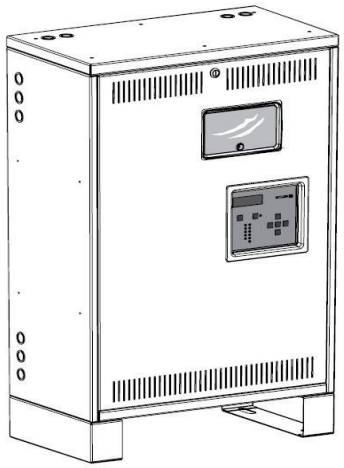
E3-MAC Series by Isolite

Installation/Operation Manual for E3-MAC Emergency Lighting Central Inverter System

1.0KW – 3.0KW Models



1KW Model – Single Cabinet

IMPORTANT SAFEGAURDS

When using electrical equipment, basic safety precautions should always be followed including the following:

READ AND FOLLOW ALL SAFETY INSTRUCTIONS

A. Do not use outdoors
B. Do not mount near gas or electric heaters.
C. Use Caution when servicing batteries. Battery acid can cause burns to skin and eyes. If acid is spilled on skin or in eyes, flush acid with fresh water and contact a physician immediately.
D. Equipment should be mounted in locations and at heights where it will not readily be subjected to tampering by unauthorized personnel.
E. The use of accessory equipment not recommended by the manufacturer may cause an unsafe condition.
F. Do not use this equipment for other than intended use

This unit contains lethal voltages. There are no user serviceable parts inside. Only authorized service personnel are to be used for service.

SAVE THESE INSTRUCTIONS

The installation and use of this product must comply with all national, federal, state, municipal or local codes that apply. Please read this manual thoroughly before installing and operating this Central Inverter System. For assistance please call Technical Service at 800-967-5573 and speak to a technician during normal business hours (EST).

Table of Contents

1.0 Introduction

This Central Inverter System integrates the latest power electronics and microprocessor technology which produces a pure sine wave power output intended for use in Emergency Lighting. The system is very efficient on-line and typically has a standby power loss of only 2 percent of the systems total capacity which means it is 98% efficient. This high efficiency and the ability to turn lighting loads on and off using the optional switched load outputs make it ideal for energy saving and green initiatives. This equipment was specifically designed for modern lighting loads and as such has very high inrush current capability which are required for today's LED drivers and electronic lighting loads. It is UL-924 compliant for Self-Testing and Self Diagnostic and as such performs internal checks and tests and records them in backup logs. The MMI (Man Machine Interface) which consists of a 5 button keypad and backlit LCD display is very powerful and feature rich. Users can access all stored logs and diagnostic tools such as meter functions, they can also change alarm functions and much more. The machine was designed on a modular concept so virtually any voltage combination can be created using these modules including single phase, split phase, and three phase.

1.1 Mechanical Features

This product was designed having the electrical installer in mind. It can be easily recognized as the simplest and fastest Central Inverter installation in the industry for its KVA size and capabilities.

Batteries are Front Terminal type which makes connecting up the batteries extremely fast. Simply slide the batteries into the cabinet, connect up the jumpers and connect the inter-shelf (model dependent) wiring and the battery install is finished. All battery connections come to the front – this means no reaching to the back through a string of batteries to make connections! The AC connections are also very easy to accomplish with the contractor landing the inputs and outputs to either Circuit Breakers or Terminals, Neutral wires are connected to a common neutral buss bar and Ground wires are also all connected to a common ground bar. Contractor wiring is very similar to connecting to an electrical panel in that there are knockouts on both sides and tops of the cabinet for easy conduit connection and then wires are then easily run into the cabinet and connected to ground bars, neutral bars and circuit breakers.

The machine was designed for Seismic Zone 4, has Powder Painted 14 gauge Cold Rolled Steel construction with no visible outside bolts or rivets. Internally, it has all galvanized or painted steel parts for all the modules and shelves that resist corrosion and provide durability and high quality.

1.2 Electrical Features

This product line has one of the most flexible voltage configurations in the industry due to its modular design concept. Each module can be configured as 120 or 277 or 120/240. The modules can be arranged in parallel, series or Wye connected. This gives the capability of producing voltages of single phase (L-N and L-L), split phase (L-N-L), and three phase. By utilizing a modular concept, it provides scalability, quick delivery and in the event of issues, very fast MTTR (Mean Time to Repair).

The Inverter utilizes a bi-directional converter that is either MOSFET or IGBT technology based on the DC voltage of the system. The system does not require installers to go through a manual pre-charge and discharge procedure to start the system up because these components are built into the Inverter Modules. The overload capabilities of the system defined by its crest factor (minimum of 4.0) which means that universal ballasts and drivers present no issue starting up on Inverter Power and it can sustain a minimum of 400 percent for about a half second. During the charge mode when power passes through the internal transfer device, the system can withstand inrush currents of several thousands of amps due to its extremely high I^2t rating of the breaker and inline fuse. The system has a 0.5 lead and lag power factor capability and coupled with its fast transfer capability, it can power up ANY type of emergency lighting fixture from HID, Quartz, LED, Fluorescent, Plasma, etc.

The batteries are charged using a three rate charging scheme and are temperature compensated. The batteries used are a 10 year design life and while on float charge have practically zero ripple current through the batteries thus providing the longest possible life. An optional pure lead battery is available for use in higher temperatures to extend the batteries life. The battery string has galvanic isolation to the system line neutral and ground which makes the install very safe. Any inadvertent short circuit from a battery terminal to chassis will not cause any fault currents of any kind.

NOTE - This equipment is equipped with Brown-Out Circuitry. The set-point is around 85 percent of nominal AC input voltage and is not user adjustable. Due to tolerances, the brown out may occur up to 86 percent of nominal. In the event of a Brown-Out (Very Low AC Input) the system will transfer to Emergency Power and discharge the batteries.

2.0 Receiving and Storage

2.1 Inspection

The Cabinets and Batteries may be shipped on the same pallet or may be shipped separately. Upon arrival please inspect the contents to ensure that no shipping damage has occurred. This is especially important with the batteries – ensure that there are no cracks or leaks. If any damage has occurred notify the shipping carrier immediately and submit a damage claim.

WARNING - Do not install damaged battery as this may cause an unsafe condition.

2.2 Storage

Storage before the installation is critical for the battery life expectancy and warranty. Store the batteries indoors in a clean, dry and cool location. Storage at higher temperatures will result in accelerated rates of self-discharge and possible deterioration of battery performance and life.

WARNING – The maximum storage time from shipment to initial charge is 6 months for batteries stored at ambient temperatures no warmer than 77°F (25°C). For storage temperatures greater than 77°F (25°C) the batteries must be recharged one (1) month sooner for every 5°F (3°C) increase above 77°F (25°C).

Storage Temperature	Storage Time
32°F (0°C) to 50°F (10°C)	9 Months
51°F (11°C) to 77°F (25°C)	6 Months
78°F (25°C) to 92°F (33°C)	3 Months

Storage at high temperatures will result in accelerated rates of self-discharge and possible deterioration of battery performance and life. Storage times exceeding the above may result in plate sulfation, which may adversely affect electrical performance and expected discharge performance and life.

Failure to install and charge the batteries as noted VOIDS the battery's warranty.

DANGER - A battery can present a risk of electrical shock and high short circuit current.

Valve-regulated lead-acid (VRLA) batteries contain an explosive mixture of hydrogen gas. Do not smoke, cause a flame or spark in the immediate are of the batteries. This includes static electricity from the body. Use proper lifting means when moving batteries and wear all appropriate safety clothing and equipment.

3.0 Installation

3.1 Location

NEC article 700 EMERGENCY CIRCUITS should be referenced for proper installation of a Central Inverter System. Article 700 dictates that unit must be mounted in a permanent location. Choose a cool dry place with normal ventilation and one which will allow easy access for testing and maintenance. Avoid a location which could allow vandalism and tampering with. Avoid areas that would prohibit visual contact with the heads up LED status displays.

3.2 Operating Environment

Choose a location that is controlled between 20 and 30 degrees C. for optimum battery life and performance. The unit is UL listed between 20°C to 30°C (68°F to 86°F) because of battery discharge performance results. Do not install in a wet or damp location. Do not install in environments that will expose the unit to excessive temperatures like boiler rooms as this will significantly depreciate battery life.

Heat is the determining factor of battery life. Every means should be made to keep the batteries in an environment that keeps the batteries around 25 degrees C for rated battery life.

3.3 Ventilation

Choose a mounting location that is clean and dust free. Do not install in areas where there is particulate from heavy industrial machinery, corrosive chemicals or welding or plasma cutting environments etc.

WARNING – Batteries for this system can weigh up to 60 pounds each. Ensure that the mechanical mounting means can support this weight.

3.4 Mounting Guidelines

3.4.1 Clearance

The system is convection cooled and only uses forced air cooling under Inverter Power operation. Air ventilation is through the front and uses convention so air flows from the bottom to the top. Since code mandates that at least 3 feet of clearance is required for clearance to the front of the unit, no special requirements for cooling are required.

WARNING - Never leave objects draped over the top of the unit which would prevent proper air flow. Blocking proper air circulation may result in an over-temperature fault during Battery Charging or Inverter Power mode depending upon ambient conditions.

3.4.2 Floor Preparation

Mounting holes are provided in the Cabinet Base for Floor Mounting purposes. The location of these holes are at the base of the cabinet and will accommodate 3/8’ mounting hardware. Four mounting holes are provided and all 4 should be used when floor mounting.

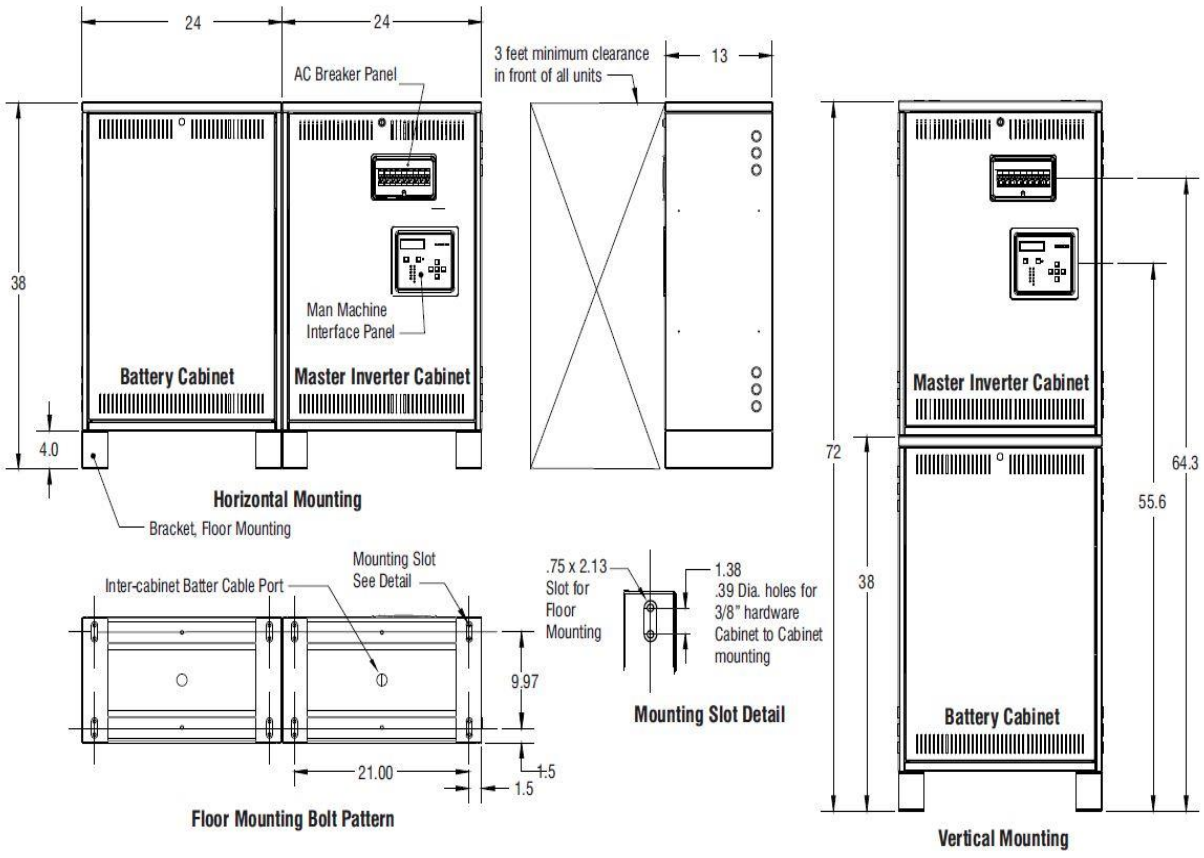


Figure 1 – Overall Dimensions

Diagram shows both side by side and top and bottom mounting configuration.

Top and Bottom mounting configuration is factory preferred for control panel access.

Battery Cables from Factory are sized for top and bottom mounting configurations.

3.4.3 Knockout Locations

EKO's (Electrical Knock Outs) are provided on the Left side, Right side and also the Top side surfaces. Ensure all metal conduit is secured and tightened creating a good connection to earth ground. Use an Ohm-Meter to check that continuity between conduit and protective earth ground has been established.

At no time is drilling allowed into the cabinet!

Drilling causes metal filings to be deposited on surfaces and could land on the Printed Circuit Boards and cause short circuits.

WARNING – Drilling into cabinet may void warranty if metal filings causes unit failure.

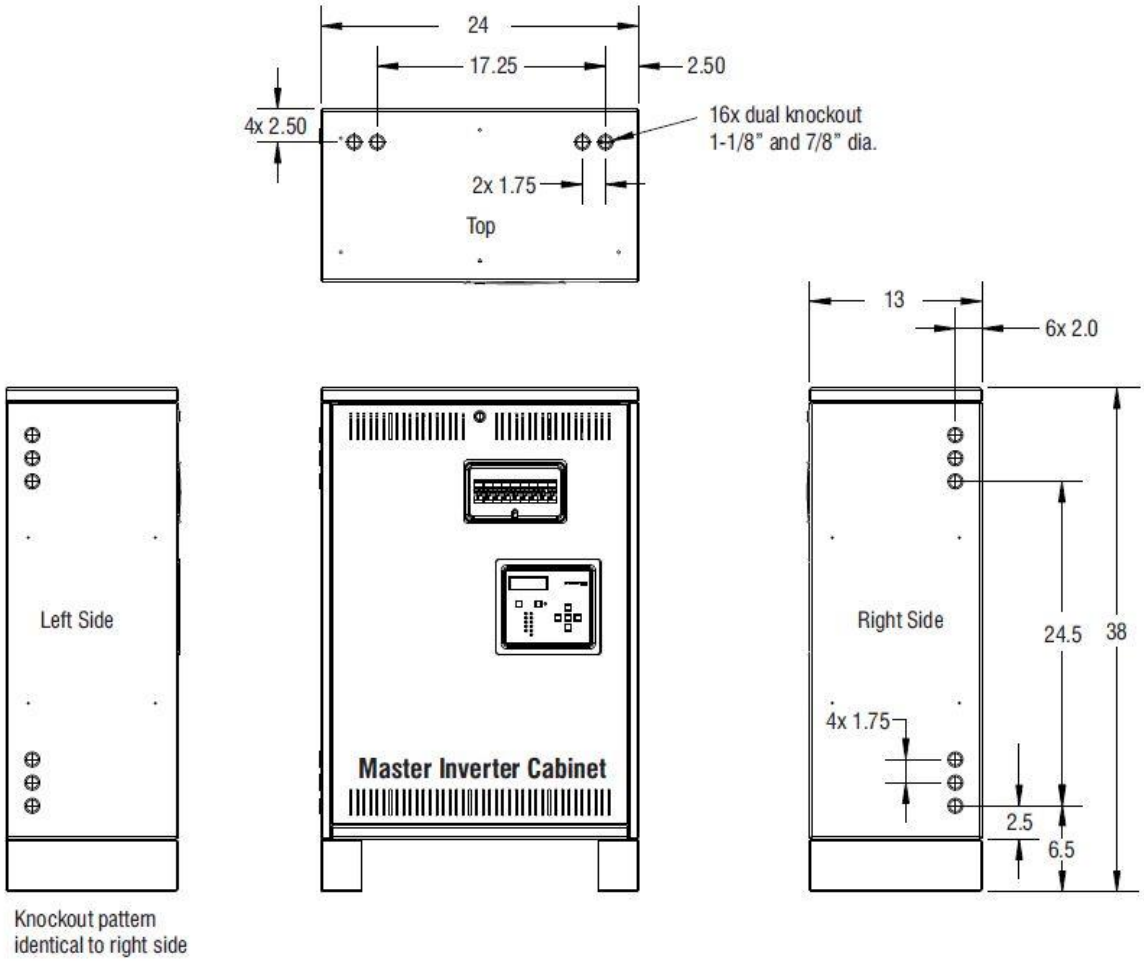


Figure 2 – Knockout locations

4.0 AC Connections

WARNING – Only qualified personnel that are familiar with AC and DC installation techniques and codes (such as an electrician) should perform the Installation.

WARNING – This system contains lethal AC Voltages. Because of these hazards of high voltage electrocution, always shut down all sources of power before you install, maintain, or service the unit.

WARNING – Remove all rings, watches, and other jewelry before doing any electrical service or installation work. Always wear protective clothing and appropriate personal protective equipment (PPE) that is suitable such as eye protection when working near batteries.

4.1 Removing the Front Cover

All the connections for the AC input and output are located on the top side of the units' enclosure. To access the wiring area, simply remove the cover by turning the covers front latch 90 degrees CCW (counter clock-wise). You will need a large flat blade (slotted) screw-driver for this.

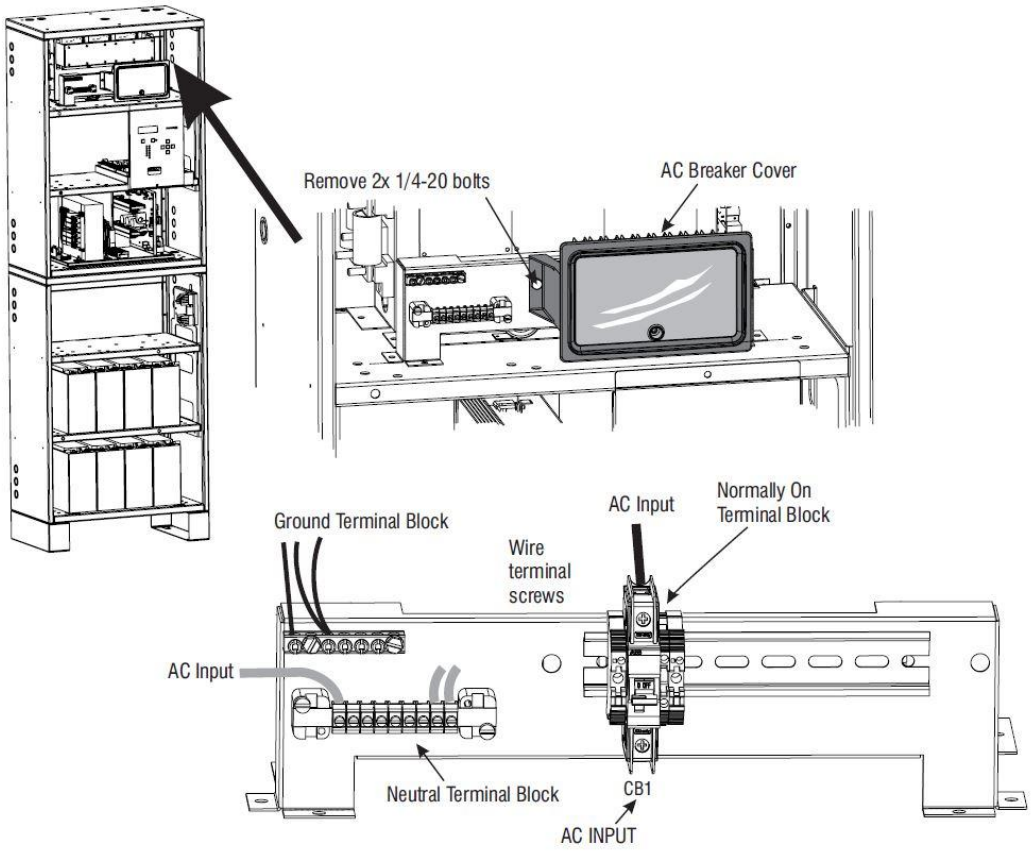


Figure 3 – Standard AC Connections for Input and Output

4.2 Removing the AC Breaker cover

To access wiring to the breakers, remove the two ¼-20 screws from the plastic breaker cover with a 3/8 socket or nut driver and the circuit breakers cover will easily remove. This cover conceals the wiring area and also provides a safety barrier so that fingers cannot inadvertently touch live parts after installation.

WARNING – Always re-install the AC Breaker cover to prevent accidental contact with live wires during routine maintenance.

4.3 Installing the Input Wires

Once the Cover and Circuit Breaker cover are removed,

1. Ensure that the incoming AC voltage is the same AC voltage rating as the unit.
2. Ensure that the feed breaker from the panel has at least the same breaker rating as the input breaker.

Once Feed Voltage and Breaker size is correct, connect the Utilities Feed Line voltage to the Input Circuit Breaker. There will also be a dedicated position for Neutral, and Ground. Ensure that the connections are tight by giving the wires a good pull and ensure that the wires are secured into the blocks. Connection to these blocks will require a small flat bladed screw-driver for the neutral bar and a larger flat blade (slotted) screw-driver for the ground bar. Connection to the circuit breaker works best with a #2 Phillips head screw-driver.

NOTE - The circuit breaker to the far left is always the input breaker – Output breakers are always to the right of the input breaker. Please check the labeling on the breaker cover for breaker number assignments.

NOTE – AC Input and AC output wires must be run in separate conduit or raceways per NEC ARTICLE 700. Please ensure all codes and standards are observed.

NOTE – Ensure that the Neutral and Ground potential does not exceed 5 VAC for proper function. Anything above 5 VAC typically indicates that there may be a grounding issue or inadequate conductor size or continuity. This should be looked at immediately as it could cause a safety concern.

NOTE – Neutral and ground should never be tied together anywhere in the system. Always keep Neutral and Ground wires separate and ensure no shorts occur.

NOTE – Neutral connections in the system are a “Pass Through’ which means Input and Output Neutrals are directly connected.

NOTE – Never mix Neutrals on the building wiring (Non-Emergency) with the Emergency wiring. Dedicated wiring is required by NEC code ARTICLE 700.

4.4 Installing the Output Wires

Connect the load wires to the provided terminal block labeled N. On. If switched loads were installed from the factory, connect the switched loads to the breakers to the right of the input breaker. There are dedicated neutral and ground blocks which should be shared for the AC input and AC output. Again, ensure that the connections are tight by giving the wires a good pull and ensure that the wires are secured into the blocks.

NOTE –"Wiring from an emergency source or emergency source distribution overcurrent protection to emergency loads shall be kept entirely independent of all other wiring and equipment, unless otherwise permitted" NEC ARTICLE 700 excerpt.

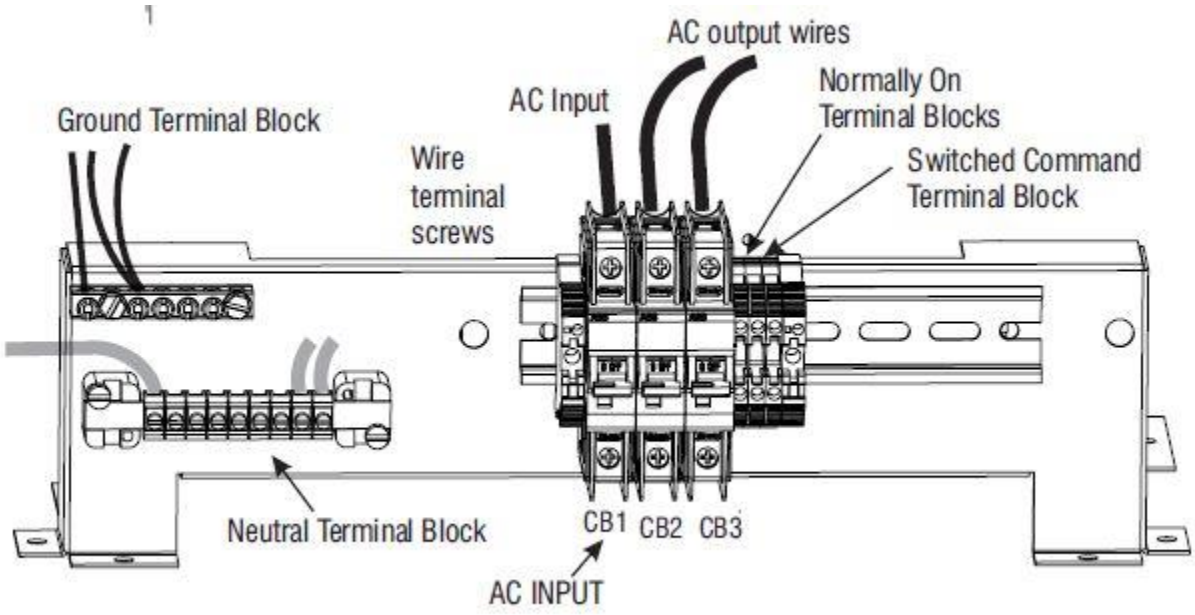


Figure 4 – Optional Output Circuit Breakers and Switched Command

5.0 Battery and DC Connections

WARNING – Only qualified personnel that are familiar with AC and DC installation techniques and codes (such as an electrician) should perform the Installation.

WARNING – Remove all rings, watches, and other jewelry before doing any electrical service or installation work. Always wear protective clothing and appropriate personal protective equipment (PPE) that is suitable such as eye protection when working near batteries.

WARNING - Batteries contain tremendous energy and can explode if short circuited. Precautions should be taken to eliminate possible short circuits. Do not install batteries until unit is completely mounted and secured in a permanent location with all conduit and AC wiring connected.

5.1 Battery Inspection

Inspect the batteries for any physical damage such as cracks or any other sign of leaking electrolyte. Batteries contain Sulfuric Acid which is highly corrosive. A leak from a battery will cause an unsafe condition.

5.2 Battery Installation

The batteries used in this system are front access so no pre-wiring is required to the battery terminals. Simply load the batteries into the cabinet in an orderly manner. If seismic bracing is provided, ensure the brackets are secured.

Torque on all lugs to the batteries are 20 Newton Meters or 30 Inch Pounds.

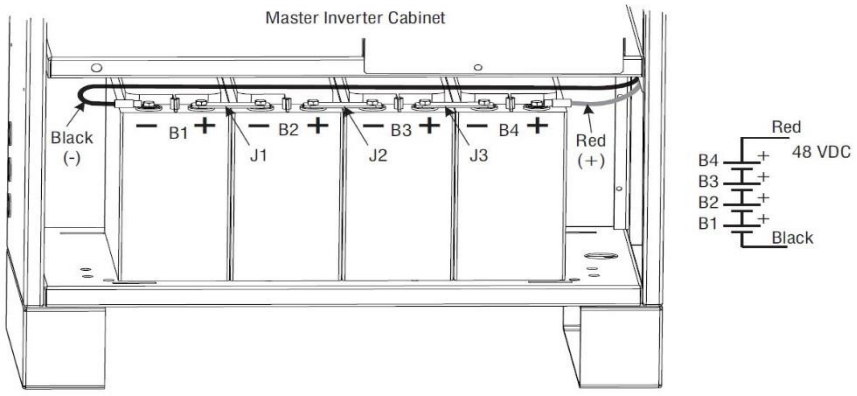
NOTE – The cover should already be removed from installing the AC Input and Output wiring. Please refer to section 4.1 for Cover Removal.

5.3 DC Voltage of System

The systems DC battery voltage is model dependent. Please see Figures 5-8 for specifics on configuration.

All required cables are provided by the manufacturer.

NOTE – Battery potential has galvanic isolation from AC potential. Battery voltage measurement must be performed with both meter leads connected to the battery terminals.



Battery Connection 1.0 KW 48 VDC

Figure 5– 1KW / 48VDC Diagram

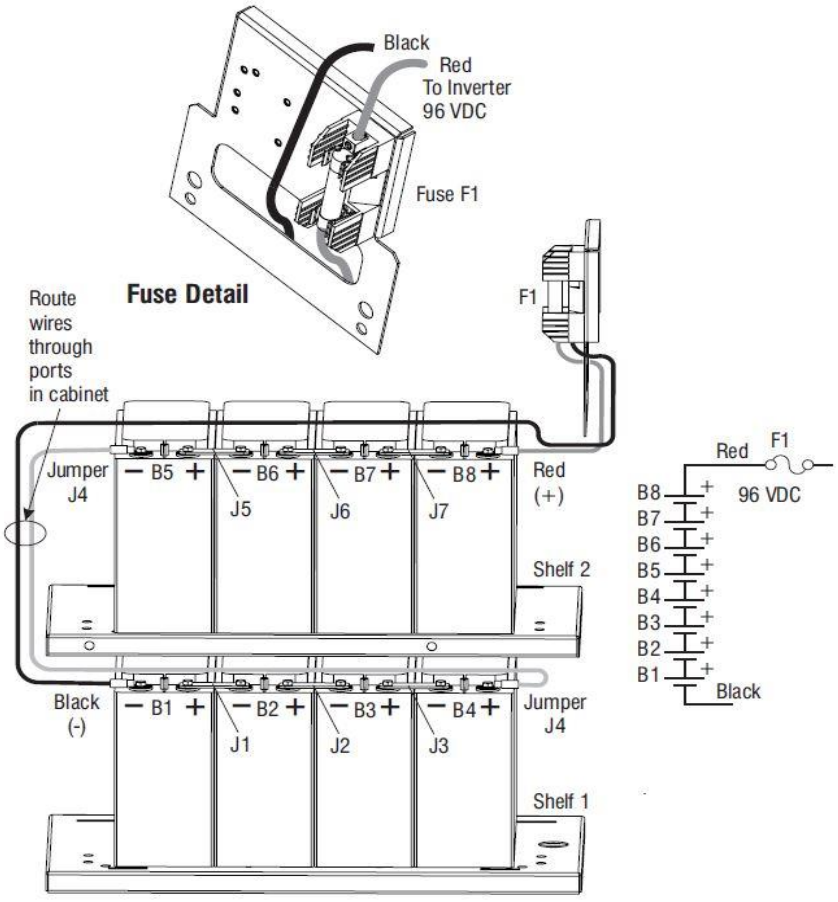


Figure 6 – 2.2KW / 96VDC Diagram

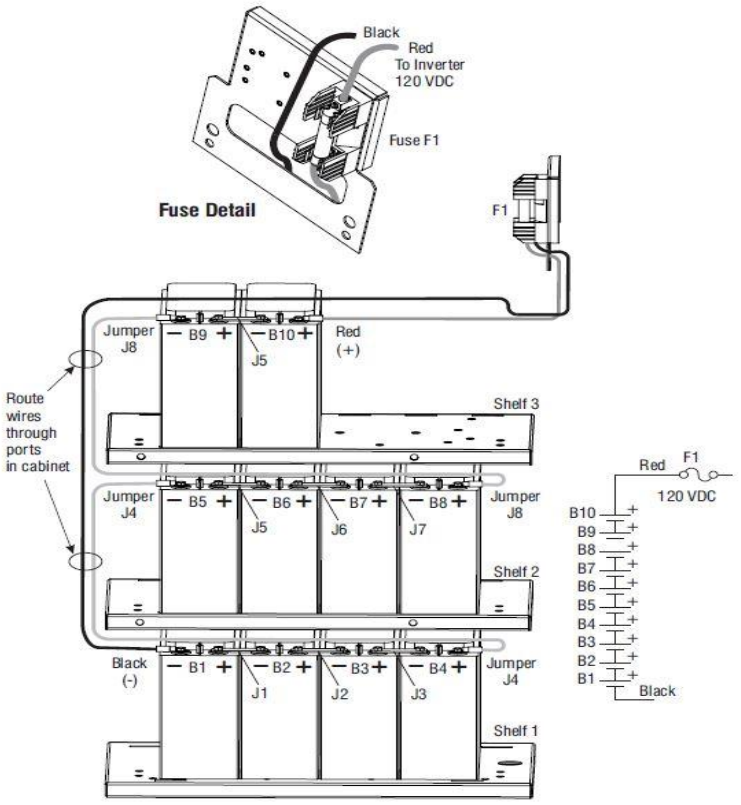


Figure 7 – 2.8KW / 120VDC Diagram

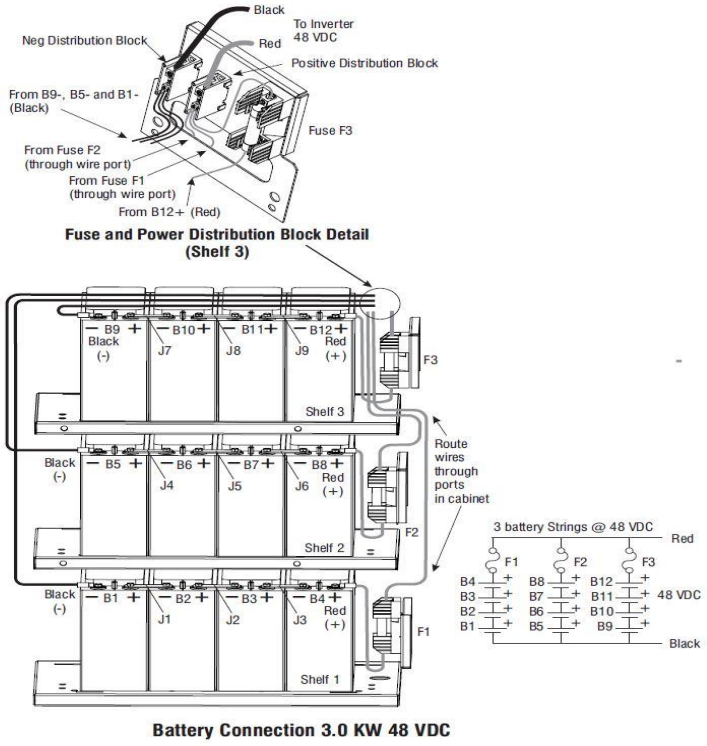


Figure 8 – 3.0KW / 48VDC Diagram

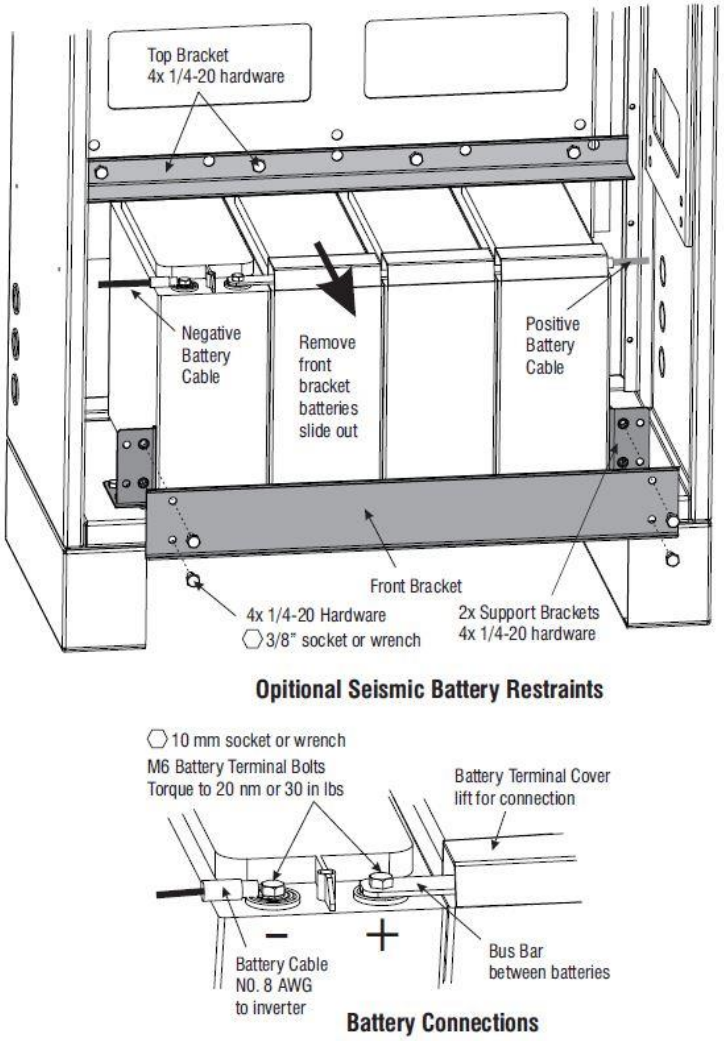


Figure 9 – Optional Seismic Restraints Illustration

6.0 Start up and shut down procedures

Start-Up

After the AC input and output wires are connected and the batteries are properly installed, the unit is ready to be started up. Start-up requires that the AC input be present. The unit will not start up without AC input voltage.

Ensure that the incoming AC voltage is reaching the unit by turning on all feed circuit breakers. Once AC input is verified, simply turn on the systems on/off switch located behind the removable front cover. Place the switch in the right position to on. The unit will go through a series of relay clicks to verify proper connections and then go into the charge mode. The unit is now on-line and ready. Verify that all load connections are operating within the specifications of the unit by measuring AC currents on both the line and load and measure all neutral currents to ensure line and neutral currents are the same.

Press the Test button on the front panel to verify that the optional switched/normally off loads are all operational and again measure currents.

If alarms occur during start-up, see section 8.3 for possible explanations. Also see section 9.1 for Start-Up Mode explanations

Shut-Down

To shut the system completely down simply place the system on/off switch to the off position and place the input circuit breaker and any optional output breakers to the off position.

If the unit is Shut-Down for a long duration please see Battery Storage Section 2.2 to ensure that the batteries are not damaged from the effects of self-discharge and high ambient temperatures.

7.0 Specifications

Input

Voltage	Model and Voltage Dependent (see chart 7.1)
Current	Model and Voltage Dependent (see chart 7.1)
Frequency	60Hz +/- 2 Hz
Protection	Input Circuit breaker with fast acting semiconductor fuse in series for Selective Coordination and improved KAIC withstand
Power Factor	0.5 lead to 0.5 lag

Output

Voltage	Model and Voltage Dependent (see chart 7.1)
Current	Model and Voltage Dependent (see chart 7.1)
Frequency	60Hz +/- 0.02 Hz crystal controlled during emergency mode
Overload	120 percent for 10 minutes, 400 percent for 500 mS
Transfer Time	Less than 2mS (fast transfer)
Output Distortion	Less than 3% THD
Crest Factor	4 minimum for all models
Load Power Factor	0.5 lead to 0.5 lag
Protection	Optional circuit breakers
Output Types	Normally On, Optional Switched/Normally Off

Battery

Type	Valve-Regulated sealed lead-calcium. Upgrade option available
Charger	3 rate with Temperature Compensation
Recharge Time	24 Hour recharge standard.
Protection	Automatic Low Voltage Disconnect (LVD) set at 1.67 VPC Automatic restart upon utility return
Runtime	90 Minutes, @ 25 deg. C
DC Voltage	Model and Voltage Dependent (see chart)
DC Current	Model and Voltage Dependent (see chart)

Environmental

Operating Temp	20 to 30 degrees Centigrade (Battery Discharge rating for UL)
Storage Temp	-20 to 70 degrees Centigrade (Electronics) 0 to 40 degrees Centigrade (Batteries)
Relative Humidity	<95 % (non-condensing)

Physical

Cabinet	NEMA Type 1 enclosure, 14 AWG powder painted CRS
Cooling	Natural Convection – Fans only for Inverter Mode and High Charge Mode

7.1 Product Line Voltage Current Chart/Matrix

VA Output	Module Size	Module QTY	Input/Output Voltage	Input Current	Output Current	Battery Voltage	Battery Current
1000	1000	1	120	10.5	8.3	48	23.5
	1000	2	208	6.0	4.8	48	23.5
	1000	1	240	5.3	4.2	48	23.5
	1000	1	277	5.0	4.1	48	23.5
	1000	2	480	2.9	2.3	48	23.5
2200	2200	1	120	22.9	18.3	96	24.9
	1100	2	208	13.2	10.6	48	50.9
	2200	1	240	11.5	9.2	96	24.9
	2200	1	277	9.9	7.9	96	24.9
	1100	2	480	5.7	4.6	48	50.9
2800	2800	1	120	29.2	23.3	120	25.1
	2800	1	240	14.6	11.7	120	25.1
	2800	1	277	12.6	10.1	120	25.1
3000	1000	3	120/208	10.5	8.3	48	76.4
	1000	3	277/480	5.0	4.1	48	76.4

8.0 Man Machine Interface (MMI)

8.1 Introduction:

The Man Machine Interface (MMI) or Front Panel consists of a 5 button keypad (Left Key, Up Key, Right Key, Down Key and Enter Key) for menu navigation, a 4x20 character backlit White LCD display, Heads-Up LEDs for quick diagnosis of system status and alarms, Dedicated System Test pushbutton and Alarm Silence On/Off pushbutton. There is also an SD card for downloading the Logs to transfer to a computer for analysis.

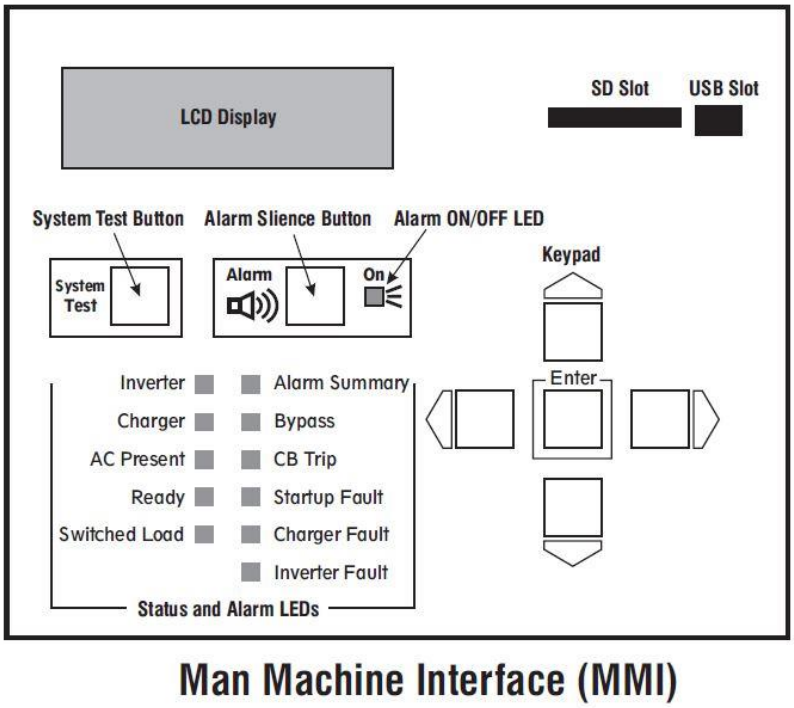


Figure 10 – MMI Front Panel Interface

8.1.1 System Test Button:

Pressing the System Test pushbutton will initiate a 30 second test of the system. This test will comply with the UL924 self-testing and self-diagnostics by analyzing battery voltages and output loads. All switched loads are energized during a system test.

8.1.2 Alarm Silence Button:

Pressing the Alarm Silence button will silence the audible alarm and also turn off the Alarm On/Off LED. The Alarm Silence is equipped with a “ring-back” feature so that if an alarm is still present 24 hours after the alarm is silenced, the audible alarm will re-activate.

During a System Test and also during a power outage when the system is on Inverter Power, the audible alarm will beep momentarily once every second.

8.1.3 Keypad and Display Features:

Using the Keypad and 4x20 Display, the user can access all features of the system including Meter Measurements, User Settings, Test Logs, Alarm Logs, Event Logs, System Info, Alarms and System Info. The Home Menu is a scrolling menu that scrolls between the Company and Product information on one page and then the Date and Time and Alarms (if Present) on another page. To Leave the Home Menu, Press the Enter (center) Button. From there press the down arrow to scroll down to see the available menus.

8.1.4 SD Card:

The SD card slot is available for downloading all the Test, Event and Alarm Logs as a backup to a computer for analysis or record keeping. To initiate the SD card storage feature, the user must do so through the User Menu so it is password protected. Please see the Backup Logs section in User Menu for instructions for this process.

8.1.5 USB Slot:

The USB slot is not available to the User and is available only to Factory or Qualified Field Service Technicians. Its purpose is for system updates such as software and critical system parameter changes through a file structure and internal flash memory drives.

8.2 Main Menu:

The Main Menu is the First Menu available after the Home Page that Automatically Scrolls between Company info and Date and Time. The Main Menu consists of sub-menu selections and are Meter Menu, Alarms, Event Log, Test Log, Alarm Log, User Setup, Factory Setup and System Info. To reach the Main Menu, simply press the Enter button from the Home Page. Then use the up and down arrow key to select between all the Sub-Menus previously listed and once the desired Sub-Menu is reached, simply press the Enter Key to access that Sub-Menu for immediate entry.

8.3 Meter Menu:

The following 11 functions are available through the Meter Menu.

Input Voltage, Output Voltage, Output Current, Output VA, Battery Voltage, Battery Current, Battery Power, Temperature, System Days, Inverter Minutes and Inverter Events. Output Voltages and Currents are True-RMS measurements while Battery measurements use an Averaging technique. The Measurements are updated on the MMI screen approximately every half second and are of high resolution and near instrument quality. All system parameters are calibrated from the factory and are done so at full scale.

8.4 Alarm Menu:

If alarms are present, the active alarms will be displayed in the Alarm Menu. If no alarms are active, the display will read Alarms (0). There are many alarms that the system can diagnose. Some alarms are fixed and some are programmable through the User Menu.

Fixed alarms are not user adjustable nor can they be turned on or off – they are always active and are imperative for proper safeguarding and operation of the system. The factory has broken down these alarms into three modes of operation which are Startup, Charger and Inverter modes. The possible fixed alarms are Startup Alarms (Communication, Setup Conflict, Battery Voltage, Back-Feed, Transfer /AC Fuse, Overload, Mis-Wire, Incorrect AC), Charger Alarms (Communication, Over-Temperature, DC Fuse, No Charge, Overcharge, Back-Feed, AC Fuse/Wiring, Program Reference), Inverter Alarms (Communication, Over-Temperature, Overload, Crest Factor, V-Out, Back-Feed, Low Battery, Program Reference), Phase Rotation, CB Trip, UPS Bypass, Overload, and Overload Shutdown.

User programmable alarms include Low Battery, Near Low Battery, High Temperature, Utility Failure, Low VAC, High VAC and Load Reduction. These can be turned on and off and adjusted through the User Menu.

The system is provided with an Inrush alarm to detect high inrush current associated with modern lighting loads. This feature is factory adjustable and if this alarm occurs, please consult factory for troubleshooting the connected load.

Further explanation of Alarms and possible causes shall be explained throughout this document.

8.5 Event Log:

An Event is when the System transfers from Battery Charging mode (99.9% of life) over to Emergency Power and starts to discharge the battery. This occurs when a system test is initiated or when a power outage occurs. During an Event, the system keeps a record of critical parameters such as Time and Date of the event, Output Voltage, Current, VA, Battery Voltage, Battery Current and Battery Power. Since the system is constantly measuring these parameters, it stores the Beginning of the Event and the End of the Event and saves this information in a file. Up to 100 Events can be stored before memory will start to overwrite the oldest event so the process is First In – First Out and event #1 will always be the newest.

8.6 Test Log:

Identical to the Event Log with the exception that the Test Log is only stored when a system test is either a) initiated from either a manual process of the User pressing the Test Button on the front panel keypad or b) when the system is instructed by the automatic monthly or yearly test.

8.7 Alarm Log:

In the event an alarm occurs from one of many that the system can produce, this alarm is immediately stored into memory. The alarm log has a record of any and all alarms the system has experienced and is valuable for troubleshooting and detecting issues. The Alarm Log is stored in a First in – First out process just like the other logs and has the capability of storing up to 1000 alarms.

8.8 User Menu:

From the Scrolling Home Pages, press Enter Key and down arrow to select User Menu and press Enter to get to the password entry screen. **The User Password is 4 keystrokes - Left Key, Right Key, Left Key, and Right Key.** Upon successful password keystrokes, the User Menu is accessible and now several alarms can be turned on and off and threshold levels for these alarms can be changed. If the password keystroke was not successful, the Enter Password will be prompted again and the user has the option of going back with the left key or trying again.

8.8.1 Date and Time – The date and time is preset from the Factory (East Coast Time), user adjustable and battery backed up. The Date and Time are extremely accurate and have a couple second per year gain/loss accuracy. All Test, Event and Alarm Logs are time stamped from the machines date and time settings. Furthermore, all Month and Year Tests are synchronized to the machines date and time settings so it is imperative that the correct date and time are set. Daylight savings time is not compensated for so in the event your area observes daylight savings time, please change the machines time for most accurate settings.

8.8.2 Month Test – Per the NFPA and UL requirements, a system test of the Emergency Lighting equipment should be performed once per month. Which Day of the month and what time of day are fully adjustable. Factory default is First Day of month at 8:30 AM the test will be performed.

8.8.3 Year Test – In addition to the Month Test requirements of the NFPA and UL, it is recommended that a 90 minute discharge be performed once per year. The Month, Day and Time of this test is fully adjustable and the Factory default for this test is off. If the Yearly test is enabled, the system will undergo a full 90 minute discharge test at the time and date determined by the settings.

8.8.4 Low VAC Alarm – User can enable or disable this alarm by selecting the up or down arrow keys to “On” or “Off” and then press the Enter Key. If the user enables this alarm, the default setting is 85 percent of nominal line but is fully adjustable. Using the up or down key, adjust the voltage to the desired level but, there are high and low limits to this alarm and are within the range of 100 percent to 60 percent respectively. Low VAC Alarm factory default setting is off.

8.8.5 High VAC Alarm – This alarm works just like the Low VAC alarm so it can be enabled or disabled and adjusted however, the default setting for this alarm is 115 percent of nominal line. The high and low limits are 140 percent and 100 percent respectively. High VAC Alarm factory default setting is off.

8.8.6 Low Battery Alarm – Low Battery alarm is Factory Enabled and is set to 85 percent of battery nominal. For a 48VDC system, this translates to approximately 40.8VDC. This alarm level can be user changed and is adjustable from Nominal to 85 percent of nominal which translates to 48V to 40.8V for a 48VDC system.

8.8.7 Near Low Battery Alarm – Near Low Battery alarm is Factory Enabled and is set to 98 percent of battery nominal. For a 48VDC system, this translates to approximately 47VDC. This alarm level can be user changed and is adjustable from Nominal to 85 percent of nominal which translates to 48V to 40.8V for a 48VDC system.

8.8.8 Utility Failure Alarm – This alarm can be turned on and off and has no threshold levels. Factory Default setting for this alarm is off.

8.8.9 High Temperature Alarm – The system has an internal temperature sensor so the system temperature may be a bit higher than ambient temperature – please keep this in mind if using the High Temperature Alarm. The High Temperature alarm is adjustable from 0 °C - 60 °C and is activated when the temperature goes above this level. Factory default for this alarm is off and if enabled will immediately default to 40 °C (about 104 degrees F.)

8.8.10 Time Delay – Time Delay is a feature that keeps the switched loads on for the duration of the Time Delay setting. If Time Delay is set to off, the switched outputs will immediately go off upon event ending (Power Loss or System Test). If Time Delay is set to 10, the switched loads will remain energized for 10 minutes after power has been restored. This feature is useful when there are HID (High Intensity Discharge) lights on the site and these lights have a re-strike time before they can be turned on again due to the cooling process. The factory default setting for this is off but can be User Adjusted up to 15 minutes.

8.8.11 Load Reduction Alarm – Load Reduction is an alarm available to quantify if Load Changes have occurred. When the Load Reduction option is enabled, the actual output current is compared to a user adjusted load current setting during an event only! It only looks at load current during an event because due to modern lighting management, the loads can continuously change from Motion Sensors, Occupancy Sensors, etc. These constant load changes may trigger an alarm but in reality, the system is operating as designed. When the Actual Output Current deviates more than 10 percent high or 10 percent low from that Load Current Setting, an alarm will be tripped. The factory default for this setting is off and if enabled the adjustment for the load current setting is from zero amps to system full scale current in 0.1A increments.

8.8.12 Relay 1 – A user programmable alarm function or status function can be tied to a Form-C relay to integrate into a building management system. The relay can be triggered on the following status or alarm features – AC Present, Battery Charging, Inverter On, High Temperature, Utility Failure, Near Low Battery, Low Battery, High VAC, Low VAC and Relay Off. The factory default setting for Relay1 is off.

8.8.13 Relay 2 – Identical to Relay 1 in function. Relay 2 is an independent relay with its own Form-C contacts.

8.8.14 Backup Logs – To use the Backup Logs function, an SD card must be inserted into the SD card slot. When the Backup Logs function is selected, ALL internal logs from Test Logs, Event Logs, Alarm Logs and Discharge Logs will be written to the SD card. The files that are stored are Text files for each individual log and may consist of thousands of files. This process may take several minutes to finish due to the limitations of the internal processor speed and all of the tasks that it is simultaneously performing.

8.8.15 Contact Name – A Contact Name can be entered into the system for storage. The contact name is then viewable in System Info. The Name can be changed using the keypad by scrolling through the alpha/numeric selections with the up and down arrow keys. When the correct number or letter is reached, scroll left or right for the next character or press Enter when finished.

8.8.16 Contact Phone – A Contact Phone Number can be entered into the system for storage. The contact phone number can be viewed in the System Info. The Contact Phone number can be changed using the keypad by scrolling through the alpha/numeric selections with the up and down arrow keys.

When the correct number or letter is reached, scroll left or right for the next character or press Enter when finished.

8.9 Factory Setup:

This menu is not available to Users and is reserved for qualified field technicians and Factory Representatives.

8.10 System Info:

The System info displays the software revision of the MMI and the Controller IO on the first screen. The second screen

There are several menus available to assist diagnosing connected equipment.

9.0 System Operation

9.1 Start-Up Mode

When the system is first turned on, it goes through a sequence of self-tests to ensure proper connections and it checks for faults that may be present. This is the System Start Up mode and it must qualify several things before advancing to go into the Battery Charging mode.

There will be two distinct clicks of relays as it goes through the self-check sequence. These relay clicks are the diagnostics of the system turning on the output relays to check if any voltages are present and then tickling the output with a small voltage to see if short circuits or overloads are present.

The hard coded faults (see User Setup for all programmable alarms) that are checked for during start-up mode are:

COMMUNICATION – This occurs when the inverter module(s) is not connected

SETUP CONFLICT – This occurs when there is a module or phase configuration discrepancy

BATTERY VOLTAGE – This occurs when the Battery Voltage is too low or too high

BACK-FEED – This is when AC voltages are present at any of the outputs. If there are AC voltages present at any of the outputs, it means that there is a mis-wire and the utility AC power is being back-fed into the system.

TRANSFER-AC FUSE – Either the fuse has blown or there is a defective Solid State Transfer Device

OVERLOAD – Too much load connected to the output

MIS-WIRE – Could be a pulled wire from the installation or incorrect wiring on a module

INCORRECT AC – The wrong voltage is being applied to the system

After all the Start-Up diagnostics are performed, the system is OK to proceed to the Battery Charging mode.

9.2 Battery Charging Mode

The Battery Charging mode is where the system will remain for 99.9+ percent of its life. In this mode, AC power is being passed through to the units output and subsequently its loads and the batteries are keeping a float charge. The charger is floating at 2.27 Volts per Cell (VPC) and is temperature compensated to 4mV per deg. C (per cell), centered at 25 degrees C.

For higher temperatures, the float voltage would go down and for lower temperatures, the float voltage would go up.

For a system that has a nominal DC battery voltage of 48V, this means that float voltage is 54.4 VDC (2.27 VPC) and the LVD voltage is 41 VDC (1.67 VPC).

Float voltage varies with temperature, LVD voltage is fixed.

The typical float voltages that the system's charger would compensate for are:

Temperature	**48V Nominal**	**96V Nominal**	**120V Nominal**
10 Deg. C	55.20 VDC	110.40 VDC	138.00 VDC
15 Deg. C	54.96 VDC	109.92 VDC	137.40 VDC
20 Deg. C	54.72 VDC	109.42 VDC	136.80 VDC
25 Deg. C	54.48 VDC	108.96 VDC	136.20 VDC
30 Deg. C	54.24 VDC	108.48 VDC	135.60 VDC
35 Deg. C	54.00 VDC	108.00 VDC	135.00 VDC
40 Deg. C	53.76 VDC	107.52 VDC	134.40 VDC

Above 40 deg. Centigrade no additional compensation is performed.

9.3 Switched Output

The Switched Output is an optional output that can be switched on and off and is controlled by an external voltage applied to the Switched Enable input. The designed function is to act as an interface to energy saving controls such as time clocks, daylight harvesting, photo-sensors or any building occupation sensing. It is also tied in to the VTD function so if the VTD is desired for normally off loads, connect these loads to the Switched Output.

The Switched output can be energized while in the Battery Charging mode of operation by applying 120 or 277 VAC to the Switched Enable Input.

When this system changes mode of operation to the Battery Power mode, the Switched Output will automatically energize.

9.4 Inverter Power Mode

Inverter Power Mode can have several other names such as Emergency Power and Discharge Mode. This terminology may be used throughout this document.

During Inverter Power mode, the system is producing a pure sine wave for the output loads and the batteries are being discharged. The output current is limited by an active pulse by pulse current limit technique and limits the power electronics from failure. The current limit is set to the crest factor value or 4 times the average output current.

In the event of an overload there are several ways that the Inverter will protect itself. First is the pulse by pulse limit and second is by average sensing. The pulse by pulse is a transient protection and occurs in the micro-second time scale, the average sensing looks at a heavily filtered signal and occurs in the seconds time scale.

Since the crest factor is very high on the inverters output, loads that have high inrush currents are quickly up and running. This is very beneficial with Normally Off and Switched Loads which seem to be more prevalent with modern lighting and green building design techniques.

Transfer time between Battery Charge Mode and Inverter Power mode occurs at two different speeds. Since this system is a line interactive, it senses the utility power and transfers when it thinks that the utility has failed. This analysis sometimes causes transfers when in actuality no power is lost and only a transient occurred on the incoming utility. The two different speeds of Fast Transfer and Slow Transfer are important for different applications.

Fast Transfer – Used for applications that require HID lights to be supported. The transfer time is guaranteed to be less than 2 milliseconds and is sufficient for any HID application.

Slow Transfer – Used for applications that do not require a Fast Transfer and this is less susceptible to transfer to Inverter Power during normal operation. Power must be out for a complete line cycle or 16 milliseconds. Slow Transfer is the mode preferred to run an installation with Normally Off loads. Normally Off loads may require darkness at all times unless there is definitely a power outage as the case like a Movie Theater.

The Normally On, Normally Off and Switched outputs are all producing voltage during Battery Power mode.

10.0 Warranty

There are two separate warranty periods for this Central Inverter System. The Electronics/Cabinet warranty period is for 3 years from the date of shipment. It is warranted against defects in workmanship and materials under normal and proper use.

The batteries are covered under a separate warranty and these durations may change dependent on battery type.

Battery Type	Warranty Duration
Pure Lead	7 years full, 14 years pro-rata
Standard VRLA	1 year full, 9 years pro-rata

Extended Warranty is available through a factory start-up plan. Please call Technical Support for details.

10.1 Technical Service and Support

Our technical support staff is available before, during, and after the installation of this product. Should you need help, please contact our service center at:

Service Center	800-967-5573

We are available during normal business hours Eastern Standard Time Zone.

10.2 Return Material Authorization (RMA)

At no time will material be accepted as returned goods without a RMA number issued from the factory. If parts are deemed defective by our Technical Service group and are troubleshot at the site to be defective they can be exchanged at no cost during the warranty period with an RMA.

When returning defective parts back to the factory, the RMA number must be written on the packaging, bill of lading, or shipping labels so it can be properly identified.

Technical Service will make every effort to troubleshoot the problem over the phone before an RMA will be issued. Phone troubleshooting may save both the customer and manufacturer added time and thus expense. Cooperation is greatly appreciated.

11.0 Maintenance and Service

CAUTION – Whenever maintenance and service is to be performed, it may be desirable to shut unit down. Please refer to Start up and Shut Down procedures for details.

CAUTION – Always assume AC and DC Voltages are present at the output terminals because the system is capable of providing output voltage from the batteries when there is no AC input. The unit can pass through AC voltages from input to output with no batteries connected if the installation switch is on.

Routine Maintenance

Routine Maintenance should be considered any maintenance that does not require removing the systems front cover. These maintenance items includes Circuit breaker re-setting and periodic cleaning of dust from the cover and cabinet base to ensure proper convection air flow. Since no fans are required on this system for 99.9 percent of the products life, air flow moves by convection. Convection air circulation is from bottom to top as heat naturally rises.

Keep all foreign objects off the top and away from the front of the unit as these may impede convection air flow.

The system automatically performs monthly tests and keeps a log of all the events and monthly tests in the event log.

Periodic inspection of the logs will see how the unit is performing. A quick test by manually pressing the test button will transfer the system to Inverter Power and will turn on all the connected loads such as the Normally Off and the Switched load.

Ensure there are no faults present. If there are faults, please refer to the User Interface section for a complete detail of what this fault may indicate.

Test

By pressing the TEST button on the MMI front panel, the unit will transfer to Battery Power. This test will run for at least 30 seconds and will exit back to Battery Charging upon synchronizing to utility power.

11.1 Battery Maintenance

The batteries used in this system are sealed lead calcium and are termed “Maintenance Free”. This term may be misleading because ALL batteries require periodic maintenance even if it only consists of a visual inspection. We recommend the following maintenance plan:

- Once every 3 to 4 months the batteries should be visually inspected for cracks, leaks, bulging or deformities and corrosion buildup on terminals.
- Once every year all the batteries should be inspected to ensure all connections are tight and re-torqued to the requirements outlined in 5.2 Battery Installation section.

11.2 Battery Replacement

This system is a UL approved and listed component with exact battery requirements. Failure to replace the batteries with the exact same type will VOID the UL approval. For battery replacement, please call the service number listed in the warranty section so that the unit performs as it was intended.

WARNING – Only qualified personnel that is familiar with AC and DC installation techniques and codes (such as an electrician) should perform the removal and replacement.

WARNING – Remove all rings, watches, and other jewelry before doing any electrical service or installation work. Always wear protective clothing and appropriate personal protective equipment (PPE) that is suitable such as eye protection, etc. when working with batteries.

WARNING - Batteries contain tremendous energy and can explode if short circuited. Precautions should be taken to eliminate possible short circuits.

WARNING – Batteries contain lead. Follow all local and state requirements for battery disposal. Please dispose of properly by recycling.

TIP – Discharging the batteries by letting the system run on Battery Power can be beneficial for several reasons. First, it verifies that the batteries need replacing if it does not make 90 minutes of discharge time. Second, it depletes the battery which reduces the fault current available at the batteries terminals. A completely discharged battery that ran to LVD still has fault current available – just not nearly as much. By running the battery to LVD, the available fault current would be substantially less and safer if an inadvertent short circuit were to happen during the removal or transportation process to the recycling facility.

To remove the batteries, shut the unit completely down by turning off the System On/Off switch and remove AC power Feed source by turning off the input circuit breaker.

Disconnect the battery inter-connect jumpers and the wires for inter-shelf connection if present. After all wires are disconnected, simply slide the batteries forward for removal.

DANGER – The worst thing that can happen when removing or installing batteries is an inadvertent short circuit. All means must be taken to ensure that all lugs are secure and insulated after removal from the batteries post. Batteries contain tremendous short circuit energy and are on the magnitude of thousands of amps. When a short circuit occurs, it first creates a very loud shock. If the short circuit creates a welded lug so that the short circuit remains conducting current, the battery may explode.

Extreme danger and bodily injury can be caused by primary and secondary effects of the short circuit. Primary effects would be burns, vision or hearing loss. Secondary effects could be falling off a ladder or sustaining injuries not created by the battery itself.

DANGER – DO NOT TOUCH BATTERIES UNLESS TRAINED OR KNOWLEDGEABLE AND KNOW THE HAZZARDS!

WARNING – Always use the correct tools with insulated handles and wear the appropriate personal protective equipment (PPE) required for battery work.

To install new batteries, see section 5.0 Battery and DC Connections.

12.0 Web Interface

12.1 User Setup:

User Account set up requires a valid Central Inverter System serial number to setup up an account. With a verification of a valid serial number the following information is required for the user to finish setting up the account:

Customer Name, User Name, Password, Address (up to 2 lines), City, State, Country, Phone1, Phone2 and Email address.

- This information is required for the Factory to Verify and Authenticate the account. If account information is not valid, the factory will remove account and deny access to machines.

Once the user has gone through this account setup process, they can access critical information on their system by logging into their account and clicking on the Control Panel icon for their machine.

12.2 Control Panel (System Home) Page:

The Control Panel acts as the Systems Home Page. From this page, it is possible to see several critical functions listed below plus several icons will link the user to many more features.

Meter Functions – Input Voltage, Output Voltage, Output Current, Output VA, System Battery Voltage, Battery Current (charging and discharging), Battery Power, System Temperature, System Days, Inverter Minutes and System Events.

Also included in the Control Panel is the System Status and include indicators for Battery Charging, Inverter Power On, AC Present, System Ready, and Switched Load Energized. The Alarm Summary indicator and critical alarms indicators include Unit in Bypass, Circuit Breaker Trip, Startup Fault, Charger Fault and Inverter Fault.

A System Test can be initiated by an icon located on the Control Panel. Immediately after pressing this Icon, the system will perform a system test and when complete will record test parameters in the Test Log. Please see System Logs for details.

From the Control Panel Page the user has access to several links and include User Setup, Alarms, Charts and Graphs and System Logs. Just click on the icons on the home page to access these features.

12.3 User Setup Page:

The user can change system parameters along with alarm trigger points and enable/disable alarms. The following features can be changed by the user:

Date and Time settings(Year, Month, Day, Hour, Minute), Month Test Settings(Day, Hour, Minute) enable/disable, Year Test Settings(Month, Day, Hour, Minute) enable/disable, Low VAC Alarm enable/disable and set-point, High VAC Alarm enable/disable and set-point, Low Battery Alarm enable/disable and set-point, Near Low Battery Alarm enable/disable and set-point, Utility Failure Alarm enable/disable, High Temperature Alarm enable/disable and set-point, Time Delay setpoint (0-15 minutes), Load Reduction enable/dis-able and set-point, Relay 1 and Relay 2 activation event (Low VAC Alarm, High VAC Alarm, Low Battery Alarm, Near Low Battery Alarm, Utility Failure Alarm, High Temperature Alarm, Inverter On, Battery Charging and AC Present), Contact Name up to 20 characters, Contact Phone up to 20 Digits.

12.4 Alarms Page:

All possible system alarms are listed on the Alarms Page. If the Alarm is active, a Red indicator will be present next to the alarm function. This aids in troubleshooting the system and pin-pointing issues that may arise during the life of the product.

The following Alarms can be displayed:

Inverter Alarms – 8 distinct alarms including Communication, Over-Temp, Overload, Crest-Factor, Out of Range Output, Back-Feed, AC Fuse/Wiring, Programming Reference.

Charger Alarms – 8 distinct alarms including Communication, Over-Temp, DC Fuse, No Battery Charge, Overcharge, Back-Feed, AC Fuse/Transfer Device, Programming Reference.

Startup Alarms – 8 distinct alarms including Communication, Setup Conflict, Battery Voltage, Back-Feed, AC Fuse/Transfer Device, Overload, Mis-Wire, Incorrect AC

Phase Rotation, Circuit Breaker Trip, Unit in Bypass, Inrush Alarm, Low Battery, Near Low Battery, High Temperature, Overload, Overload Shutdown, Utility Failure, Low VAC, High VAC, Load Reduction

12.5 Charts and Graphs Page(s):

Since all critical data is taken every second from the inverter, real-time information such as Meter and Status and Alarms are all live 24-7. This capability enables real-time monitoring of certain critical data and present it for analysis.

The Following charts are available and can be graphed in month or day format along with the capability of downloading files for alternate charting and graphing or simply just storage – this is only limited to the users imagination of what to do with the data.

12.5.1 Temperature: Graphed in Degrees Centigrade, useful for knowing battery history and proper float voltage monitoring. Graph can be scaled to Days (28-31) by choosing the Year and Month, or Hours (24) by choosing the Date. A popup calendar or numeric selector will appear when choosing time fields to adjust chart time scale.

12.5.2 Output VA: Graphed in Min (Minimum) and Max (Maximum) readings for each hour and day. Min and Max values of Output VA can be selected/un-selected by mouse click and cause the graph to show both records simultaneously or one record at a time. Similar to Temperature, the graph can be scaled to Days (28-31) by choosing the Year and Month, or Hours (24) by choosing the Date. A popup calendar or numeric selector will appear when choosing time fields to adjust chart time scale. Since this chart is a 3-D column chart, an adjustment of the Alpha Angle and Beta Angle can be adjusted for optimum viewing.

12.5.3 Battery Voltage: Graphed in hours, this chart is the highest resolution and also is a Zoom-able type chart. If a discharge event has occurred, this chart can be zoomed into the discharge time scale and with extreme precision, the battery voltages can be measured over the entire discharge period. The chart starts every day at zero hours or 12:00 AM. To zoom into the desired time, simply click the mouse and hold it down while dragging the mouse over the time of interest. As the mouse is dragged across an area, the color will change showing the progress. Then, simply release the mouse button and the chart will automatically update to its new time scale.

12.5.4 Discharge Events: Graphed in whole numbers representing discharges that occurred in a user selected time period. A 3-D Column Chart with adjustable Alpha and Beta Angle for optimum viewing. The graph can be scaled to Days (28-31) by choosing the Year and Month, or Hours (24) by choosing the Date. A popup calendar or numeric selector will appear when choosing fields to adjust this column chart time scale.

12.5.5 Discharge Duration: Graphed in Minutes representing the total discharge time (actual time duration the batteries discharged) for the user selected time period. A 3-D Column Chart with adjustable Alpha and Beta Angle for optimum viewing. The graph can be scaled to Days (28-31) by choosing the Year and Month, or Hours (24) by choosing the Date. A popup calendar or numeric selector will appear when choosing fields to adjust this column chart time scale.

12.5.6 Discharge Power: Graphed in VA Output for the user selected time period. Similar to Output VA such that Minimum and Maximum values of Output VA can be selected/un-selected and cause the graph to show both simultaneously or one at a time. The graph can be scaled to Days (30) by choosing the Month, or Hours (24) by choosing the Date. A popup calendar or numeric selector will appear when choosing fields to adjust chart time scale. Since this chart is a 3-D column chart, an adjustment of the Alpha Angle and Beta Angle can be adjusted for optimum viewing.

12.6 System Logs Page(s):

The Inverter keeps a record of all critical events such as system tests and events and also any alarms that occur. The System Logs accessible are Test Logs, Event Logs, Alarm Logs and Discharge Logs.

12.6.1 Alarm Logs Page: Displays all of the Alarms sequentially so that number 1 was the most recent alarm. Displays the Alarm Date, Alarm Time and Alarm Type.

12.6.2 Test Logs Page: Displays all of the System Test results. Similar to Alarm Log, the first log is the most recent System Test. Displays Start Date, Start Time, Duration of Test, Faults Present, Starting and Ending AC Output Voltage, Starting and Ending AC Output Current, Starting and Ending Temperature, Starting and Ending Battery Voltage.

12.6.3 Event Logs Page: Identical to Test Logs except that the cause of the log was a power outage or event. Displays all the same information as the Test Logs.

12.6.4 Discharge Logs Page: Displays the battery voltage after each minute of battery discharge during a test or event. If test or event was shorter than a minute, no data was stored.