Cordex PSU, 24V/400W or 48V/650W

Web Enabled, DIN Rail/Wall Mount Power Supply
Installation & Operation Manual

Part # 0100011-J0
Effective: 07/2020

Your Power Solutions Partner

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 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.

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1 Introduction

1.1 Product Overview

- Clean and reliable DC power supply for critical loads available in two options: 24V/400W or 48V/650W
- Internet ready and remotely accessible for complete and cost effective system and site monitoring
- Advanced battery charging, monitoring and testing to ensure sufficient reserve power availability and prolonged battery life
- Configurable platform with I/Os for site monitoring, user-definable alarms, data logging and control
- Extended temperature range for installation in harsh outdoor environments
- Wide AC input operating range for world wide installation requirements

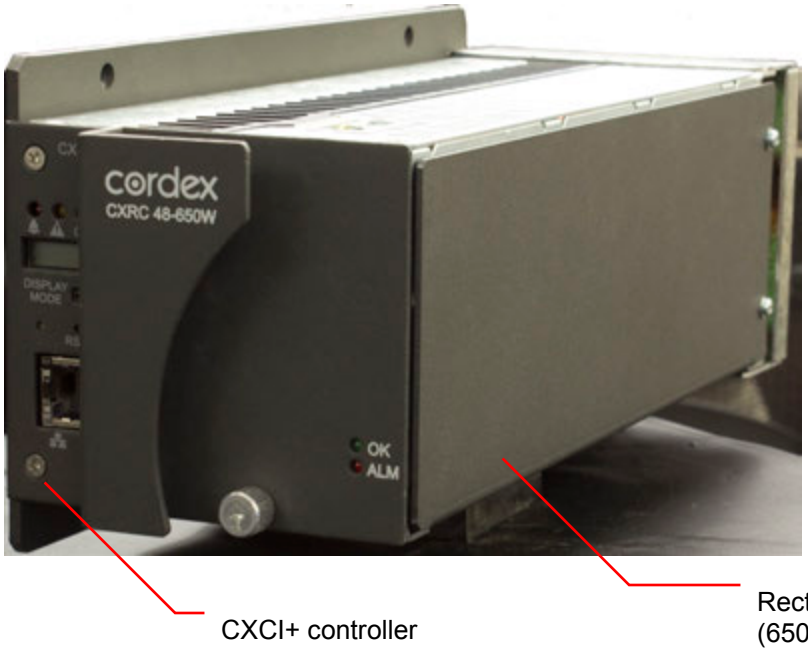

Figure 1– Cordex PSU, 24V/400W or 48V/650W shelf system with integrated CXCI+ controller

1.2 Specifications

The product is available under the following part numbers:

- 24V-400W model, DIN Rail mount: #0100011-002
- 48V-650W model, DIN Rail mount: #0100012-002

Electrical		
	>48V/650W	**>24V/400W**
Input voltage:		
Operating:	120/208/240Vac	120/208/240Vac
Extended:	Low: 90 to 120Vac (de-rated power)	
Input frequency:	45 to 65Hz	45 to 65Hz
Current:	5.0A max	4.9A max
Power:	650W max	400W max
Power factor:	>0.99%	>0.99%
THD:	<5%	<5%
Efficiency:	>90%	>88%
Output voltage:	42 to 58Vdc	20 to 30Vdc (24V Nominal)
Output current:	13.5A max	14A max
Load regulation:	Static <±0.5%	Static <±0.5%
	Dynamic <±2% for 50 to 100% load step	Dynamic <±5% for 50 to 100% load step
	2ms recovery time	2ms recovery time
Load regulation:	Static <±0.1%	Static <±0.1%
	Dynamic ±1% for any change within rated	Dynamic ±1% for any change within rated
Noise:		
Voice band:	<32dBrnC	<32dBrnC
Wide band:	<10mV RMS (to 10MHz)	<10mV RMS (to 10MHz)
	<150mV pk to pk (to 100MHz)	<100mV pk to pk (to 100MHz)
Psophometric:.	<1mV RMS	<1mV RMS
Mechanical		
Dimensions (HxWxD):	117mm x 281mm x 101mm (4.6in x 11.1in x 3.98in)	
Weight:	3kg (6.6lbs)	
Mounting:	Panel	
	DIN rail (standard TS-35/7.5 or 15 Mounting Rail)	
Connections:		
AC, Load & Battery:	Screw terminal 4mm^2 (#12AWG)	
Alarms & I/Os:	Screw terminals 2.5mm^2 to (#14AWG)	
Environmental		
Temperature:		
Operation:	- 40 to 50˚C (-40 to 122˚F)	
Extended:	51 to 70˚C (123 to 158˚F)	
Storage:	- 40 to 85˚C (-40 to 185˚F)	
Humidity	0 to 95% RH non-condensing	
Altitude:	-500 to 3000m (-1640 to 9840ft)	
Heat Dissipation:	<110 BTU per hour	
Other	MTBF: 369,000 hrs @30°C ambient; test model Telecordia SR-332, Issue 2	
Agency Compliance		
Safety:	CSA C22.2 No 60950-1-07 (2nd Ed) / UL 60950-1 (2nd Ed) cCSAus Marked	
	IEC 60950-1:2005 (2nd Ed) / EN60950-1:2006 CE Marked	
EMC:	ETSI 300 386-2	
Emissions:	CFR47 (FCC) Part 15 - Class A Device	
	EN 61000-3-2	
	EN 61000-3-3	
Immunity:	EN 61000-4-2, EN 61000-4-3	
	EN 61000-4-4, EN 61000-4-5	
	EN 61000-4-6, EN 61000-4-11	
	ANSI / IEEE C62.41 CatB3	

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

2 Features

Alpha's Cordex PSU is an integrated, fully-featured DC power system in a compact form factor. It is designed to provide power to critical loads while enabling remote site monitoring and delivering critical information on demand. The PSU supplies reliable and low output ripple current along with short circuit, over voltage, over temperature and over load protection. It also features advanced battery charging, monitoring and testing functionality. Two temperature, two digital and one analog inputs can be used for monitoring system alarms such as intrusion detection or equipment malfunction.

2.1 Cordex Integrated System Controller (CXCI+)

The integrated CXCI+ controller offers comprehensive local and remote control and monitoring, including a web server, providing easy set up using a standard Windows Internet Explorer browser. SMTP features "enable alarm" condition settings and multiple automatic notification options by e-mail to a computer, server or smartphone.

Sites without internet access can use the integrated CXCI+ controller as an advanced standalone data logging system, allowing the capture of data from multiple inputs such as AC/DC voltages, load/battery current, and cell voltage/temperature.

The CXCI+ captures and retains 90 days of statistical data and 500 alarm events, ready for download to a laptop for site history file and analysis of system performance, power system details, thermal performance of outdoor enclosures and failure conditions.

NOTE: *Customer settings for the CXCI+ are provided in a separate software manual:included in the PSU documentation package.*

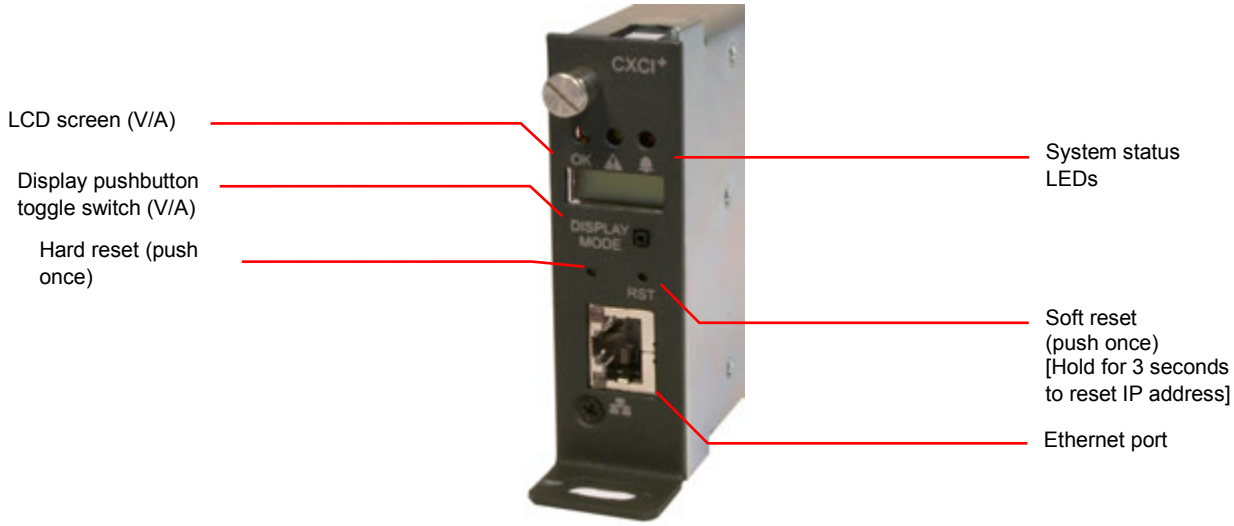

Figure 2 Cordex CXCI+ controller front panel

2.1.1 Front panel user interface

Display:	4-digit display for monitoring system voltage (V) and current (A). A pushbutton switch toggles the display.
GUI:	Embedded web based GUI accessed via Ethernet using internet browser
LEDs:	Alarm indication: • AC mains OK — Green • Minor alarm — Yellow • Major alarm — Red Progress and Status Indication: • Self-test: LEDs all on at the same time • File transfer: red LED on when recovering from invalid firmware application

Audio speaker:	Sounds an intermittent tone during active alarms
Reset:	Soft reset button: push once to reset controller; push hold for 3 sec to reset IP address Hard reset button: use to reset controller when controller is hung up and not responding
Ethernet Port (RJ-45 jack)	10/100 Base-T for TCIP/SNMP/Email features (standard network cable) Local access, e.g., laptop computer (crossover cable)

2.2 Analog Input Channels

Voltage Inputs:	Two voltage input channels, V1 and V2, provide monitoring of discharge and charge voltage. The CXCI+ software is pre-configured to monitor V2 for load and battery voltage. V2 is used as the system reference for rectifier float voltage, low voltage disconnect (B), system high voltage alarm, and system low voltage alarm. V1 is available for additional voltage measurements.
Current Inputs:	The CXCI+ software is pre-configured to monitor I1 for load current wired internally to the system current shunt.
Temperature Inputs:	Two temperature input channels, T1 and T2, provide monitoring of battery temperature and temperature compensation (temp comp) or room/ambient temperature. A voltage is supplied to these terminals to power the temperature sensors.

2.3 Digital Input Channels

The CXCI+ can accommodate up to two channels and can monitor digital alarm/control signals from sensors such as a door alarm and other types of site monitoring equipment.

2.4 Alarm and Control Output Relays

The CXCI+ contains four Form C digital alarm output relays to extend alarms and control external apparatus. Each internally generated alarm or control signal can be mapped to any one of relays K2-K4, or, several signals may be mapped to just one relay or none at all. Relay K1 is mapped to the LVBD.

2.5 Network Connection and Remote Communications

The Cordex system can be set up, monitored and tested via Ethernet 10/100 Base-T serial data connection. The communication protocol supports a web interface. All alarming and control of Cordex rectifiers is accomplished with a CXC via a CAN bus.

A step-by-step connection wizard – provided to establish remote communications with your CXC – is available on the Alpha website (www.alpha.ca).

2.6 Rectifiers

Figure 3–Rectifier front panel (400W shown)

2.6.1 Front Panel LEDs

The front panel LEDs provide rectifier status summary and help to locate a specific module under CXC control.

OK	The top LED (green) is on when AC is within a valid range and the rectifier is delivering power to the load. The LED turns off when AC has failed or when the rectifier is off; for example, when commanded by the CXC controller. AC voltage is invalid if the AC Mains Low or AC Mains High alarm is active.
ALM (Alarm)	The bottom LED (red) is on continuously in the event of an active Module Fail alarm. The LED flashes (~2Hz) when a minor alarm is detected.The LED remains off in the absence of an alarm.
Locate Module command from CXC	LEDs flash in a distinct pattern that makes it easy to identify the rectifier visually among adjacent rectifiers.
Firmware upload in progress	The LEDs flash in the same pattern as the “locate module” command described above.

2.6.2 Mechanical

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

2.7 True Module Fail Alarm

The power module has a “true” fail alarm, which 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.*

2.8 Heat Dissipation

Heat dissipation is achieved through natural (bottom to top) convection cooling.

2.9 Over Temperature Protection

Each PSU 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 restarts automatically once the temperature returns to a safe level.

2.10 Wide AC Range

A minor alarm is generated when the AC input voltage drops below specification. The unit will deliver derated output power down to 90Vac.

For voltages above 240Vac, power factor and total harmonic distortion may be derated.

2.11 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.

2.12 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.

2.13 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.

[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.

2.14 High Voltage Shutdown (HVSD)

This feature provides protection to the load from over voltage conditions originating from the rectifier. It operates by shutting down the rectifier module when a high output voltage condition occurs. Indication is through the red Alarm (Module Fail) LED. The module 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.

2.15 Battery Eliminator Operation

The PSU maintains all specifications (except where indicated) with or without a battery attached in parallel to the output; however, if a battery 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.

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

This chapter is provided for qualified installation personnel.

NOTE: *Mount in a clean and dry environment*

4.1 Safety Precautions

WARNING
Hazardous voltages are present at the input of power systems. The DC output from the rectifiers and battery system, 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/distribution center, follow these precautions:

- Remove all metallic jewelry; e.g., watches, rings, metal rimmed glasses, necklaces.
- Wear safety glasses with side shields (and prescription lenses if necessary) at all times during installation.
- Use OSHA approved insulated hand tools.

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 PSU Preparation/Mounting

CAUTION: The PSU requires at least 2" of space around the unit to meet cooling requirements.

4.2.1 DIN rail Mounting Option

- Standard TS-35/7.5 or 15 mounting rail

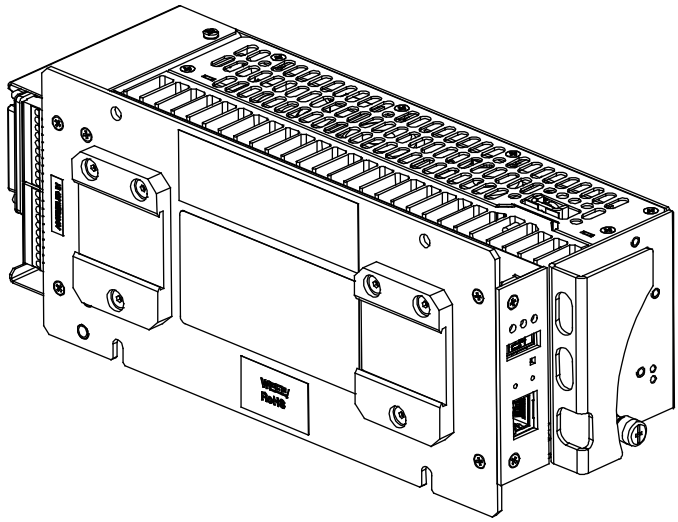

Figure 4–DIN rail mounting option

4.2.2 Panel/Wallmount Option

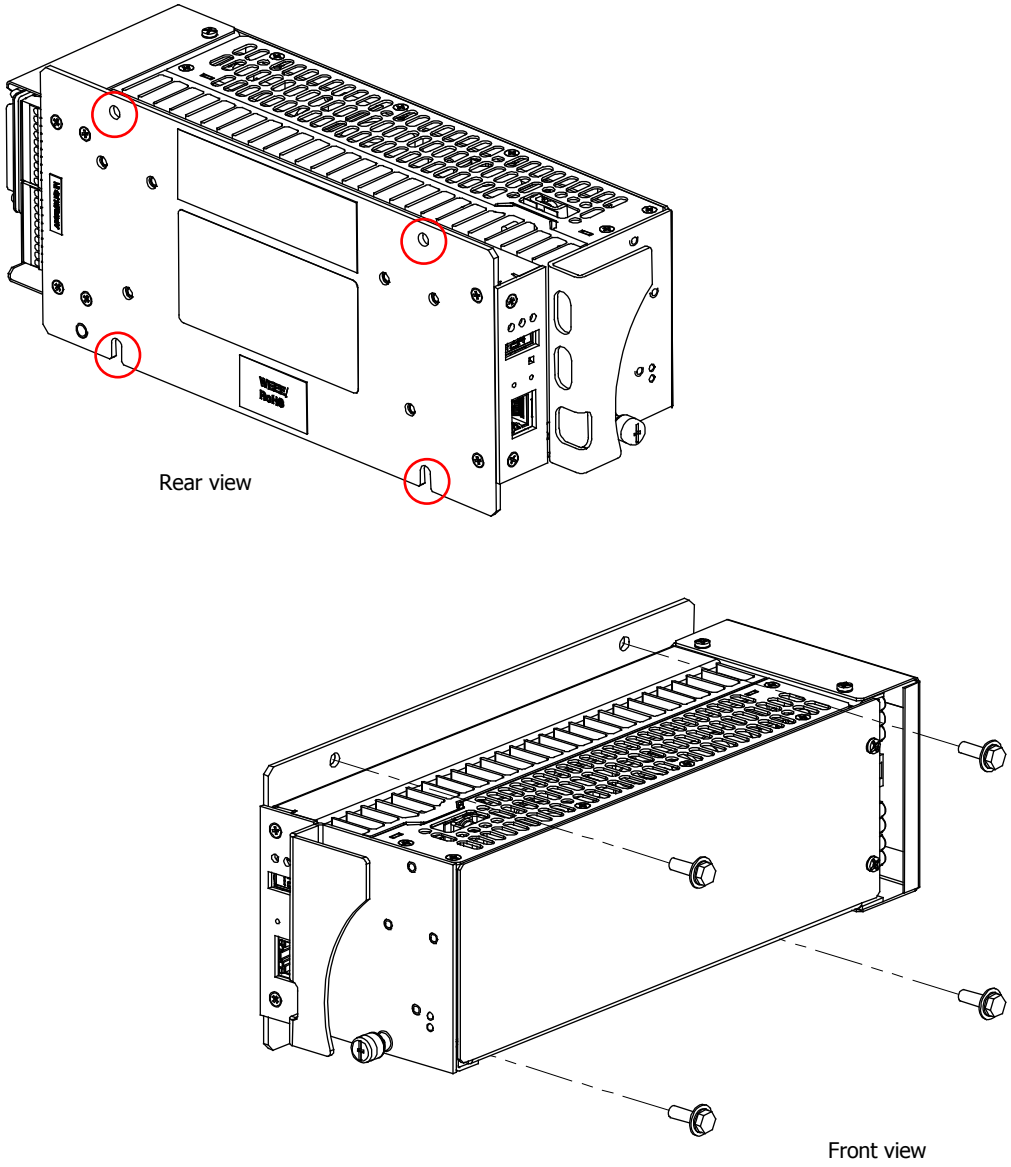

Figure 5-Panel/Wallmount Option

The Cordex PSU can be mounted to surfaces such as wood (at least 3/4" thick), metal or concrete with #10 (M5) fastening hardware that is appropriate for the chosen surface.

1. Remove the 2 DIN rail mounting clips (3x screws per clip shown in Figure 4).
2. Mount horizontally on a vertical surface using appropriate #10 (M5) fastening hardware in the 4 locations shown in Figure 5.

5 Wiring and Connections

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.

5.1 Tools Required

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 24/48Vdc load (optional)
- Cutters and wire strippers
- Crimping tool (optional for large gauge wire)
- Socket and rachet set (Imperial measure)
- Anti-static wrist strap
- Computer (laptop) with Microsoft® Internet Explorer
- Crossover cable RJ-45 (for access using the Ethernet port).

5.2 Power System Chassis Ground and DC Ground Reference

WARNING
For safety reasons, ensure the system is properly bonded to the building's ground grid.

Both the shelf chassis ground (via power system chassis ground) and common return shall be connected to the site ground to ensure correct operation of the system and to prevent drifting floating analog (especially current) readings.

5.3 AC Feeder Protection/Sizing

It is recommended to use 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.

Circuit Breaker Exact Value to Use	90 deg. C Wire Gauge to use at 30 deg. C ambient
15A	2.50mm² (#14 AWG)

Table A–Recommended AC supply configuration

5.4 AC Input

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.

5.5 Wiring Schematic

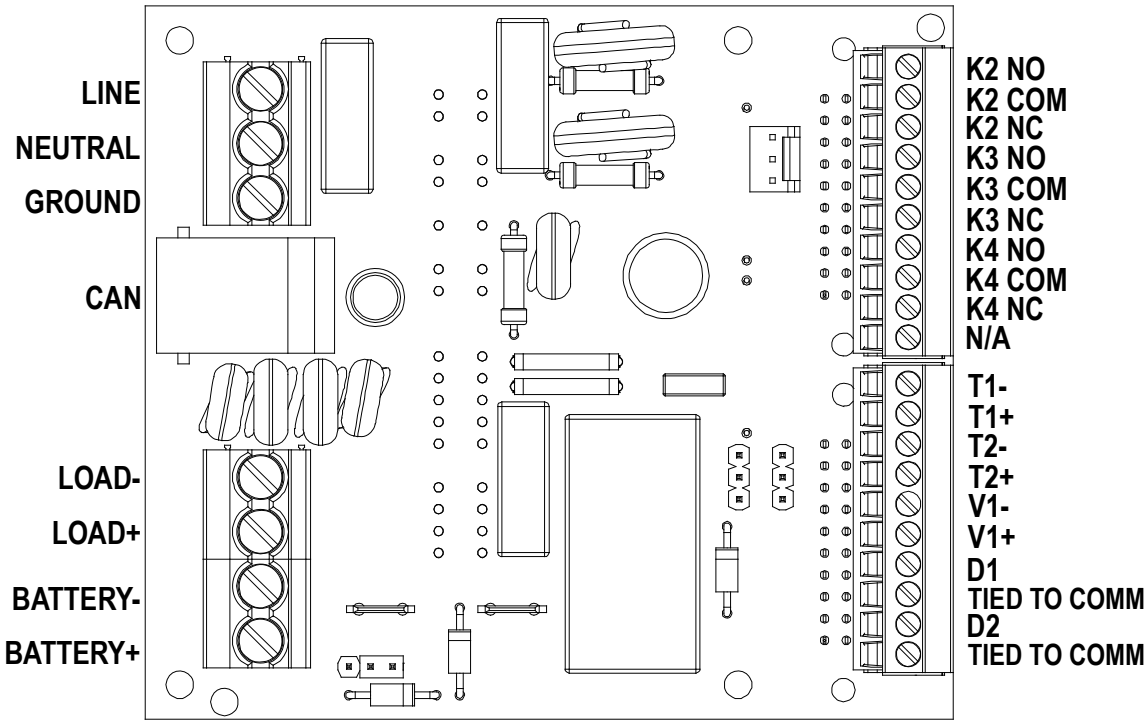

Figure 6 – Wiring Connections

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

WARNING
Leave cables disconnected at battery and verify output polarity using a voltmeter. Make final connections at the battery 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 Load

Secure the positive and negative cable leads to the output terminal blocks of the correct polarity—see Figure 6.

The common output leg of the rectifier should be connected to ground. This is typically done at the load common termination point (negative bus bar for +24V systems).

Replace rear cover once all connections have been completed.

5.8 Network Connection and Remote Communications via CXCI+

The Cordex system can be set up, monitored and tested via Ethernet 10/100 Base-T serial data connection. The communication protocol supports a web interface. Some standard scenarios are described below:

5.8.1 Ethernet Port for Network Connection (Standard Network Cable)

The Ethernet port is designed for CXCI+ connection to a user supplied network (TCP/IP secured by user) via a front panel RJ-45 jack.

Connect to the CXCI+ using a standard network cable.

5.8.2 Ethernet Port for Local Connection (Crossover Cable)

Local access (e.g. laptop computer) is also possible from the Ethernet port connection using a standard network crossover cable.

5.9 Signal Wiring Connections

Refer to Figure 6 for the location of the terminal block.

For terminal block connections, the recommended wire sizes are 1.5 to 0.14mm² (#16 to #26 AWG) for the temperature range of 0 to 50 deg. C (as per UL/CSA). Control and sense wires shall be UL approved Style 1015 (for Canadian users, TEW type).

CAUTION: to reduce risk of fire, use only 0.14mm² (#26 AWG) or larger wire.

Description	Default Name	Signal Type	Range
LVBD Control (internal)	K1, Relay 1	NO/COM/NC	60Vdc / 1A
Alarm Output 2	K2, Relay 2	NO/COM/NC	60Vdc / 1A
Alarm Output 3	K3, Relay 3	NO/COM/NC	60Vdc / 1A
Alarm Output 4	K4, Relay 4	NO/COM/NC	60Vdc / 1A
Digital Input 1 (internal)	D1, Digital 1	Pos (+) or Neg (-)	0—60Vdc
Digital Input 2	D2, Digital 2	Pos (+) or Neg (-)	0—60Vdc
Voltage Input 1	V1, Load Voltage	Pos (+) / Neg (-)	0—60Vdc
Voltage Input 2 (internal)	V2, Load and Battery Voltage	Pos (+) / Neg (-)	0—60Vdc
Temp Probe 1	T1, Analog Input T1	Pos (+) / Neg (-)	0—20Vdc
Temp Probe 2	T2, Analog Input T2	Pos (+) / Neg (-)	0—20Vdc

Table B–Signal wiring connections for PSU

* NO and NC Form C contacts available. Can be configured to de-energize on alarm (DOA) or energize on alarm (EOA).
** See Table C for definitions of logic and system.
*** Voltage (Input) is 0—60VDC, Temp Probe is 0—20VDC with power source.

NOTE: *The signal cables should be bundled together and tie-wrapped.*

5.9.1 Analog Inputs for CXCI

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.

5.9.1.1 Voltage

Voltage Input #1 (load voltage per CXC software) terminals 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 software) is wired internally 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 LVD).

5.9.1.2 Temperature Sensor

Temperature Probe input channels provide connections for up to two temperature sensors. A voltage is supplied to these terminals for sensor measurements. Connect the red lead to “+” and the black lead to “-“.

5.9.1.3 Current

Current Input #1 (load current per CXC software) is wired internally to the system current shunt (75A/50mV) in the negative lead.

5.9.2 Digital Inputs for CXCI

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

D1 is wired internally for CB/fuse trip. D2 is available for customer connections as required.

5.9.2.1 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; e.g., positive input for +24V systems. The other input terminal is wired to the Ground (common) of the system through a relay (dry contact – usually located on the equipment requiring monitoring). This method (see Figure 7) allows the digital input to receive (or not receive) a Ground signal on an alarm.

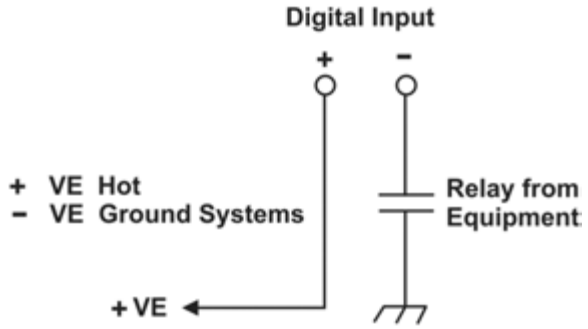

Figure 7–Showing digital input connection method

5.9.2.2 Programming the Digital Input

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 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—3	9—60

Table C–Voltage level definitions for digital inputs

5.9.3 Alarm (Relay) Outputs

CAUTION: Relay contacts are not power limited. Connect relay outputs to SELV circuits only.

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. See Figure 8.

CAUTION: Connect the common contact of the relay to the powered line. Use the NO or NC contact as the output.

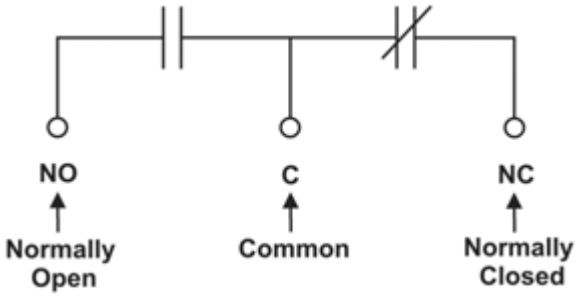

Figure 8–Showing relay connections

Relays can be programmed to energize or de-energize during an alarm condition (see CXC Software manual).

NOTE: *When the CXCI+ reset button is pressed or power is lost, all relays de-energize.*

These relays could be used for additional external LVD contactor control; however, this would not provide the redundant LVD control as with the assigned output pins described in section 5.9.4.

5.9.4 LVBD Control (Battery Disconnect) Option

The disconnect option is controlled by and connected internally to relay K1..

5.9.5 LVD Control Alternative

The LVD Control functions can be hardwired directly from an alarm output relay to an external LVD contactor (or panel). See **Controls** menu defaults in the CXC Software manual.

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 shut down.

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 four 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. **NOTE:** *After five minutes without communications with the system controller, the rectifier will revert to Safe Mode voltage and clear any current limit adjustments made by the controller.*

Table D–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 E–Output current/power modes

6.3 400W PSU Factory Ranges and Defaults

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

Setting	Range (minimum to maximum)	Default
Float (FL) Voltage	23.75 – 29.30V	27.00V
Equalize (EQ) Voltage	24.90 – 29.30V	27.50V
Battery Test (BT) Voltage	22.00 – 26.00V	23.00V
Safe Mode Voltage	23.00 – 28.00V	25.70V
OVP	See note below – 30.30V	28.50V
Current Limit (CL)	23 – 100%	100%
Power Limit (PL)	0 – 100%	100%
Module Start Delay	0 – 250s	1s
System Start Delay	0 – 600s	0s
Low Voltage Alarm (LVA)	21.00 – 26.00V	22.00V
High Voltage Alarm (HVA)	26.00 – 30.30V	27.75V
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
NOTE: OVP cannot be set below the present system/FL/EQ/BT voltage setting or the safe mode voltage (default) of 25.7V.		

Table F–Cordex 24-400W factory ranges and defaults

6.4 650W PSU Factory Ranges and Defaults

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

Setting	Range (minimum to maximum)	Default
Float (FL) Voltage	48 – 58V	54V
Equalize (EQ) Voltage	50 – 58V	55V
Battery Test (BT) Voltage	44 – 52V	46V
OVP	See note below – 59V	57V
Current Limit (CL)	23 – 100%	100%
Power Limit (PL)	0 – 100%	100%
Module Start Delay	0 – 250s	1s
System Start Delay	0 – 600s	0s
Low Voltage Alarm (LVA)	42 – 52V	44V
High Voltage Alarm (HVA)	52 – 59V	55.5V
EQ Timeout	1 – 2399h	30h
BT Timeout	1 – 250h	8h
Softstart Ramp-rate	Normal/Fast	Normal
CL/PL Alarm	Enable/Disable	Disable
Remote Shutdown	Enable/Disable	Enable
Ramp Test	Enable/Disable	Enable
NOTE: OVP cannot be set below the present system/FL/EQ/BT voltage setting or the safe mode voltage of 51.4V.		

Table G–Cordex 24-400W factory ranges and defaults

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

- 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 CXCI, 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 CXCI+ (web browser), set Float and Equalize voltage to the levels specified by the battery manufacturer.
- Using the CXCI, 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

7.4.1 Soft Reset

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

7.4.2 IP Address Reset

To reset the IP address, press and hold the front panel reset button for three seconds. The CXCI+ unit beeps three times, IP is reset (to 10.10.10.201) and DHCP is disabled. The settings are saved and the unit is then reset.

This reset allows local access; for example, with a laptop and a standard network crossover cable. See the current version software manual for details.

7.4.3 Hard Reset

The hard reset button is the unmarked button on the front panel (see Figure 2). This reset button can be used to restart the microprocessor if the soft reset button fails to operate as described in section 7.4.1.

CAUTION: Use of hard reset may cause loss of data.

7.4.4 Time Settings

The CXCI+, upon startup*, will set the time based on the following:

- Attempt to synchronize with the NTP server (see www.NTP.org).
- Retrieve the last time stamp from the Event Log.
- Retrieve the last time stamp from the Statistics Log.
- Set the time to 2005-01-01 midnight.

* Whenever the unit is reset or power is completely removed from the CXCI.

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 H–Sample maintenance log

8.1 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, which are easily replaced in the field using the following procedure:

1. Shut off the unit and wait five minutes for the output capacitors to discharge.
2. Loosen the thumbscrew that secures the power module to the shelf and remove the module from the shelf.
3. Turn the module around to face the back of the unit and remove the three (3) screws securing the rear grill/cover. Remove the rear cover. See Figure 9:

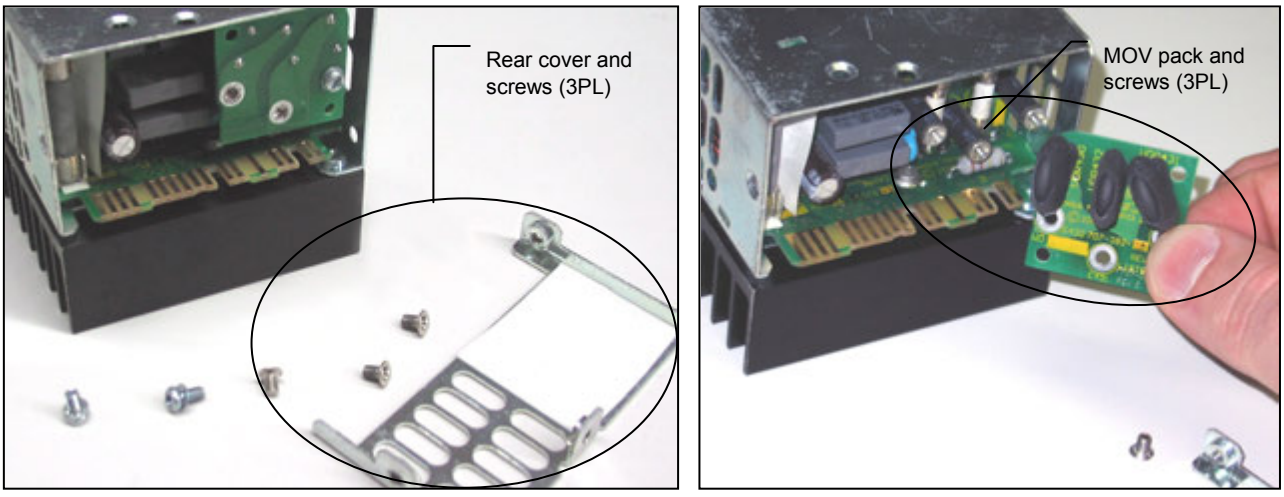

Figure 9–Showing MOV removal and replacement

4. Locate the “MOV pack.” Remove the three (3) screws securing the MOVs and remove.
5. Decontaminate the affected area 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.
6. Install the replacement MOV pack and reassemble the unit following the preceding steps in reverse order.

9 Warranty and Service Information

9.1 Technical Support

Free Technical Support is part of the AOE customer satisfaction commitment. The phone numbers below can also be used to access a wide range of service solutions both at your premise and at the AOE facility nearest you.

Tel: +49 9122 79889 0
Mail: info@alpha-outback-energy.com

9.2 Warranty

Alpha and Outback Energy GmbH 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 AOE'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 AOE will pay the cost of shipping the repaired or replacement unit back to the customer.

9.3 Battery Warranty

Note that battery warranty terms and conditions vary by battery and by intended use. The most common battery warranty provided by Alpha is a two year full replacement warranty with a pro-rated warranty for the following three years. Pro rated warranty provides a credit applicable toward the purchase of new batteries from AOE. The credit is calculated as the purchase price multiplied by the percentage of the battery life that was not available (in months). Battery warranty coverage is lost where the battery charge is not maintained for 6 months. Contact your AOE sales representative or the Technical Support team at the above number to understand your entitlements under Battery Warranty.

9.4 Return of Material

Please contact Technical Support at the number above to obtain a Service Repair Order (or Return Material Authorization) number BEFORE sending material back. This will ensure that your service needs are handled promptly and efficiently.

10 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
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	Transmission control protocol
THD	Total harmonic distortion
UL	Underwriters Laboratories

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Power