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.*

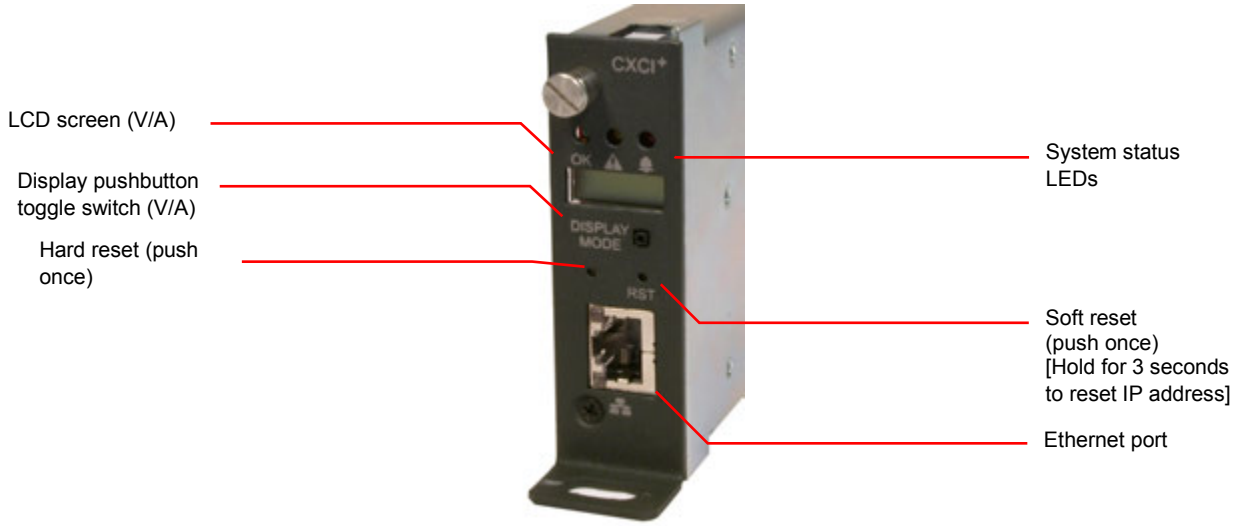

Figure 2 Cordex CXCI+ controller front panel

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

4.2.2 Panel/Wallmount Option

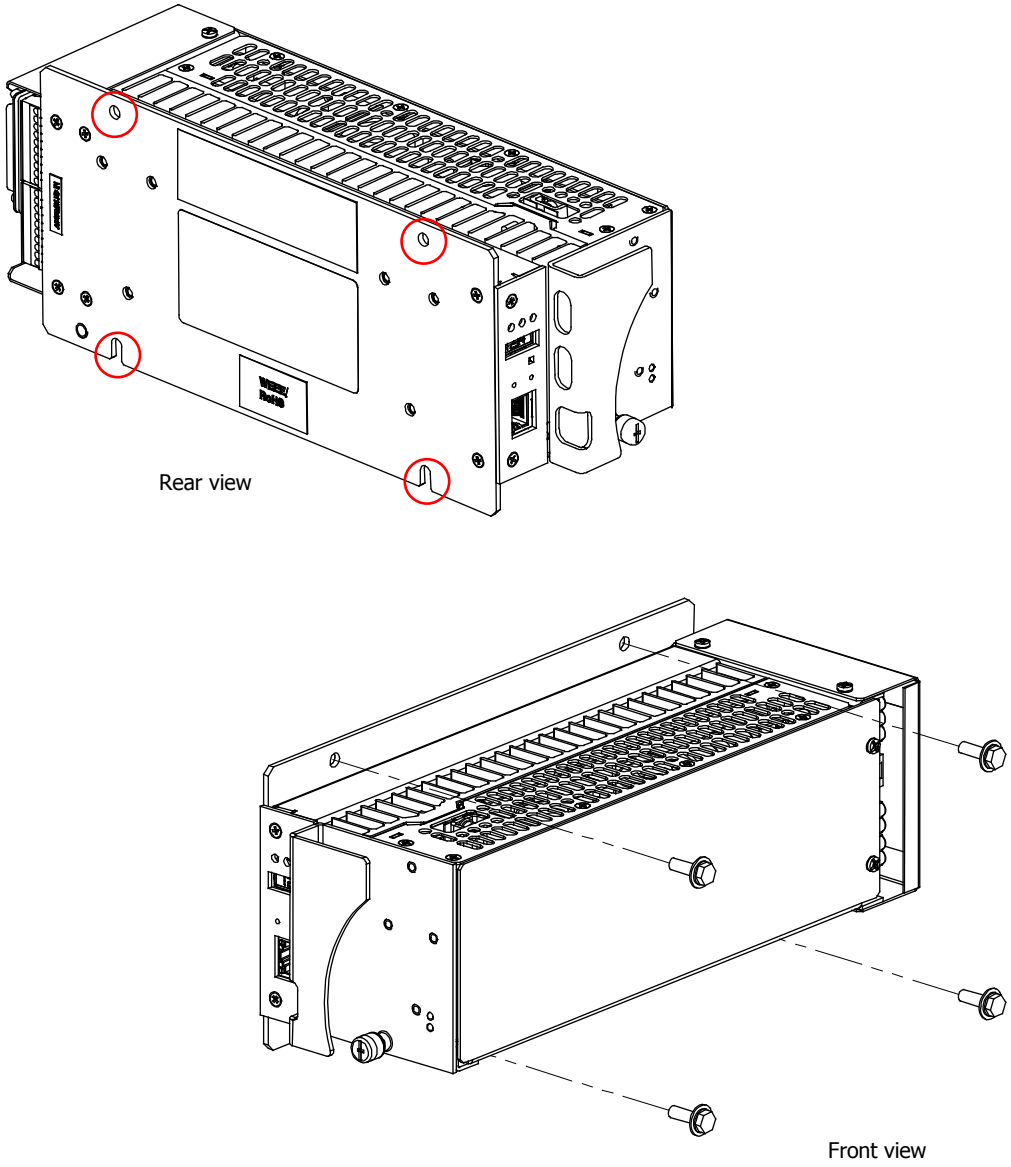

Figure 5-Panel/Wallmount Option

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.

5.9.2 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.

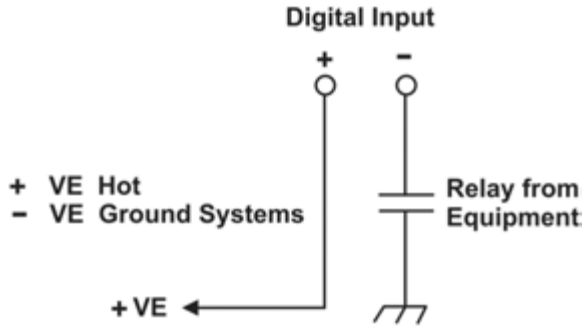

Figure 7–Showing digital input connection method

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.

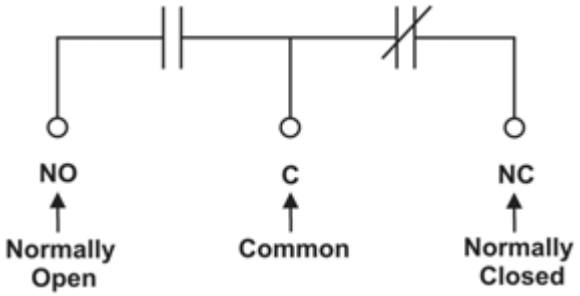

Figure 8–Showing relay connections

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:

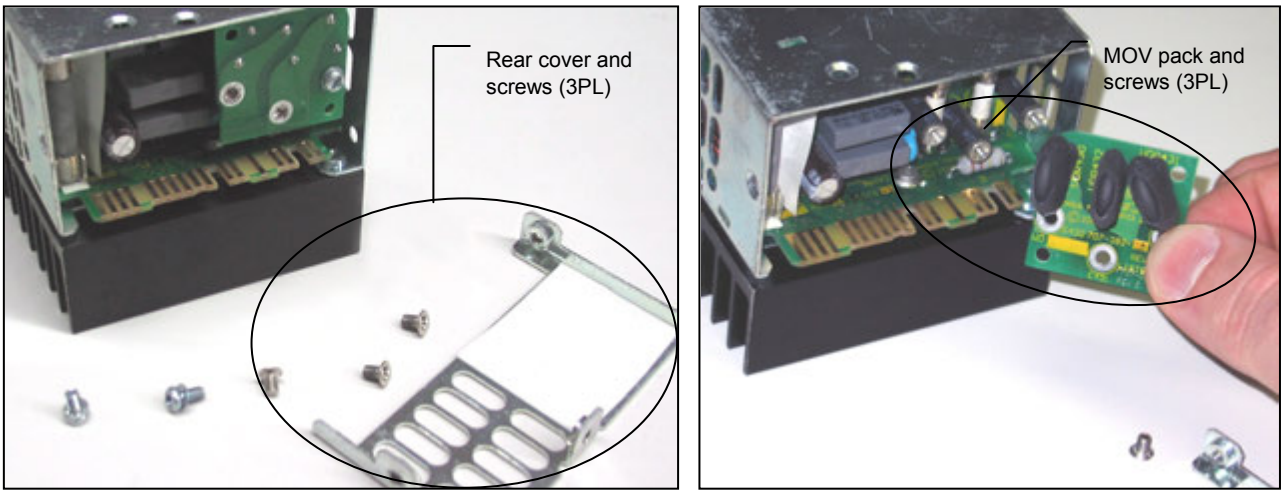

Figure 9–Showing MOV removal and replacement

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 Alpha 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 Alpha 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 AOE 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.

For more service and warranty information, visit the AOE website:

www.alpha-outback-energy.com

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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