ACS HP Series Battery Charger

Quick Start Guide

Effective: December 2011

Power

Alpha Technologies

ACS HP Series Battery Charger
Quick Start Guide

Effective Date: December, 2011

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NOTE:

Photographs contained in this manual are for illustrative purposes only. These photographs may not match your installation.

NOTE:

Operator is cautioned to review the drawings and illustrations contained in this manual before proceeding. If there are questions regarding the safe operation of this powering system, please contact Alpha Technologies or your nearest Alpha representative.

NOTE:

Alpha shall not be held liable for any damage or injury involving its enclosures, power supplies, generators, batteries or other hardware if used or operated in any manner or subject to any condition not consistent with its intended purpose or is installed or operated in an unapproved manner or improperly maintained.

Contacting Alpha Industrial Power: www.alpha.com

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SAFETY NOTATION

Review the drawings and illustrations contained in this manual before proceeding. If there are any questions regarding the safe installation or operation of this product, contact Alpha Industrial Power, Tel: 1-800-996-6104 Fax: 1-678-584-9259 or the nearest Alpha representative. Save this document for future reference.

To reduce the risk of injury or death, and to ensure the continued safe operation of this product, the following symbols have been placed throughout this manual. Where these symbols appear, use extra care and attention.

NOTE:

A NOTE provides additional information to help complete a specific task or procedure.

ATTENTION:

The use of ATTENTION indicates specific regulatory/code requirements that may affect the placement of equipment and /or installation procedures.

CAUTION!

The use of CAUTION indicates safety information intended to PREVENT DAMAGE to material or equipment.

WARNING!

WARNING presents safety information to PREVENT INJURY OR DEATH to the technician or user.

GENERAL SAFETY PRECAUTIONS:

This unit and its associated hardware must be serviced only by qualified, authorized personnel.

Unit must remain locked at all times, except when authorized service personnel are present.

Remove all conductive jewelry or personal equipment prior to servicing equipment, parts, connectors, wiring, or batteries.

Read and follow all installation, equipment grounding, usage, and service instructions included in this manual.

Use proper lifting techniques whenever handling enclosure, equipment, parts, or batteries.

Batteries contain dangerous voltages, currents and corrosive material.

Battery installation, maintenance, service and replacement must be performed by authorized personnel only.

Never use un-insulated tools or other conductive materials when installing, maintaining, servicing or replacing batteries.

Use special caution when connecting or adjusting battery cabling. An improperly connected battery cable or an unconnected battery cable can result in arcing, a fire, or possible explosion.

A battery that shows signs of cracking, leaking or swelling must be replaced immediately by authorized personnel using a battery of identical type and rating.

Avoid any contact with gelled or liquid emissions from a valve-regulated lead-acid (VRLA) battery. Emissions contain dilute sulfuric acid which is harmful to the skin and eyes. Emissions are electrolytic, which are electrically conductive and are corrosive. Follow the Chemical Hazards notes if contact occurs.

Do not smoke or introduce sparks in the vicinity of a battery.

Under certain overcharging conditions, lead-acid batteries can vent a mixture of hydrogen gas that is explosive. Proper venting of the enclosure is required.

Follow the battery manufacturer's approved transportation and storage instructions.

Never charge a frozen battery.

Never energize a physically damaged charger.

Prior to installation, verify that the AC input voltage to the unit and its equipment match with respect to voltage and frequency.

Prior to installation, verify that the output voltage from the unit or its equipment match the voltage requirements of the connected equipment (load).

Prior to installation, verify that the unit's utility service panel is equipped with a properly rated circuit breaker for use with the equipment inside. Refer to manufacturer's recommendations.

Review and upgrade utility service panel circuit breaker requirements whenever the equipment within the enclosure is changed.

Prior to installation, contact local utilities, local building maintenance departments, and cable/piping locator services to ensure that installation does not interfere with existing utility or building cables/piping.

Before performing any maintenance on this, make sure that the battery and the AC Power are disconnected. Note that both AC and DC current are present in this unit even with indicators and breakers set to the "OFF" position.

Do not exceed the output rating of equipment. Verify load requirements prior and during connection process.

Prior to handling the batteries, touch a grounded metal object to dissipate any static charge that may have developed in your body.

The charger contains electrostatically-sensitive equipment. Use proper electrostatic discharge (ESD) procedures to prevent any severe damage to the electronic components.

Utility Power Connection Notes

Connecting to the utility should be performed only by qualified service personnel and in compliance with local electrical codes. Connection to utility power must be approved by the local utility before installing the system.

Equipment Grounding Connection Notes

In order to provide a ready, reliable source of backup power it is necessary to connect the system to an effective grounding and Earthing system that not only provides for the safety of the service personnel responsible for its operation and maintenance, but also facilitates the proper operation and protection of the equipment within the network. Such a grounding system provides protection with respect to operator safety, system communication, and equipment protection.

WARNING!

Low impedance grounding is mandatory for personnel safety, critical for the proper operation of the system and must be in place and connected to the system before the supply cables are connected.

SAFETY GROUND

The safety ground is a two-part system, comprised of the utility service and the ACS HP Series Battery Charging system.

1. Utility service

As a minimum requirement for the protection of equipment, the local utility service must provide a low-impedance path for fault current return to Earth. This must meet or exceed the requirements of the US National Electrical Code or the Canadian Electrical Code. The connection between the system and the utility must also meet or exceed the requirements of the US National Electrical Code or the Canadian Electrical Code.

2. The grounding system

The grounding system consists of a low-impedance connection between the enclosure and an Earth Ground (located at least 6’ away from the Utility Earth connection).

This impedance between the system and Earth must not exceed 0.1 Ohms.

Lightning Strike Ground

Lightning strikes, grid switching, or other aberrations on the power line and/or communications cable have the potential to cause high-energy transients which can damage the powering or communications systems. Without a low-impedance path to ground, the current, when traveling through wires of varying impedance, produce damaging high voltage. The most viable method available to protect the system from damage is to divert these unwanted high-energy transients along a low-impedance path to ground. A low-impedance path to ground prevents these currents from reaching high voltage levels and posing a threat to equipment. The single-point grounding system provides a low-impedance path to ground, and the key to its success is the proper bonding of the ground rods, so the components of the grounding system appear as a single point of uniform impedance. We recommend the use of a surge arresting device electrically bonded to the ACS HP Charger Ground System.

What This Manual Covers

This user's manual contains important technical instructions to be followed by qualified personnel for the installation, start-up, and maintenance of this unit. It is recommended that this manual be read closely to ensure and reliable operation of this equipment.

Who Should Read This Manual

The Product Safety Information chapter and the Operation chapter are intended for anyone who will be operating the ACS HP Series Battery Charger. The Installation and Maintenance chapters are intended for qualified installers, trained electricians or technicians who are fully educated on the hazards of installing electrical equipment such as uninterruptible power supplies and their associated batteries and accessories.

How to Use This Manual

Before you begin installing or operating the system, please ensure that you are familiar with all the warnings and cautions described in this manual (see Product Safety Information). Once you are aware of all the safety issues, then you can start to plan the installation per ***Section 2.0, Installation***. After you have completed the installation, you can start learning how to operate the system to meet the needs of your application.

1.1 Product Overview

The ACS HP Series Battery Charger is a modular, switched mode AC-DC conversion design, consisting of one or more Cordex rectifier modules coupled with a Cordex CXC microprocessor controller. This charging system possesses a unity power factor with efficiency greater than 93%, a negligible THD input level, and clean output power, providing reliable, quality DC power for many years.

The 4RU shelf of the unit accommodates up to five, hot swappable Cordex 4.4 kW rectifiers, which allows for N+1 or N+N redundancy capability, as well as expansion capability up to 175A output capacity. The hot swappable design of the rectifiers allows them to be inserted or removed from the shelf without requiring the power to be cut to or from the system or the load.

Configuration, monitoring, and control of the charging system is provided by the Cordex CXC controller, either locally via the CXC touch screen display or remotely via an ethernet or RS-232 connection and an internet browser (DNP3 Level 2 communication is also available as an optional feature). Battery management, data logging, and temperature compensation are just some of the standard features supplied by the CXC controller.

Other standard features of the ACS HP series battery charger include high interrupting current input and output circuit breakers, AC and DC surge protection, common Form C alarm relay contacts, and high voltage shutdown.

For full component technical and operational details of the ACS HP series battery charger, please refer to the following manual sections pertaining to the Cordex 125-4.4kW modular switched mode rectifiers, the Cordex CXC controller, and the Cordex CXC controller software .

1.2 Theory of operation

Please refer to the power circuit block diagram on the following page for a theory of operation of the ACS HP switched mode AC-DC conversion system. The 187-312 VAC, 50/60 Hz input is fed through a circuit breaker into a full wave rectifier, which in turn provides a 120 Hz (340V peak) pulse train to an input filter circuit. The input filter provides a nominal 290 VDC "raw supply", with approximately 30 VP-P 120 Hz ripple, to the transistor switching circuit. The transistor switching circuit “chops” the raw supply into a 525VP-P, 100 kHz (nominal) rectangular waveform with a nominal 66% duty cycle. This high frequency switching waveform is then fed into a ferrite power transformer, in which the waveform is “stepped down” and isolated. A rectifier circuit then converts the power transformer output to a DC pulse train with a nominal 160 V peak. Next, a two-stage output filter averages and smoothes this pulse train downward, providing the nominal 125 VDC output with low noise. A voltage error amplifier circuit senses the output voltage and compares it with the voltage reference to provide a voltage error signal. Similarly, a current error amplifier, using a shunt resistor and scaling amplifier, senses the output current and compares it with the desired maximum output current, in order to provide a current error signal. These signals are then fed into the pulse width modulator (PWM) via ORing circuitry so that either voltage or current regulation is achieved. The PWM controls the "ON" time of the switching transistors, varying the output as commanded by the error amplifiers. The PWM also senses the switching transistor current on an instantaneous basis to provide cycle-by-cycle protection of the switching transistors. An auxiliary supply, powered via a small 50/60 Hz transformer, and a DC/DC converter power the control circuit and front panel circuitry. The PWM receives the ON/OFF command and clock signal from the front panel circuit and control circuitry.

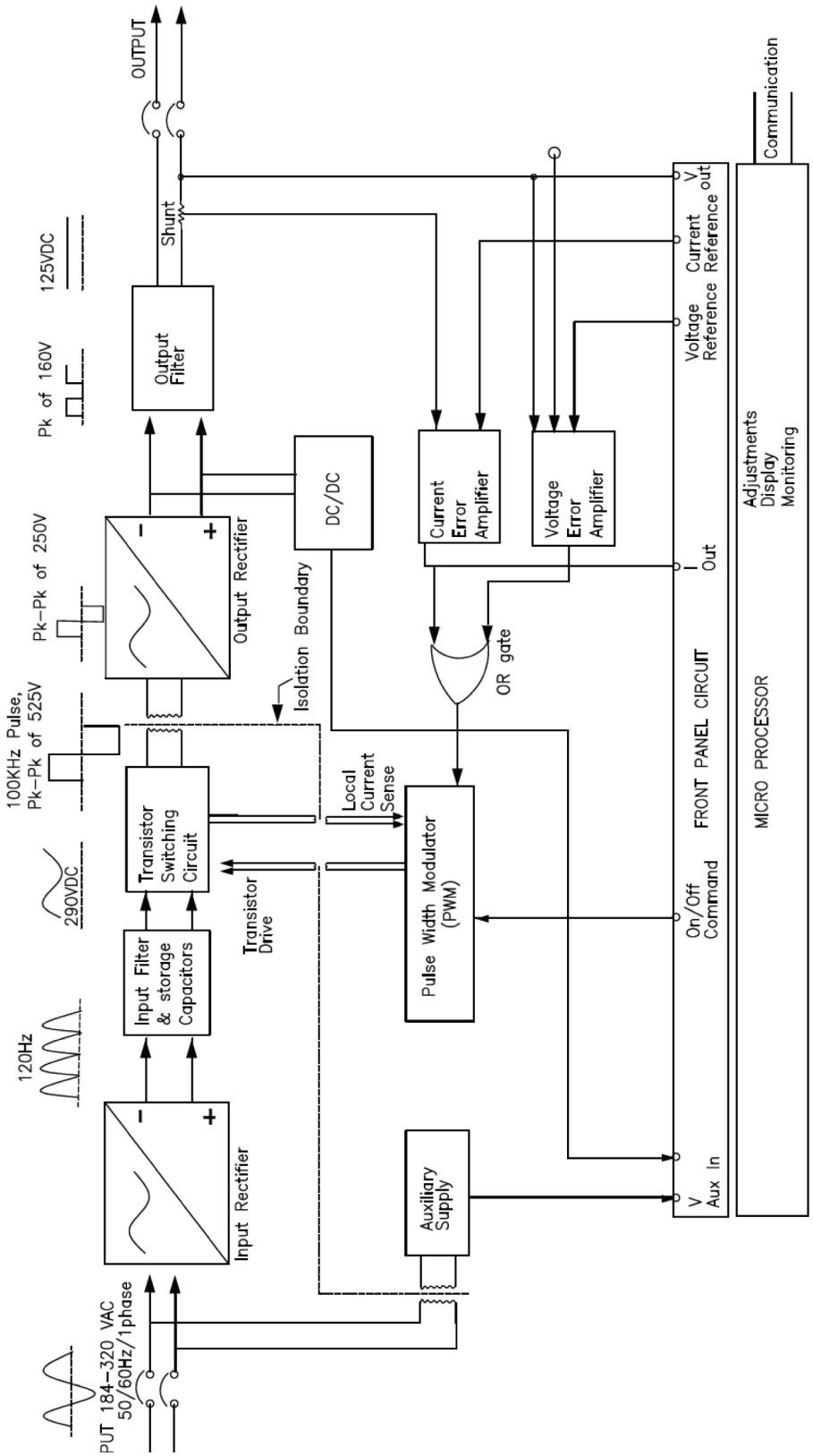

Fig.1-1, Simplified Block Diagram

1.3 System Components

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

1. Blank equipment panel.
2. Cordex 4.4kW rectifiers Loaded onto pre-installed shelf. The shelf contains up to five hot-swappable 4400W Rectifier modules. The Rectifiers are used as the charging component of a hybrid “UPS” system.
3. Cordex Controller CXCR: Controls the entire AC and DC power system. Provides web-based and local display interface to set configurable features of Inverters and Rectifier modules, battery charging voltages, and system-wide alarms.AC Output Distribution Panel: DIN rail circuit breakers can be installed to feed individual AC load circuits.
4. Main breaker panel: Serves as main disconnect for the Inverter AC input.
5. Auxiliary/Distribution breaker panel
6. Blank equipment panel.
7. Perforated ventilation panel.

Fig.1-2, Configured Charger System

1.4 Specifications

Specifications		
Electrical		
Input:		
Voltage:		
Nominal:	*208 to 250Vac*	
Operating:	*187 to 312Vac*	
Extended:	*187 to 90Vac (derated)*	
Phase:	*1 or 3*	
Frequency:	*45 to 70Hz*	
Current:	*23A/module-nom. (130A Max@ 175ADC output)*	
Power:	*4400W continuous/module*	
Power Factor:	*>0.99 (50 to 100% load)*	
THD:	*<5%*	
Efficiency:	*>93%*	
Output:		
Voltage:	*90 to 160Vdc*	
Current:	*35A/module-nom. (200A Max @ 110VDC)*	
Load Regulation:	*Static <±0.5%*	
Line Regulation:	*Static <±0.1%*	
Transient Response:	*<±5% for 40 to 90% load step, 30ms recovery time*	
Ripple:	*±30mVrms Battery Eliminator*	
Mechanical		
Dimensions:		
	Standard	**XL**
mm:	*1049 H x 622 W x 597 D*	*1806 H x 700 W x 622 D*
in:	*41.25 H x 24.5 W x 23.5 D*	*71.1 H x 27.55 W x 24.5 D*
Weight:	*100 kg (220 lbs) for 105A system*	*115 kg (253 lbs) for 105A system*
Cabinet:	*NEMA 1 (black finish)*	*NEMA 1 (black finish)*
Environmental		
Temperature		
Standard:	*-40˚ to 50°C (-40˚ to 122°F)*	
Extended:	*-40˚ to 75°C (-40˚ to 167°F)*	
Storage:	*-40˚ to 85°C (-40˚ to 185°F)*	
Humidity:	*0 to 95% RH non-condensing*	
Elevation:	*-500 to 2,800m (-1,640 to 9,186ft); to 4,000m (13,124ft) derated to 40˚C (104˚F)*	
Audible Noise:	*<55dBa @ 1m (3ft)*	
Ventilation:	*Forced Air/Convection*	
MTBF:	*>350,000 hours*	

Standard Features
Full graphic touch screen LCD with virtual alphanumeric and numeric keyboards
Modbus Protocol
Access GUI user interface via Internet browser through Ethernet port or RS-232 craft port on CXC Controller
High interrupting current input and output breakers (10kA IC)
Reverse polarity protection
AC and DC surge suppression
Current limit protection
Soft start protection
Common Form C alarm relay contacts
High voltage shutdown
AC failure alarm
High/Low voltage alarm
Charger failure alarm
Positive/Negative ground fault alarm
DC output failure alarm

Standard Features *(continued)*	
Control Functions	
Automatic, scheduled, or manual float charging (adjustable) *Automatic, scheduled, or manual equalize charging (adjustable)* *High/Low voltage alarm setting (adjustable)* *Charge current limit (adjustable)* *Automatic or manual battery testing* *Battery capacity and runtime prediction* *Temperature compensation*	
Daily Statistics:	*Minimum, maximum and average on input channels, with date and time stamp* *Battery current, rectifier current, and AC mains voltage for prior 90 days*
Event Log:	*On all events such as alarms, power on, any change of state of the digital inputs, or other miscellaneous events*
Battery Log:	*Battery health history on last 20 discharges, time of discharge, and battery capacity*

Options
Low voltage disconnect
DC Output Panel
Up to 10 x 2 Pole, 5-60A breakers (10kA IC) with alarm monitoring
DNP3 Level 2

Standards, Certifications
Safety:
EN 60950
UL 60950-1 (pending)
CSAC22.2 No. 60950-1-03
CE EN 60950, CB Scheme
Telcordia (Bellcore) GR-1089-CORE
EMC:
EN 55022 (CISPR 22)
EN 61000-3-2 EN 61000-3-3
EN 61000-4-2 EN 61000-4-3
EN 61000-4-4 EN 61000-4-5
EN 61000-4-6 EN 61000-4-11
ETS 300 019-1-1 ETS 300 019-1-2
ETS 300 753 IEC60950
ICES-003 Class B FCC Part 15 Class B
FCC Part 68

2.1 Installation Notes

- The ACS HP Series Battery Charger is designed to be installed in a controlled environment, sheltered from rain, excessive dust and other contaminants.
- The system arrives pre-wired, and the installer is responsible for connecting the utility input to the system, the battery strings, and the system to the load.
- All wiring must be in accordance with applicable electrical codes.
- Access to connection points is provided from the front of the system rack.
- The required gauge of the AC input, DC+/DC- input and AC output cabling is determined by the current rating, Circuit Breaker rating, typical ambient temperatures and must meet the applicable local electrical codes. Typically the AC input and standard AC out put is 6 wires (L1, L2, and L3, N, N, G) up to 350 kcmil THHW or RW90 type cable that will connect to the UPS with trade size up to 3.5 conduit.

Tools required:

Various tools are required for product installation. This list serves 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 ratchet set

2.2 Recommended Installation Layout

Verify input (supply) wiring has been run to site in accordance with applicable local and national electrical codes.

The ACS Series system is heavy equipment. To prevent personal injury or equipment damage, use lifts and extreme care when handling.

Ventilation and Cooling:

The rectifier/charger is rated to better perform within 18°F (–10°C) and 122°F (+50°C) temperature range.

To calculate the required air displacement (exchange) volume, please use the following equation:

V = BTU x e (0.125 x H x Tk/To) / (Tr -Tk)

Where:

V = Air flow: [cubic meter/hour]

BTU: Total dissipated heat

Tr: Maximum allowed room temperature [°K] {i.e. 50°C = 323°K]

Tk= Temperature of input cooling air

To= 273 °K H = Altitude [km]

For adequate ventilation and safe access, verify the following minimum clearances around the charger:

3 in. (10 cm) on the sides and top of the unit.

7 in. (18 cm) in back of the unit.

3 feet (1 meter) in front of the unit.

Should seismic conditions require a more secure installation the unit may be bolted to the floor. Four (4) holes are provided for this purpose.

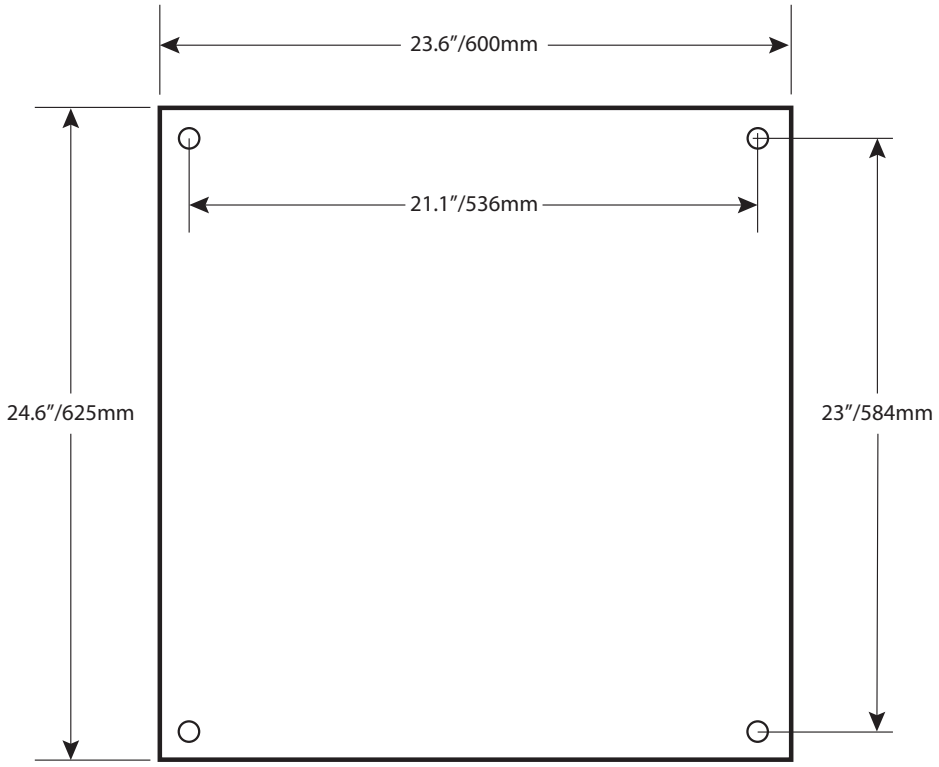

Fig. 2-1, Cabinet Footprint with dimensions

2.3 Electrical Connection and Wiring

Always refer to the ACS system electrical schematic diagram for proper installation.

Before connecting the ACS Series Battery Charger insure that:

The battery is disconnected (if applicable)

The circuit breakers are “OFF”

The relays, fuses and circuit boards are installed

The unit is wired in accordance with the instructions (refer to the wiring connections and electrical diagram)

Wire size is very important. The nameplate provides the essential information regarding the input and output voltages and currents. Refer to your Local or National Electrical Code for WIRE GAUGE and GROUNDING instructions.

CAUTION!

WARNING!

Wire ampere capacity must be sized to the maximal correspondent current. Correct voltage and polarity are of critical importance. Check all connections for tightness and polarity. Connect battery (if applicable) to the output terminals observing its polarity.

2.4 Installing the Rectifier Modules

Before installation, verify all upstream and downstream circuit breakers are in the OFF (open) position.

NOTE:

The Rectifier shelves are factory-installed and pre-wired. In the event a shelf requires removal or replacement, contact Alpha Industrial Power service at 1-800-996-6104.

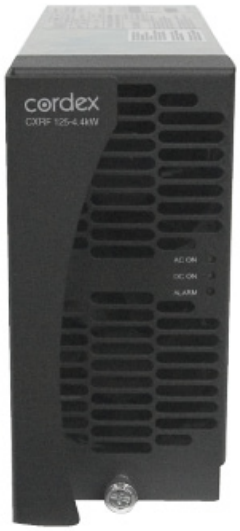

Fig. 2-2, Rectifier Module

Rectifier Module Installation Procedure:

1. Load the first module in the leftmost position on the shelf. Populate the shelf from left to right. Do not force the module into place; all modules are keyed to ensure the correct module (voltage/polarity) type is used.
2. Insert by placing the rectifier module on the shelf bottom and sliding the module into the rear connector (inside the shelf). Press firmly into place to fully engage the rear connector in the shelf receptacle.
3. Turn the front panel thumbscrew to secure the module in place.
4. Reverse the above steps to remove a module.
5. Repeat for each succeeding module in the configuration.

3.1 Placing the System into Service

CAUTION!

This procedure must be performed by a qualified service technician.

WARNING!

To meet North American safety standards, do not change the output voltage and frequency settings.

NOTE:

Perform each step and verify no alarm conditions exist upon completion of the step. If an alarm condition exists, determine the cause of the alarm and correct before proceeding to the next step.

3.1.1 Initial Start-Up

Before applying input power, verify the following:

1. AC input and DC output voltages match the voltages as listed on the ACS unit's nameplate.
2. Load operating voltage complies with the DC output voltage of the ACS charger.
3. Correct polarity of Utility and battery connections.
4. Unit is correctly grounded to building grounding system.
5. Rectifier Modules are installed and operational.
5. Unit connected to load.
6. All input circuit breakers open.
7. All output circuit breakers open.

Apply input power in the following sequence:

1. Apply power to the equipment from the source panel .
2. Turn on AC breaker (turn to "ON" position) .

   The system soft starts by increasing the output current and the voltage. Wait for several seconds until the system output voltage and status is indicated on the LCD screen. If calibration of the unit is necessary, refer to the Cordex Controller and Controller Software manuals for more information.
3. Turn the DC breaker (if supplied) to the "ON" position.
4. Verify no rectifier alarm conditions are present.
5. Close breakers to load.

3.2 Rectifier Operational Status

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.

NOTE:

For detailed installation, operation and fault diagnosis information, refer to the Cordex 125-4.4kW Modular Switched Mode Rectifier technical manual (p/n 010-589-B2).

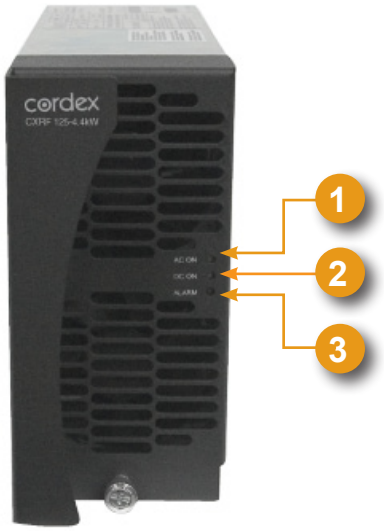

Fig. 3-1, Rectifier LEDs

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 normal 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 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

3 Alarm

The bottom LED (red) will flash 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 module's output capability has been reduced or a minor component failure has been 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 power is present.

3.3 CXC Controller Operational Status

The Charging system is shipped with the Cordex CXC Controller pre-installed. Detailed information regarding installation, operation and fault diagnosis can be found in the Cordex Controller technical manual (018-570-B2).

Fig. 3-2, Cordex Controller Front panel

3.3.1 Startup and Reset Procedure

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

3.3.2 Normal Operation

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

Active areas to tap and activate are noted below:

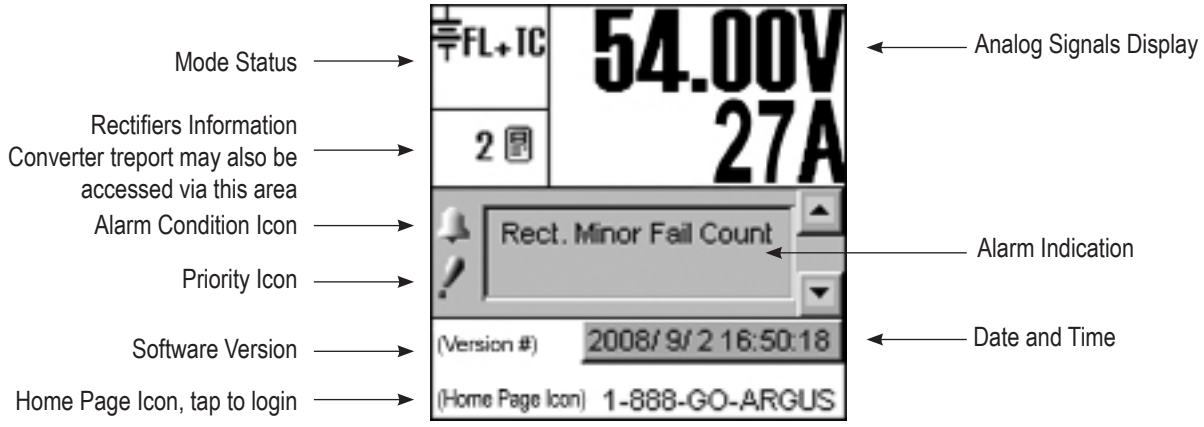

Fig. 3-3, Normal Operating Mode “Home Page”

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

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

3.3.3 Menu Navigation and Sample Programming

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

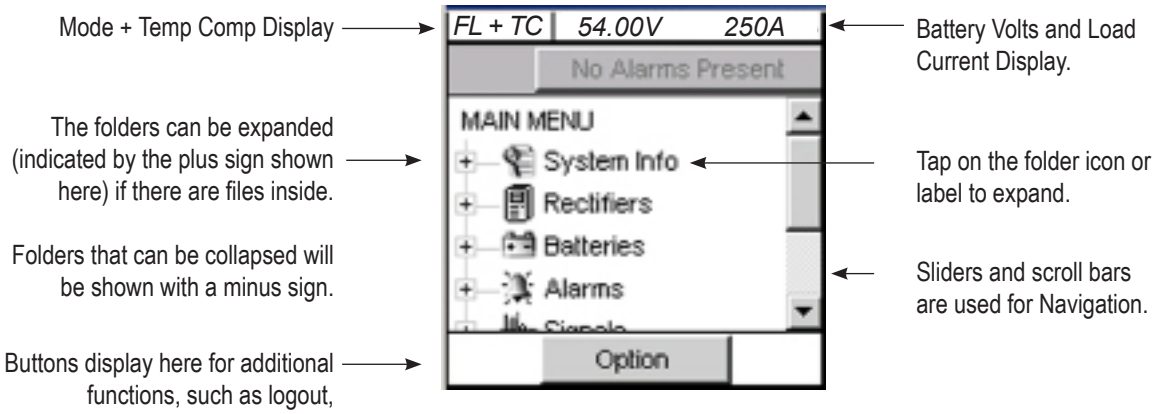

Fig. 3-4, Navigation Screen

Emergency Shutdown Procedure

CAUTION!

WARNING!

In an emergency, Line power may be disconnected at the service entrance or main electrical panel to protect emergency personnel, but there can still be AC power present at the UPS output. You must always turn OFF the battery circuit breaker.

1. Turn OFF the battery Circuit Breaker of the UPS.
2. Turn OFF the Generator (if connected).
3. Turn OFF the input Circuit Breaker of the UPS.
4. Disconnect the AC input power to the UPS.
5. Disconnect the battery string from the UPS.

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