE: *It is recommended that the first module be inserted into the front leftmost position using the side of the shelf as a guide. Subsequent modules may be inserted using the previous module as a guide.*

Tighten the screw on the bottom of the faceplate to secure the module to the shelf.

NOTE: *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.*

To remove a module, loosen the screw on the bottom of the faceplate. Grasp handle and pull out, sliding the module away from the rear connector and out of the shelf.

5 Wiring and Connections

This chapter provides cabling details and notes on cable sizing for DC applications with respect to the Alpha Cordex 125-4.4kW modular switched mode rectifier.

5.1 Safety Precautions

WARNING
Hazardous AC voltages may be present. Ensure power at the AC service panel is off before attempting work on the AC connections. Use a voltmeter to verify the absence of voltage. Clearly mark the correct polarity of the battery leads before commencing work on DC connections.

Refer to the previous (Installation) chapter for additional safety precautions.

5.2 Tools Required

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

- Slot head screwdrivers (blade sizes: 1/4", 1/8", 1/16")
- Philips head screwdriver, #2 (tip size 3/16")
- Digital voltmeter equipped with test leads
- Adjustable 125/220Vdc load (optional)
- Cutters and wire strippers
- Crimping tool (optional for large gauge wire)
- Socket and rachet set (Imperial measure).

5.3 Power System Chassis Ground and DC Ground Reference

WARNING
For safety reasons, ensure the system is properly bonded to the building's ground grid. 125/220Vdc systems are typically floating; i.e., not connected to earth ground.

Connect the chassis ground to the site ground to ensure correct operation of the system and to prevent drifting floating analog (especially current) readings.

5.4 AC Feeder Protection/Sizing

To maximize system reliability, each power module should be fed 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. Refer to the specifications at the front of this manual for Alpha recommendations.

5.5 AC Input Connections

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.

CAUTION: AC input wires should be routed in flexible or rigid conduit as far away as possible from the DC power wires to minimize EMI disturbances.

Ensure all modules are removed from the shelf.

The wireway is designed for two customer-supplied 1" conduit fittings for AC supply located one on each side of the shelf.

Remove the metal covers (2 places) from the rear of the shelf to expose the AC input terminal blocks, L1 and L2 for each rectifier. Each terminal pair relates to an individual power module as marked.

Attach the conduit retainers to the wireway hole(s) and route the AC cables through.

Secure the wires to the AC input and chassis ground terminals as required.

Tighten the cable connector to the AC cable (conduit similar).

Replace rear cover(s) once all connections have been completed.

5.6 Calculating Output Wire Size Requirements

Wire size is calculated by first determining the appropriate maximum voltage drop requirement. Using the formula below calculate the CMA wire size requirement. Determine the size and number of conductors required to satisfy the CMA requirement.

CMA = (A x LF x K) / AVD, where:

CMA = Cross section of wire in circular MIL area
A = Ultimate drain in amps
LF = Conductor loop feet
K = 11.1 constant factor for commercial (TW type) copper wire
AVD = Allowable voltage drop

Check again that the ampacity rating of the cable meets the requirement for the installation application. Consult local electrical codes (NEC, CEC, etc.) for guidelines. If required, increase the size of the cable to meet the code.

5.7 DC Output Connections

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

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

5.7.1 Cable

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; i.e., +Vcable to +Vpost. 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 at the rear of this manual.

5.7.2 Bus Bar

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; i.e., +Vcable to +Vpost. 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 at the rear of this manual.

5.8 CAN Serial Ports

Two CAN Serial ports (modular jacks with offset latches), are provided for communications with Alpha's Cordex rectifiers and other CAN-enabled equipment. These are located on the left side of the shelf (as viewed from the front).

Daisy-chain from shelf to shelf (CAN OUT of one shelf to CAN IN of another) as necessary and ensure that only the last shelf is terminated. See Figure 2.

5.8.1 CAN Termination

A jumper (or switch depending on your configuration) allows setting of the CAN OUT to be open (to the next shelf in the system) or terminated. Termination must be enabled in final shelf on the CAN bus only. Access termination selection (inside the shelf) by removing the leftmost rectifier #1 (MDL 1).

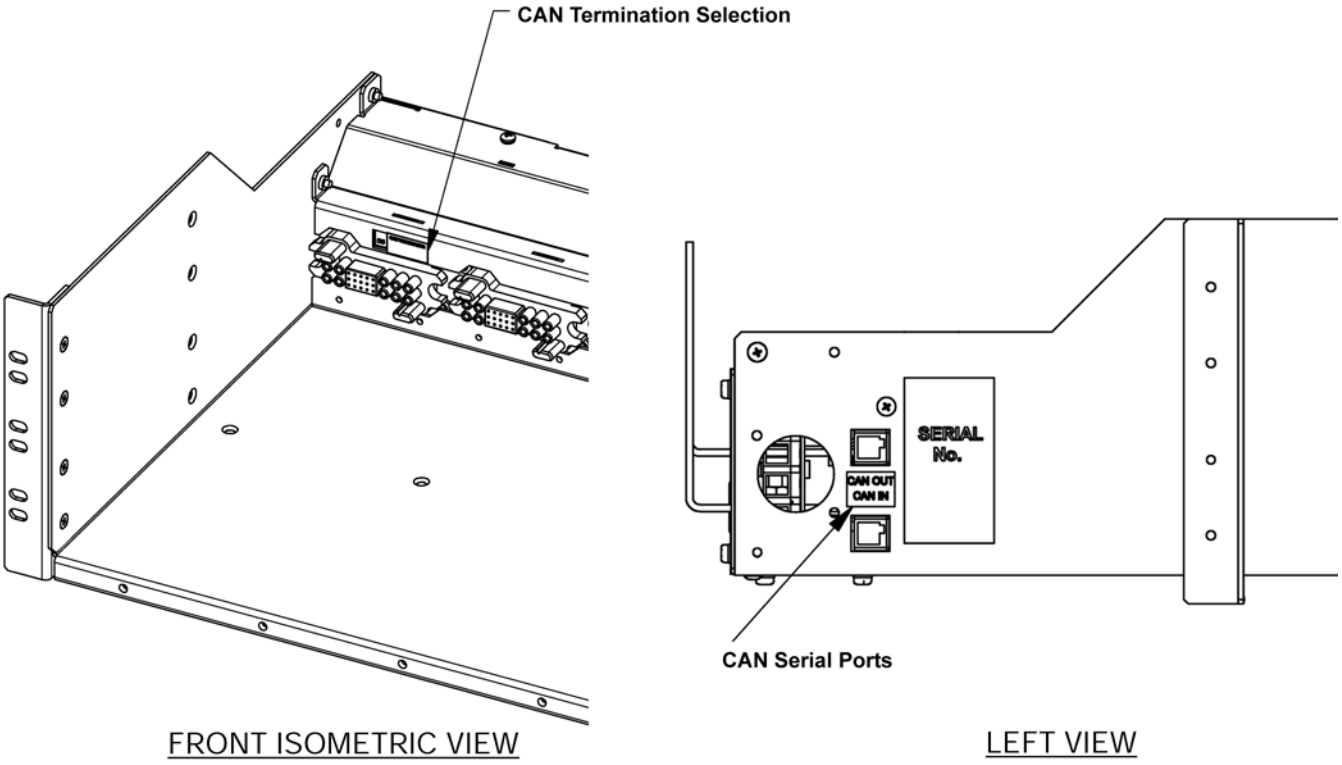


Figure 2–CAN serial ports and termination selection

6 Operation

6.1 Main Rectifier States

Rectifier operation can be broken up into five main states:

1. Off,
2. Start delay,
3. Soft start,
4. Normal operation,
5. Turning off.

Each state is characterized as being distinct and necessary for the operation of the rectifier. These states are briefly described below.

6.1.1 Off State

The rectifier will be in the Off state immediately after power is applied to the rectifier or after a rectifier shutdown. The shutdown source may be remote or local shutdown, AC shutdown, OVP or thermal shutdown.

When the rectifier is in this state the DC-DC converter is turned off and the CXC will be monitoring its inputs for the proper conditions to begin the start up sequence.

When the conditions have been met for the rectifier to start up, it will transition to the Start Delay state.

6.1.2 Start Delay State

When the rectifier is in the Start Delay state, the DC-DC converter is held off and still not sourcing power and is waiting for a given amount of time before transitioning to the next state.

When in this state, the CXC continues to monitor its inputs.

After the Start Delay state the rectifier will transition to the Soft Start state.

NOTE: *Soft start, or current walk-in, gradually increases the voltage and current output of the rectifier upon startup. This is done to reduce the instantaneous load on the AC source.*

6.1.3 Soft Start State

When the Soft Start state is entered, the rectifier will be turned on and the output voltage and output current will be gradually increased. If a load is present, the rectifier will begin to source power.

When the voltage and current limit ramps have finished, the rectifier will transition to the Normal Operation state.

6.1.4 Normal Operation State

The Normal Operation state is the state that the rectifier will be in performing all of the rectifier functions and features specified herein.

From this state, the only valid transition is to the Turning Off state. This transition will happen if the rectifier is required to shutdown.

6.1.5 Turning Off State

The Turning Off state is entered because a short delay is required before the rectifier actually turns off to take care of any initialization requirements.

When this short delay has elapsed, a transition to the Off state is made.

6.2 Main Rectifier Modes

In addition to Main Rectifier States, there is a set of Main Rectifier Modes. These modes can be divided into two categories as follows:

6.2.1 Output Voltage Modes

Voltage modes can be thought of as modes that, under software control, can 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 (such as the rectifier being in current limit).

The following table lists the five Output Voltage Modes and a description of when they are active:

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	Output voltage is set to the safe mode voltage setting.
Manual Test	Output voltage can be manually adjusted outside of the standard adjustment ranges.

Table A–Output voltage modes

6.2.2 Output Current/Power Modes

These modes directly affect the output current and power.

The following table lists the four Output Current/Power Modes and a description of when they are active:

Output Current/Power Mode	Active when…
Temperature foldback mode	Output current and power limit have been reduced due to high temperature of the heatsink or internal ambient temperature sensor.
AC foldback mode	Output current and power limit have been reduced due to low AC input voltage. *Note: 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.

Table B–Output current/power modes

6.3 Can Bus Communications

The CAN bus is used for communication between the rectifier and CXC.

The communication between the rectifier and CXC consists of commands and data transfer that are used during the operation of the power system to configure the rectifier with system settings and to monitor rectifier status.

6.4 Factory Ranges and Defaults

The following tables lists the rectifier settings/ranges/defaults; changes are made via the CXC:

Setting	Range (minimum to maximum)	Default
Float (FL) Voltage	90 – 160V	130.5V
Equalize (EQ) Voltage	90 – 160V	132.9V
Battery Test (BT) Voltage	90 – 160V	106.3V
OVP	See note below – 160V	137.8V
Current Limit (CL)	9 – 100%	100%
Power Limit (PL)	0 – 100%	100%
Module Start Delay	0 – 250s	1s
System Start Delay	0 – 600s	0s
Low Voltage Alarm (LVA)	90 – 160V	106.3V
High Voltage Alarm (HVA)	90 – 160V	134.1V
EQ Timeout	1 – 2399h	30h
BT Timeout	1 – 250h	8h
Softstart Ramp-rate	Normal/Fast	Normal
CL/PL Alarm	Enable/Disable	Enable
Remote Shutdown	Enable/Disable	Enable
Ramp Test	Enable/Disable	Enable

Table C–Cordex 125-4.4kW factory ranges and defaults

NOTE: *OVP cannot be set below the present system/FL/EQ/BT voltage setting or the safe mode voltage of 118.9V.*

7 System Startup

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

7.1 Check System Connections

- Ensure AC is off, battery is disconnected, and all power modules are removed from the shelf.
- Triple check the polarity of all connections.

7.2 Verify AC and Power the Shelf

- Install one power module.
- Verify AC input voltage is correct and turn on the corresponding AC input feeder breaker.
- The power module OK LED should illuminate after a preset start delay.
- Using the CXC, test functionality of various module alarms and controls.

7.3 Check Battery Polarity and Connect

- Verify correct battery polarity using a voltmeter (ensuring no cells or batteries are reversed).
- Connect battery as required to the output of the system or turn on battery breaker.
- Install remaining power modules.
- In the adjustments menu of the CXC, set Float and Equalize voltage to the levels specified by the battery manufacturer.
- Using the CXC, test functionality of various module alarms and controls. In addition, perform a load test with the system using a resistive load box as needed.

7.4 CXC Reset

The reset button located on the front panel of the optional CXC is for restarting the microprocessor. When pressed momentarily, the unit beeps twice then resets. The front-panel LED's will illuminate temporarily, but will extinguish after the system has finished its 15-second self-test.

8 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 repairs.

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

WARNING: HIGH VOLTAGE AND SHOCK HAZARD.

Use extreme care when working inside the shelf while the system is energized.
Do not make contact with live components or parts.

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

Procedure	Date Completed
Clean ventilation openings	
Inspect all system connections (re-torque as necessary)	
Verify alarm/control settings	
Verify alarm relay operation	

Table D–Sample maintenance log

Rectifiers could fail due to lack of maintenance and should be checked frequently until a proper maintenance schedule is developed to suit site conditions.

8.1 Spare Parts List

Item	Qty	Part No.	Rev.	Description	Circuit Designation or Remarks
List 0; On Site:					
0	2	747-212-20 List 0		Assy,Fan,Cordex 24-3.1kW	Fn100,101
1	1	707-374-20 List 0		Assy,PCB,Trans Protn,Cordex 3.6kW	(A8)

8.2 Fan Replacement

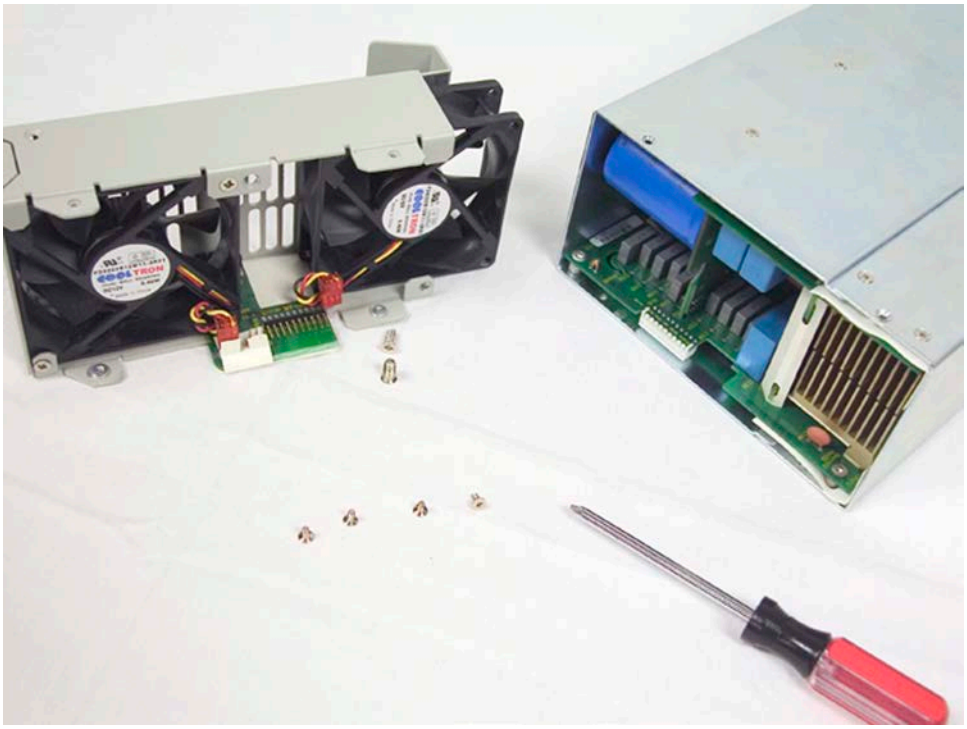


Figure 3–Fan replacement

1. Shut off the unit and unscrew the front fastener that secures the power module to the shelf.
2. Slide the module 10 cm (4") out of the shelf and wait two minutes for module capacitors to discharge.
3. Remove the four screws (two each side) that secure the front panel to the module chassis.
4. Slide the front panel out.
5. Disconnect the fan power lead wires (one set per fan) and front panel ribbon cable from the module.
6. Remove the screws that secure the fans to the front panel.
7. Note the direction of airflow and remove the fans from the front panel.
8. Install the replacement fans following the preceding steps in reverse order.

8.3 MOV Replacement

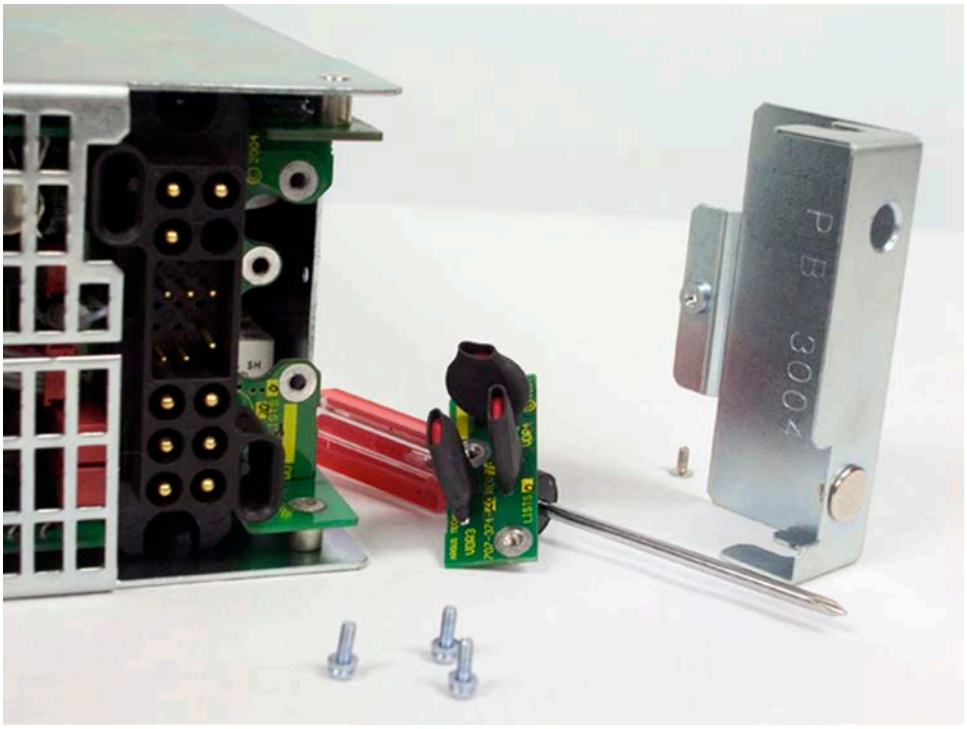


Figure 4–MOV replacement

The MOVs (metal oxide varistor) are used to protect the power modules from power line surges and the surges caused by lightning strikes. High capacity surges may permanently damage MOVs but they are easily replaced in the field using the following procedure:

1. Shut off the unit and unscrew the front fastener that secures the power module to the shelf.
2. Slide the module 10 cm (4") out of the shelf and wait two minutes for module capacitors to discharge.
3. Turn the module around to face the back of the unit and remove the one screw (module bottom toward the rear) securing the MOV cover.
4. Remove the cover and locate the MOV printed circuit board (PCB).
5. Remove the three screws that secure the MOV PCB.
6. Decontaminate the area and unit with flux remover or a similar cleaning compound. This is to remove any metallic particles or carbon, which may have been deposited when the MOV failed.
7. Install the replacement MOV PCB following the preceding steps in reverse order.

9 Warranty

Alpha Technologies Ltd warrants all equipment manufactured by it to be free from defects in parts and labor, for a period of two years from the date of shipment from the factory. 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.

Visit http://www.alpha.ca for full warranty information.

10 Abbreviations and Acronyms

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
MOV	Metal oxide varistor
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

CSA/NRTL — MARKS — BACKGROUND

What are the 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]

The product on which either of these marks appear has been certified by CSA as meeting applicable Canada/US standards.

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 and UL 60950.

Alpha UPS products, bearing the aforementioned CSA marks, are certified to CSA C22.2 No.107.3 and UL 1778.

The product on which this mark appears has been certified by UL as meeting applicable Canada/US standards.

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)

What are NRTLs and what do they do?

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)

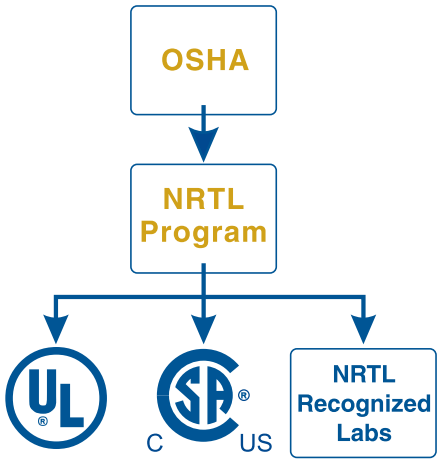
The NRTL determines that a product meets the requirements of an appropriate consensus-based product safety standard either by successfully testing the product itself, or by verifying that a contract laboratory has done so, and the NRTL certifies that the product meets the requirements of the product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

When was the NRTL started and who governs it?

In 1983, in a suit brought on by an independent testing laboratory, OSHA was court ordered to remove specific references to UL (Underwriters Laboratories) and FMRC (Factory Mutual Research Corporation) from its regulations.

In 1988, OSHA revised its regulations to remove those references and the NRTL program was established.

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



References:
Information in this document has been developed from the official websites of the respective organizations.
(1) www.csa-international.org
(2) www.scc.ca
(3) www.ulc.ca
(4) www.osha.gov

Specifications for Alpha's Switched Mode Rectifier Cordex 125-4.4kW

Power Module Output

Voltage:	90 to 160Vdc within rated limits
Current:	35.2A @ 125Vdc nominal (40A @ 110Vdc maximum)
Maximum Power:	4400W continuous/module
Static Load Regulation:	Better than ±0.5% for any load change within rated limits
Dynamic Load Regulation:	Better than ±5% for 40% - 90 - 40% step load change at nominal output voltage (output shall recover to static limits within 30ms)
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 shall recover to static limits within 10ms)
Hold-up Time:	>10ms
Time Stability:	≤0.5% per year
Temperature Stability:	<100ppm/°C over the operating range
Heat Dissipation:	<1080 BTU per hour
Electrical Noise:	<90mVrms 10kHz to 10MHz (wideband) <700mVp-p 10kHz to 100MHz
Acoustic Noise:	<55dBa @ 1m (3ft.) A weighted @ 30°C (86°F) [five modules in a shelf]
EMI:	The unit meets requirements of EN55022 (see Standards for more EMC)

In accordance with FCC requirements, we provide the following statement as specified in the FCC guidelines for conformance to Part 15, Class A:

> **NOTE:** *This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.*

Any changes or modifications to this equipment not expressly described in this manual could void the FCC compliance.

Power Module Input

Voltage:	208 to 240Vac nominal
Extended Operation:	Low: 187 to 90Vac (power de-rated linearly to 40% output) High: 265 to 312Vac (de-rated power factor)
Frequency:	50/60Hz nominal (45 to 70Hz)
Current:	20A @ 240Vac 23A @ 208Vac 26A @ 187Vac (maximum)
Recommended Feeder Breaker:	30A
Power Factor:	>0.99 at nominal conditions and 50-100% load
Protection:	10kA-interrupting capacity fuses in active and neutral lines
Efficiency:	>92% at nominal conditions and 50-100% load
Inrush Current:	≤ full load steady state current of the rectifier within rated limits
Start-up Ready Time:	<5 seconds (excluding soft start) to complete inrush limit routine and ac measurement (for OK signal)
Start-up Delay:	Programmable up to 120 seconds to enable stagger-start of multiple rectifiers and to minimize the effect on a supply source
Soft Start:	User adjustable to at least 5 seconds (not including start-up delay time) and is determined by output current limit ramp-up
T.H.D. (Current):	<5% at 100% load
Input Transient Suppression:	Meets ANSI/IEEE C62.41 Category B3
Input Leakage Current:	<3.5mA @ 265Vac 60Hz

Environmental

Operating Temperature:	-40 to +75°C, power derated above 50°C (122°F) (-40 to 167°F)
Storage Temperature:	-40 to +85°C (-40 to 185°F)
Humidity:	0 to 95% non-condensing
Elevation:	-500m to 2800m; to 4000m with temperature derated to 40°C (-1640 feet to 9186 feet; to 13124 feet with temperature derated to 104°F)

Miscellaneous

MTBF:	>350,000 hours ground benign @ 30°C (86°F)

Mechanical

Module

Dimensions:	160mm H x 87mm W x 300mm D [6.3" H x 3.4" W x 11.8" D]
Weight:	4.65 kg (10.25 lb.)

19" Shelf (fits 5 modules)

Dimensions:	177mm H x 442mm W x 389mm D [7" H x 17.4" W x 15.3" D]
Weight:	8.5 kg (18.7 lb.)
Mounting:	Fits 19" rack flush mount Optional 19" or 23" mid-mount brackets

Connections

Input:	Box type terminal block, 6 to 16mm^2 (#10 to #6AWG)
Output:	Bus adapters with 3/8" studs on 1" centers
Chassis Ground:	Compression lug, 6 to 16mm^2 (#10 to #6AWG)
CAN Communication:	RJ-12 offset

Safety

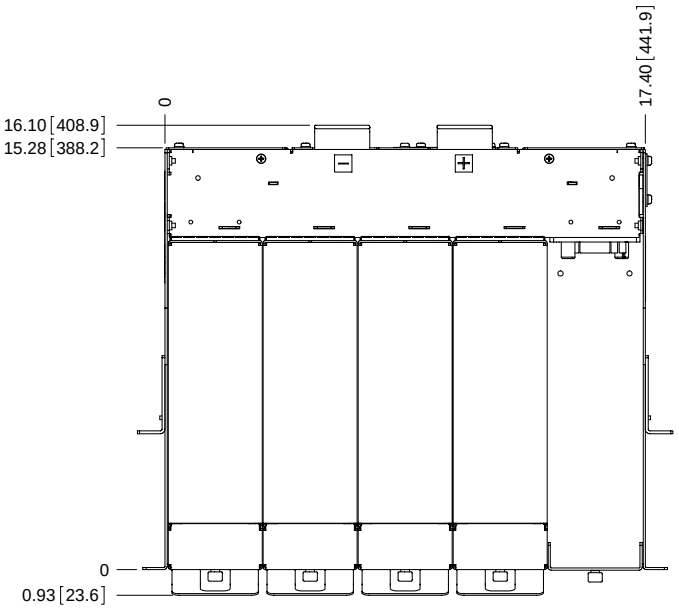
EN	60950-1:2006
UL	60950-1: 2007
CSA	C22.2 No. 60950-1-07
CE	Low Voltage Directive 2006/95/EC; EMC Directive 2004/108/EC, CB Scheme

Other Referenced Standards

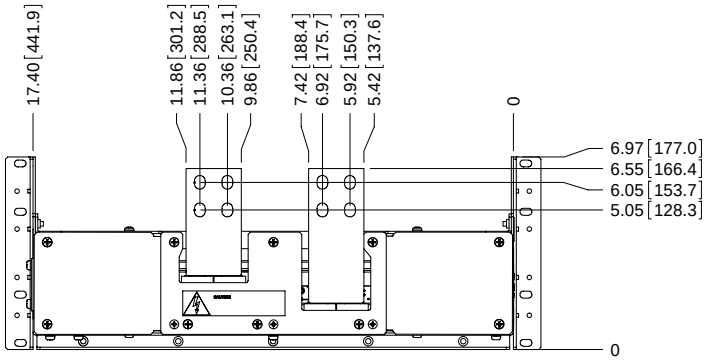
EN 55022 (CISPR 22)	Information Technology Equipment – Radio Disturbance Characteristics – Limits and Methods of Measurement
EN 61000-3-2	Harmonic Current Emissions
EN 61000-3-3	Voltage Fluctuations and Flicker
EN 61000-4-2	ESD Immunity
EN 61000-4-3	Radiated Electromagnetic Immunity
EN 61000-4-4	Electrical Fast Transient (EFT)/Burst Immunity
EN 61000-4-5	Power Line Surge Immunity
EN 61000-4-6	Conducted Electromagnetic Immunity
EN 61000-4-11	Voltage Dips, Short Interruptions and Variations
ETS 300 019-1-1	Environmental Conditions; Storage
ETS 300 019-1-2	Environmental Conditions; Transportation
ETS 300 753	Acoustic Noise Emissions
IEC 60950	Safety of Information Technology Equipment, Including Electrical Business Equipment (UL/CSA 60950)

The above information is valid at the time of publication. Consult factory for up-to-date ordering information.
Specifications are subject to change without notice.

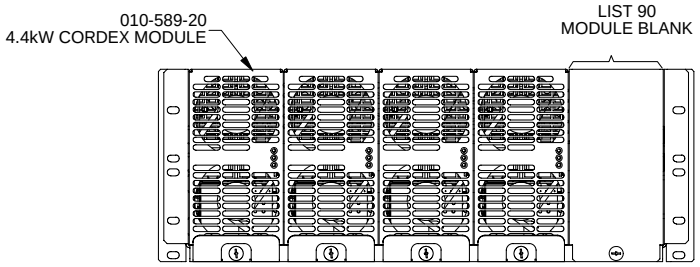
REVISIONS				
LTR	DESCRIPTION	REV BY	DATE	APPD
B	ADDED MOUNTING BRACKETS	S.D.W.		



TOP VIEW
REAR COVER IS HIDDEN
(LIST 82 OUTPUT BARS)



REAR VIEW
REAR COVER AND MODULES ARE HIDDEN
(LIST 82 OUTPUT BARS)



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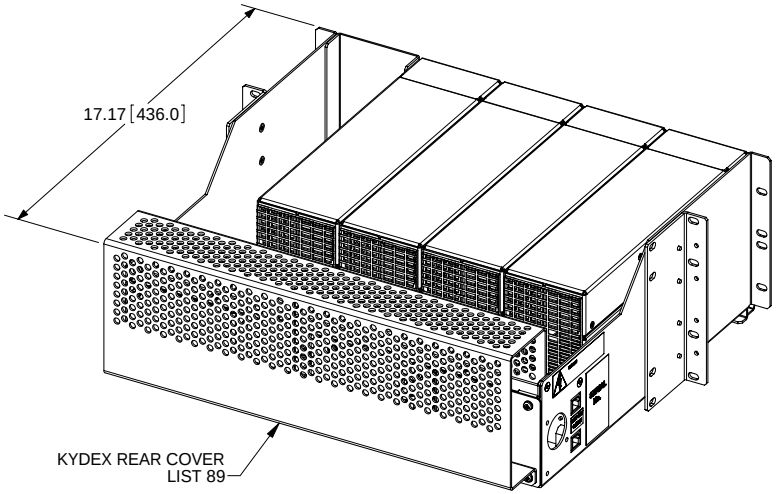

REAR ISOMETRIC VIEW

DIMENSIONS ARE IN INCHES WITH METRIC [mm] IN BRACKETS: INCHES [mm]

ARGUS

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DRAWN	EOF/J.U.	2006/05	
CHECKED	G.S.	2006/05	
APPROVED	G.S.	2006/05	FINISH

TOLERANCES
X.X ±0.04" [X] ±1mm
X.XX ±0.02" [X.X] ±0.5mm
X.XXX ±0.01" [X.XX] ±0.25mm

SCALE N.T.S.

TITLE
OUTLINE, 19" SHELF
4.4kW CORDEX

ISSUE DATE

SHEET 1 OF 2

SIZE	TYPE	DWG NO.	REV
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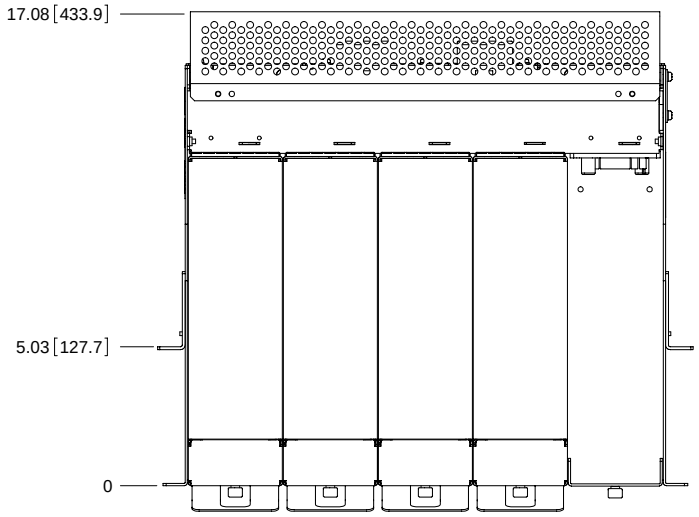
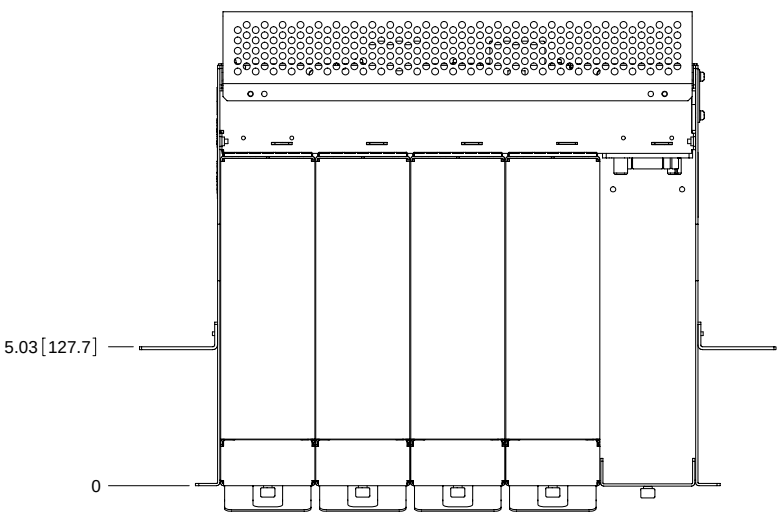


TOP VIEW LIST 19 - 19" MID-MOUNT



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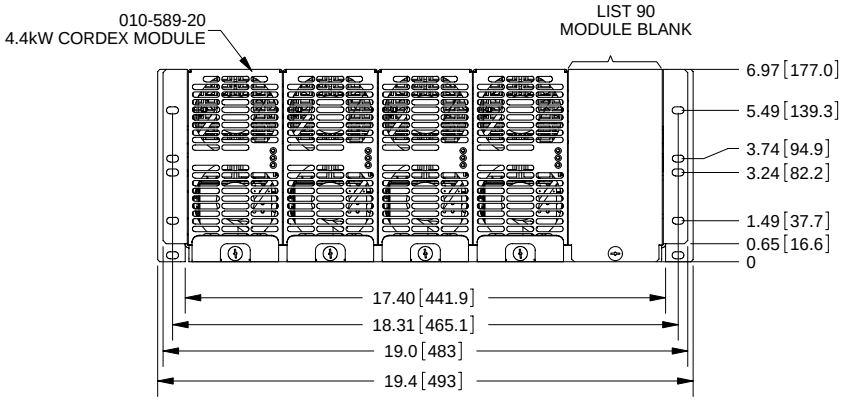
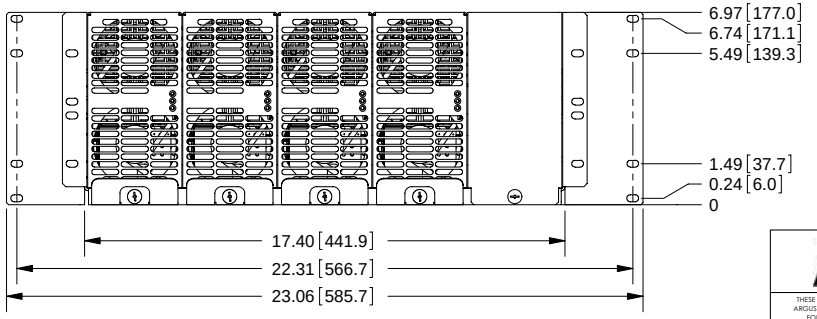


FRONT VIEW LIST 19 - 19" MID-MOUNT



FRONT VIEW LIST 23 - 23" MID-MOUNT

DIMENSIONS ARE IN INCHES WITH METRIC (mm) IN BRACKETS: INCHES [mm]

ARGUS

SCALE N.T.S.

TITLE
OUTLINE, 19" SHELF
4.4kW CORDEX

ISSUE DATE

SHEET 2 OF 2

SIZE	TYPE	DWG NO.	REV
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REVISIONS				
LTR	DESCRIPTION	REV BY	DATE	APPD
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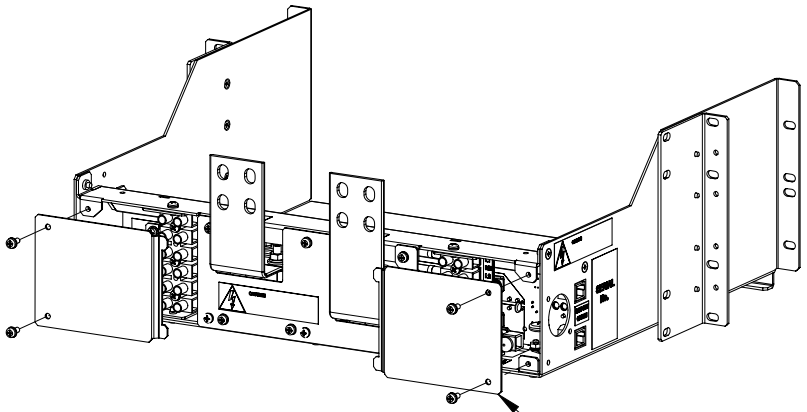

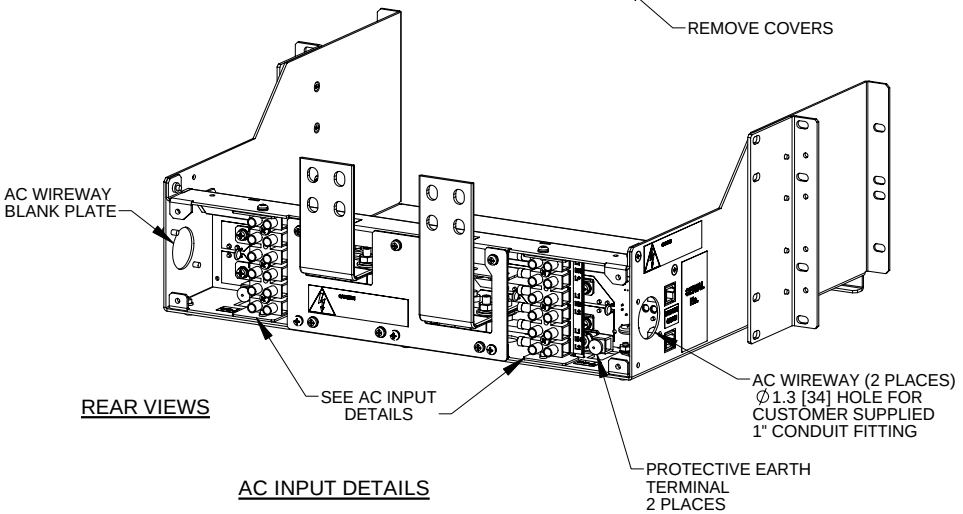

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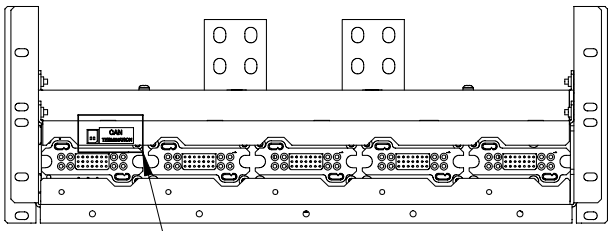
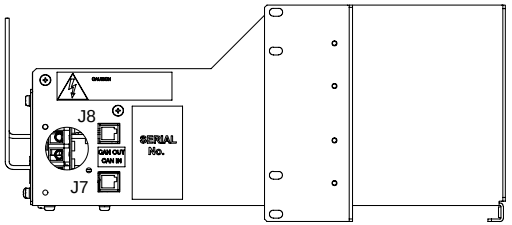


SWITCH SETTING FOR CAN TERMINATION

CAN
TERMINATED

CAN
UNTERMINATED



CAN OUT RJ12 OFFSET PIN OUT (J8)

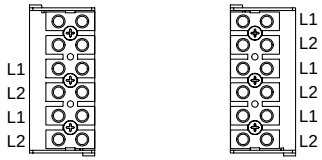
1. GND
2. CAN H
3. NOT CONNECTED
4. CAN L
5. NOT CONNECTED
6. NOT CONNECTED

CAN IN RJ12 OFFSET PIN OUT (J7)

1. GND
2. CAN H
3. NOT CONNECTED
4. CAN L
5. NOT CONNECTED
6. NOT CONNECTED

AC INPUT DETAILS

SINGLE PHASE INPUTS, 208V - 277VAC



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DRAWN	J.U.	2006/05	
CHECKED			
APPROVED	G.S.	2006/05	FINISH

TOLERANCES
X.X ±0.04" [X] ±1mm
X.XX ±0.02" [X.X] ±0.5mm
X.XXX ±0.01" [X.XX] ±0.25mm

PER P.O. and Doc. 070-024-83

SCALE N.T.S.

TITLE
CUSTOMER CONNECTION
19" SHELF, 4.4kW CORDEX

ISSUE DATE

SHEET 1 OF 2

SIZE	TYPE	DWG NO.	REV
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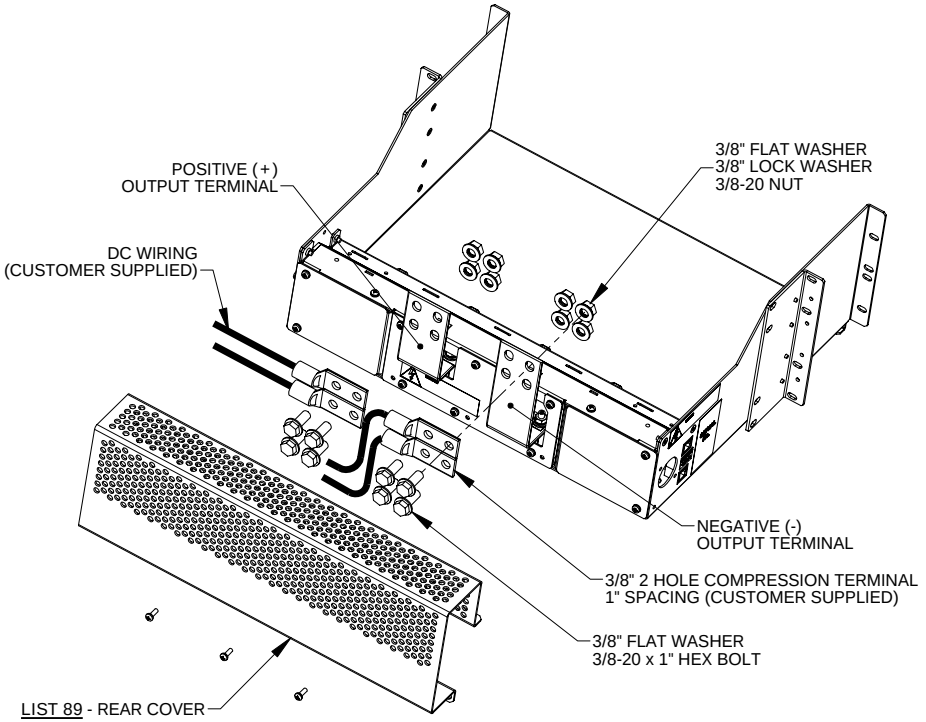
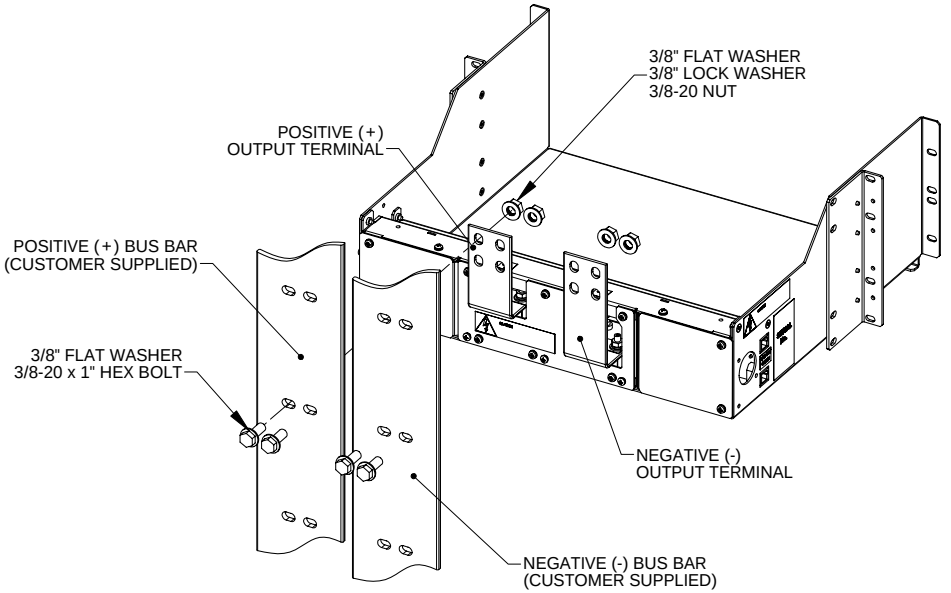
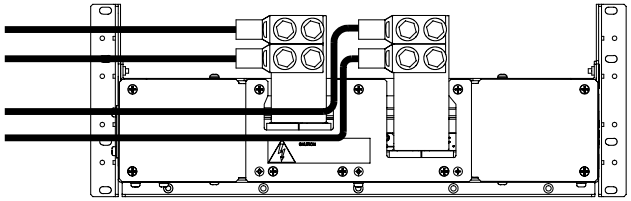


REAR VIEW - DC CABLE INSTALLATION



REAR VIEW - BUS BAR INSTALLATION



REAR VIEW - DC CABLE INSTALLATION

REAR COVER NOT SHOWN

ARGUS

SCALE N.T.S.

TITLE
CUSTOMER CONNECTION
19" SHELF, 4.4kW CORDEX

ISSUE DATE

SHEET 2 OF 2

SIZE	TYPE	DWG NO.	REV
B	D2	030-769-08	B

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Power