MODEL EB1s

BROADBAND POWER SUPPLIES

Installation & Operation Manual

Manual Part No: 017-068-A2

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Multilink Inc. 580 Ternes Ln. | Elyria,OH 44035 | 440.366.6966 | www.gomultilink.com

INSTALL AND OPERATION

The following power supply models, with their part numbers, are documented by this instruction manual. For available options, refer to the OPTIONS section of this manual.

MODEL NUMBER	PART NUMBER	INPUTS
300 VA OUTPUT RATING		
EB1s 300VA-120/60-36	017-068-39	120 VAC 60Hz /3-Battery
500 VA OUTPUT RATING		
EB1s 500VA-120/60-36	017-068-28	120 VAC 60Hz /3-Battery
EB1s 500VA-120/60-48	017-068-29	120 VAC 60Hz /4-Battery
EB1s 500VA-240/50-36	017-068-30	230 VAC 50Hz /3-Battery
EB1s 500VA-240/50-48	017-068-31	230 VAC 50Hz /4-Battery
675 VA OUTPUT RATING		
EB1s 675VA-120/60-36	017-068-56	120 VAC 60Hz /3-Battery
EB1s 675VA-120/60-48	017-068-33	120 VAC 60Hz /4-Battery
EB1s 675VA-240/50-36	017-068-34	230 VAC 50Hz /3-Battery
EB1s 675VA-240/50-48	017-068-35	230 VAC 50Hz /4-Battery
EB1s 675VA-240/60-36	017-068-42	240 VAC 60Hz /3-Battery
900 VA OUTPUT RATING		
EB1s 900VA-120/60-36	017-068-24	120 VAC 60Hz /3-Battery
EB1s 900VA-120/60-48	017-068-25	120 VAC 60Hz /4-Battery
EB1s 900VA-240/50-36	017-068-26	230 VAC 50Hz /3-Battery
EB1s 900VA-240/50-48	017-068-27	230 VAC 50Hz /4-Battery

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MODEL NUMBER	PART NUMBER	INPUTS
1350 VA OUTPUT RATING		
EB1s 1350VA-120/60-36	017-068-20	120 VAC 60Hz /3-Battery
EB1s 1350VA-120/60-48	017-068-21	120 VAC 60Hz /4-Battery
EB1s 1350VA-240/50-36	017-068-22	230 VAC 50Hz /3-Battery
EB1s 1350VA-240/50-48	017-068-23	230 VAC 50Hz /4-Battery
EB1s 1350VA-240/60-36	017-068-40	240 VAC 60Hz /3-Battery
EB1s 1350VA-240/60-48	017-068-41	240 VAC 60Hz /4-Battery
EB1s 1350VA-120/60-36 4 TAP	017-068-43	120 VAC 60Hz /3-Battery
EB1s 1350VA-240/50-36 4 TAP	017-068-46	230 VAC 50Hz /3-Battery
EB1s 1350VA-240/50-48 4 TAP	017-068-47	230 VAC 50Hz /4-Battery
EB1s 1350VA-240/60-36 4 TAP	017-068-48	240 VAC 60Hz /3-Battery
EB1s 1350VA-240/60-48 4 TAP	017-068-49	240 VAC 60Hz /4-Battery
EB1s 1350VA-120/60-48 4 TAP	017-068-50	120 VAC 60Hz /4-Battery
EB1s 1350VA-240/60-36 4 TAP Export	017-068-53	240 VAC 60Hz /3-Battery
1620 VA OUTPUT RATING		
EB1s 1620VA-120/60-36	017-068-54	120 VAC 60Hz/ 3-Battery
2000 VA OUTPUT RATING		
EB1s 2000VA-120/60-36	017-074-21	120 VAC 60Hz /3-Battery
EB1s 2000VA-120/60-48	017-074-22	120 VAC 60Hz /4-Battery
EB1s 2000VA-240/60-48	017-074-20	240 VAC 60Hz /4-Battery

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Areas of text in blue are shortcuts to relevant sections in the manual (PDF only).

EMI / RFI STATEMENT

This device has been designed and manufactured to comply with the EMI / RFI emission limits and immunity characteristics as set forth in Standards EN 55022 and EN 55024. These limits are designed to provide reasonable protection against harmful interference when this equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed in accordance with this instruction manual, may cause harmful interference to radio communications.

This device has been tested by an independent laboratory and has been certified to comply with the requirements of FCC CFR Title 47, Part 15, Subpart B. This test report is available on request.

Section 1: Critical Safety Issues

1.1 Safety Admonishments

Three different levels of safety admonishments are used within this instruction manual; specifically **DANGER**, **WARNING**, and **CAUTION**.

DANGER

The statement following the **DANGER** heading alerts the equipment user of a potentially life- or health-threatening situation unless precautions are taken against it. Admonishments of this nature usually entail the hazards of electrical shock or those encountered that may result in physical injury.

WARNING

The statement following the **WARNING** heading alerts the equipment user of a condition or procedure that could result in interruption of service to the users or subscribers of the service receiving power from this product.

CAUTION

The statement following the **CAUTION** heading alerts the equipment user of a condition that could result in damage to the subject equipment or ancillary equipment if care is not exercised during certain maintenance or operating procedures.

SAVE THESE INSTRUCTIONS FOR FUTURE REFERENCE

1.2 Emergency Shutdown Procedure

DANGER

Exercise extreme caution when performing the following procedure. Carry out the steps precisely in the order given to avoid the possibility of personal injury or equipment damage.

Perform the following procedure if the power supply must be shut down and disconnected on an emergency basis:

1. Open the enclosure containing the power supply.
2. Switch the BATTERY CIRCUIT breaker to the OFF (O) position.
3. Disconnect the AC power cord from its inlet connector at the side of the power supply. Power supply output is now disabled; however, continue with the following steps.

4. Remove the BATTERY connector from its location at the power supply front panel.
5. Disconnect the output cable from the OUTPUT connector at the power supply front panel, thus completely isolating the power supply from the outside plant.

1.3 General Safety Issues

The power supply documented in these instructions has been designed, tested and produced to ensure safe, trouble-free operation. Personnel using or installing this power supply should completely read and fully understand the following safety instructions. They are provided here as informational guidelines for your continued safety in usage of the product.

1.4 Safety Issues of Power Supply Installation and Use

The subject power supply has been designed and built to power broadband distribution equipment only. It is not intended for any other usage and provides output voltages suitable only for its intended application.

DANGER

This power supply operates from an AC source ranging from 100 to 260 volts and produces internal voltages in excess of 500 volts. DO NOT open any covers or panels or attempt to perform any service to the power supply without first removing and disconnecting all external AC and DC power sources. Only trained, qualified personnel should attempt service and repair work on the power supply.

Two Power Sources: All power supplies documented in this instruction manual use more than one source of power. If any reason exists to open the power supply enclosure for maintenance or adjustments, first turn off the BATTERY CIRCUIT breaker on the front panel, disconnect the AC line cord from its outlet and remove the BATTERY connector from its receptacle on the front panel. Be certain that at least 5 minutes has elapsed before opening covers after disconnecting operational power.

Install only gelled electrolyte valve regulated lead acid (VRLA) or AGM type batteries as a standby DC source for this power supply. See the following section 1.6 Battery Safety Issues for further information.

Ground Fault Protection: The power supply does not contain integral ground fault protection. Where such protection is required, the power supply input should be connected to a ground fault interrupter (GFI) outlet or to a branch circuit protected by a GFI circuit breaker of proper ratings.

1.5 Enclosure Safety Issues

The enclosure and the power supply must be installed by qualified technicians or installers only, using appropriate mounting hardware in accordance with local codes and construction practices.

The power supply must be installed within a grounded metal enclosure suitable for accommodating broadband power supplies. If installed outdoors, the cabinet must have a suitable weatherproof rating as a minimum requirement.

The outer enclosure housing the power supply must be of adequate strength to support the power supply and its associated batteries. Additionally, the enclosure must afford adequate ventilation for the power supply such that a minimum free air space of 52 mm (2 inches) remains around all sides and the top of the power supply.

Temperature of the air entering the enclosure must not exceed 50° C (122° F). Air intake and exhaust openings within the enclosure must not be less than what is required to maintain this temperature requirement. If these temperature limits are routinely exceeded or ventilation requirements cannot be attained, a suitable forced-air cooling system may be required within the enclosur

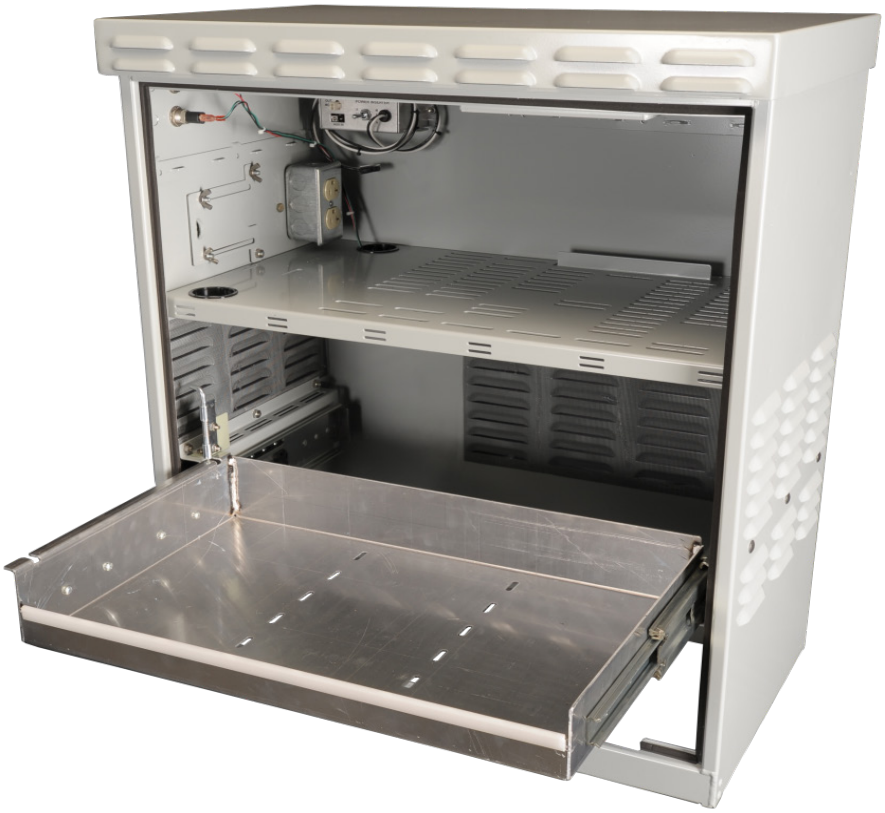

Fig. 1-1 Typical Power Supply Enclosure

1.6 Battery Safety Issues

When installing batteries for the power supply, do not mix battery types (gelled electrolyte and AGM) in the same string or within the same cabinet. DO NOT use flooded type batteries containing liquid electrolyte under any circumstances. Such batteries are hazardous to use within broadband enclosures and can degrade or destroy equipment installed in the enclosure with them. Flooded batteries also pose environmental hazards when acid containment methods cannot be employed. Use only gelled electrolyte or AGM batteries of suitable size, voltage and capacity for use in a broadband system.

Batteries can supply extremely large currents (>4000 amps) for a short period of time, sufficient to vaporize or melt metal objects. For this reason, installers must remove watches, rings and other jewelry before placing or connecting batteries in the cabinet. Insulating gloves and protective clothing should be worn during battery installation, consistent with local practices. Use only fully insulated tools designed for battery maintenance.

Batteries contain sulphuric acid in gelled or semi-liquid form. Direct contact with any spilled electrolyte from a damaged battery may result in skin irritation or chemical burns. For this reason, handle batteries carefully to avoid puncturing the case and releasing any of the electrolyte. In case of contact with the electrolyte, thoroughly wash any contaminated areas of the skin with soap and water. In case of contact with the eyes, immediately flush with copious amounts of water and seek medical attention. Minor surface spills can be neutralized with an appropriate neutralizing agent such as bicarbonate of soda (baking soda).

Always use proper lifting techniques when handling batteries. Each 12-volt battery weighs approximately 30 Kg or 66 lbs.

Personnel installing or servicing batteries must wear eye protection (goggles or full face shield) and protective clothing (apron and gloves) if necessary, according to local practices. Additionally, only fully insulated tools specifically designed for battery installation and service should be used for that purpose. Tools wrapped with vinyl or fabric-based electrical tape are NOT acceptable substitutes. (Insulated wrenches complying with IEC 60900 and ASTM F-1505 Standards
are distributed by various industrial supply organizations.)

The BATTERY CIRCUIT breaker on the front panel of the power supply must be operated to the OFF (O) position before installing, changing and connecting batteries.

Verify correct battery polarity and voltage at the DC input connector of the power supply before closing the BATTERY CIRCUIT breaker. Applying DC input of improper polarity or voltage can seriously damage or entirely destroy the power supply.

Replace any battery that is found to have a swollen or cracked case. Always recycle used batteries to reclaim lead and other materials that can pose environmental hazards if disposed of improperly.

Section 2: Introduction

2.1 EB1s Series Product Overview

Supported Firmware Versions: This manual supports features and functions of firmware releases starting at Version 3.1.2, Build 3.

Overall Operation

The EB1s Series of power supplies provide filtered and regulated AC output power of proper voltage and current values to operate amplifiers, nodes and other active devices in CATV and broadband networks. These supplies are designed to normally power the network from the commercial AC line while maintaining an emergency battery in a state of full charge. If the commercial AC line fails for any reason or if line voltage exceeds preset low or high limits, the low voltage inverter within the power supply immediately begins providing power to the network load while drawing its operating power from the battery. After commercial AC line power has been restored, the power supply will revert to its normal operating mode supplying power to the network load while drawing operational power from the commercial AC line. Simultaneously, the internal battery charger within the power supply will recharge the battery. The power supply will continue providing filtered and regulated AC to the network load.

Hot-swap Inverter Module: The EB1s features a removable Inverter Module that can easily be removed and replaced in the field without interrupting power to the load.

Primary Voltage Selection

The EB1s power supplies have been designed for operation from standard AC utility lines with an overall voltage range of 90 to 145 volts for nominal 120 VAC models or 180 to 264 volts for nominal 240 VAC models. The main transformer of the power supply is equipped with two or four primary input taps and an automatic electronic tap selector circuit connects the appropriate primary tap to the AC utility line depending on the prevailing AC voltage applied. This automatic tap selection allows the power supply to operate at its most efficient and economical point, thus minimizing input power losses and heat dissipated within the power supply enclosure.

Output Over Current Monitoring

Each output may be independently configured to trigger an output current alarm at a programmable threshold. The front panel LCD display Configuration menu contains the configuration and current thresholds. Note that this does not provide actual Current Limiting; the natural foldback characteristic of the ferroresonant transformer will limit the output current to a safe level.

Short Circuit Detection

The power supply is capable of detecting a condition that indicates that the output has a short circuit. After a short delay to determine that it is not a momentary condition, the output will disconnect from the load and after 60 seconds will attempt to re-connect. If the short circuit is still detected the output disconnects and the cycle starts again. This feature can be enabled or disabled from a Configuration Menu item.

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Missing Batteries Detection

The power supply is capable of detecting if the battery string has been disconnected. The detection test is run at an interval set by a Configuration Menu item. The same menu item can disable this feature.

Multiple Language Menus

A Configuration Menu item can select either English or Spanish as the power supply display language. Additional languages may be supported in future versions.

Sleep Mode

Sleep Mode is safety shutdown condition initiated by the system firmware. The purpose of this condition is to preserve battery life. While the inverter is running, the power supply will enter Sleep Mode if the batteries drop below the selected Low Battery Shutdown Voltage. This voltage is selected in the Configuration Menu and is 1.75 VDC per cell by default.

While in this condition the inverter and battery charger will not run and the LCD backlight will not illuminate. The LCD display, the keypad, the cabinet lights output, and the HMS communications will continue to function for as long as available battery power will allow. The Major Alarm display will list "Sleep Mode Fault" along with any other alarm conditions.

If there is voltage on the line that is not within the published specifications the power supply will attempt to maintain the output voltage but will not come out of Sleep Mode or charge the batteries until the line voltage returns to the approved range. When the line voltage returns to the specified range, the power supply will switch to Line Mode and after a delay will terminate Sleep Mode and attempt to charge the battery and return to normal operation. If battery voltage cannot be raised above the nominal battery voltage (36 or 48 VDC) the power supply will not function in Standby (Inverter) Mode.

Battery Test/Self Test

The EB1s is capable of performing a battery test. The test mode forces the power supply into battery power/inverter mode. The test can be initiated locally through the front panel, remotely through the status monitoring interface, or self initiated. If the battery string voltage falls to the programmed shutdown voltage during the test an alarm is set indicating "Battery Test Failed" and must be cleared through the LCD display. This alarm is also reported through the status monitoring interface.

Self Test: The Self Test period is programmable in the Configuration Menu for 14 or 28 days. The Self Test may also be disabled in the Configuration Menu. The duration of a test is determined by the Test Duration programmed in the Configuration menu and may be set from 1 to 60 minutes. For a test cycle to be initiated, the battery string voltage must be over 36 VDC for a 36 volt system or 48 VDC for a 48 volt system.

Local Test: The local test is initiated through the front panel. The duration of a test is determined by the Test Duration programmed in the Configuration menu and may be set from 1 to 60 minutes. For a test cycle to be initiated, the battery string voltage must be over 36 VDC for a 36 volt system or 48 VDC for a 48 volt system.

Remote Test: The remote test is initiated through the status monitoring interface. The duration of a test is determined by the Test Duration parameter programmed in the Configuration menu and may be set from 1 to 60 minutes. In addition, a Remote Test can be configured to run for an unlimited time, stopping only when halted manually or due to a test fail or power line failure. See Remote Test Time in the Configuration

section of this manual. For a test cycle to be initiated, the battery string voltage must be over 36 VDC for a 36 volt system or 48 VDC for a 48 volt system.

Status Monitoring Interface

The EB1s may be equipped with one of several embedded status monitoring options. An external transponder supporting the ANSI/SCTE 25-3 2002 standard of status monitoring may also be used.

Embedded Transponder: Embedded transponders are available from Electroline, Phoenix Broadband, and Cheetah Technologies. Refer to the transponder manufacturer's documentation for installation and operation instructions.

External Transponder: The SERIAL connector located on the front panel meets the ANSI/SCTE 25-3 2002 standard for status monitoring. Power to the transponder is provided through the SERIAL connector. The power on the SERIAL connector is NOT available if the battery string voltage is less than 31.5VDC.

A standard "straight through" CAT-5 type cable can be used to connect the SERIAL connector to the transponder. The SERIAL connector must never be connected to an ETHERNET port. Damage may occur to both the power supply and the transponder.

SERIAL Connector Pin Assignments

Pins 1 & 8, Ground
Pins 2 & 7, +24 VDC ± 15% at 200mA
Pins 3 & 6, RS-485 (+)
Pins 4 & 5, RS-485 (-)

Refer to the transponder manufacturer's documentation for installation and operation instructions.

The following Hybrid Management Sub-Layer (HMS) Management Information Bases (MIBs) are standardized documents present by the Society of Telecommunications Engineers (SCTE) for use with Hybrid Fiber Coax Outside Plant Status Monitoring. These MIBs must be used with the user's choice of Network Management Software (NMS) when interfacing any transponders or additional equipment provisioned in the HFC plant. The EB1s transponders are compatible with a variety of NMS packages including Continuity and Cheetah XD.

The following list is described in further detail and is available for download from www.scte.org.

SCTE HMS ALARMS MIB: reference HMS028R6 (SCTE 36)
SCTE HMS COMMON MIB: reference HMS024R14
SCTE HMS FIBERNODE: reference HMS025R13
SCTE HMS PROPERTY MIB: reference HMS026R16 (SCTE 38-1)
SCTE HMS PS MIB: reference HMS027R12
SCTE ROOT MIB: reference HMS028R6 (SCTE 36)
SCTE HMS GEN MIB: reference HMS033R10 (SCTE 38-6-2005)
SCTE HMS TIB MIB: reference HMS055R5 (SCTE 38-7)
SCTE HMS DOWNLOAD MIB: reference HMS063R6 (SCTE 38-8)
SCTE HMS TREE MIB: reference HMS072R10

2.2 EB1s Series Product Features

- All models have 63/89 VAC output; reconfigurable. Factory set for 89 VAC output. Some models offer a 75 VAC output tap.
- Serial status monitoring provided, compatible with HMS-022 protocol.
- High efficiency for economical line operation and longer run time from battery input.
- Ferroresonant output: filters and regulates load power.
- Liquid Crystal Display (LCD) for local visual monitoring.
- High input power factor, typically 0.9 or better (line mode).
- Wide AC input voltage range. Highly tolerant of spurious noise and low voltage conditions appearing on the AC power line.
- Temperature compensated battery charger with battery temperature sensor.
- Robust inverter circuits. Convection cooling eliminates need for forced-air cooling.
- Certified UPS product per IEC Standard 60950-1.
- Complies with EMI/RFI limits of Standards EN 55022 and EN 55024.
- Hot-swap inverter module: field replaceable without interrupting power to the load.

2.3 Unpacking and Inspection

Before installing this equipment, inspect the power supply for shipping damage or missing components. If the power supply or other items were damaged in shipment, file a damage claim with the shipping company and contact your Multilink representative immediately. Be sure to retain the original shipping carton and all packing material for the power supply until you are certain that warranty return will not be required.

<u>All EB1s Series UPS power supplies include:</u>

Power supply, ready for installation in cabinet

Power cable

Battery temperature sensor cable

Installation and operating instructions

2.4 Missing or Damaged Items

If items are found to be damaged or missing, contact the shipping company and your Multilink representative immediately. All damage claims must be filed with the shipping company conveying your equipment. Your Multilink representative will be able to assist with immediate equipment needs if necessary.

2.5 Original Shipping Container

When returning a unit for service, use its original shipping container and all original packing materials. Items damaged as a result of improper packaging will not be covered under provisions of warranty service.

2.6 Other Items

If you ordered other items such as batteries and cable kits for use with the power supply, ensure also that those items did not sustain shipping damage. As with the power supply itself, all damage claims must be filed with the shipping company and your Multilink representative should be contacted immediately.

Front Panel Connections, Controls, and Indicators

Section 3: Front Panel Connections, Controls, and Indicators

The front panel of each EB1s Series power supply contains various connectors, all operator controls and indicators. These items are described as follows. Further details regarding use of controls and indicators may be found in the Startup and Operation section of this manual.

3.1 Controls

BATTERY CIRCUIT BREAKER: 60-amp circuit breaker protects battery circuit and input wiring. This circuit breaker is also used as a DC switch to apply and remove battery input to the power supply.

3.2 Connections

See figure 3-1 and 4-1 for connector locations.

OUTPUT CONNECTORS: The power supply contains two power output connectors located on the upper left portion of the front panel. The mating Anderson®
mini-powerpole connector provides the means for connecting output power to the appropriate network power connector in the cabinet. The black connector is hot, is identified as L (line); the white connector is ground return for the output, identified as N (neutral). Each neutral contact is internally connected to frame ground of the power supply.

BATTERY INPUT: Anderson®2 Powerpole®2 type 75 A connector: used for connecting the external battery to the power supply.

BATTERY TEMPERATURE PROBE: RJ-11 connector: provides connection the external temperature probe for temperature compensated battery charging.

TAMPER SWITCH: Mini Mate-N-Lok®: connects the enclosure tamper switch to the status monitor circuits within the power supply. This allows the status monitor circuit to report an open door on the enclosure.

The tamper switch can be normally open (active high) or normally closed (active low).

CABINET INDICATOR: Mini Mate-N-Lok®3: connects the enclosure alarm and status lamps to the power supply for external status indication. The power supply will activate an external green lamp to indicate normal output voltage and will activate a red alarm lamp to indicate line failure.

SERIAL COMMUNICATION PORT: RJ-45 connector: provides connection to external status monitoring transponder. The signal provided is a serial data string in HMS-022 format.

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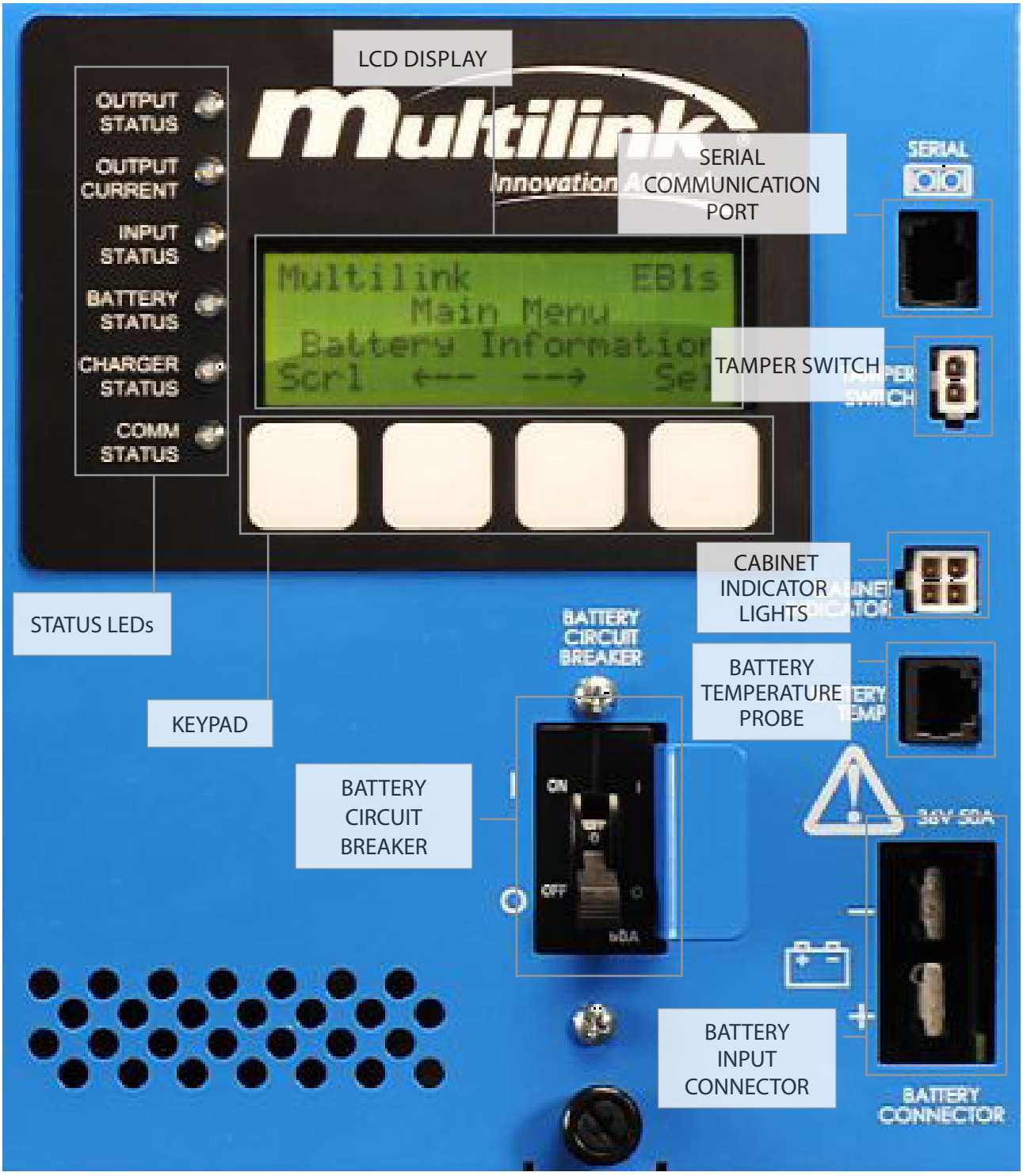


Fig. 3-1 Power Supply Inverter Module Front Panel Detail

3.3 Indicators

Liquid Crystal Display (LCD): The LCD display on the front panel of the power supply serves as the main visual communications device so the user can view a number of operational conditions in the power supply. Four membrane keys associated with the LCD display provide a means for the user to navigate the individual screens. Further description of the menu tree may be found in the Startup and Operation section of this manual.

LEDs: Six green light emitting diodes (LEDs) on the central area of the front panel provide visual indication of power supply operational status. The operation of the LEDs are as follows:

STATUS LED FUNCTIONS	OFF	ON	SLOW FLASH (0.5 Hz)	FAST FLASH (2Hz)
OUTPUT STATUS	No Output / Output voltage is below 50% of the rated specification	Normal / Output voltage is within rated specifications	Low Output / Output voltage is less than the rated specification	High Output / Output voltage is greater than the rated specification
OUTPUT CURRENT	No Load / Total Output load is less than 1 ampere	Normal / Total Output current is within rated specifications	Minor Overload / Total Output current is between 100 to 110% of rated specifications	Major Overload / Total Output current is greater than 110% of rated specifications
INPUT STATUS	Line Fault / Line Input voltage is low / EB1 is running from battery power	Normal / Line Input voltage is within acceptable range / EB1 is running from AC input	Qualifying Line or Battery Test in Progress	Line Fault / Line Input voltage is too high / EB1 is running from battery power
BATTERY STATUS	Low Battery / Battery String voltage below 1.75V/Cell	Normal / Battery Voltage in acceptable range	N/A	Battery Discharging / EB1 inverter is running / battery is being discharged
CHARGER STATUS	Battery Charger is OFF	Battery Charger is ON	N/A	N/A
COMM STATUS	Serial Port communication fault or no connection	Serial Port communication data package received	N/A	N/A

Fig. 3-2 Front Panel LED Functions

Section 4: Installation and Setup

4.1 Preparation

Installing and wiring any model within the EB1s Series power supplies into an enclosure may be accomplished by connecting input and output wiring to the appropriate connectors of the power supply. The AC input cord of the power supply mates with standard receptacles of the region served. All other connectors on the front panels of the modules mate with industry-standard connectors widely available and used within the broadband industry. Moreover, connectors used in this power supply mate with accessory harnesses and assemblies designed and manufactured by Multilink Inc. Refer to the OPTIONS section of these instructions for further information.

In all installations, the following conditions apply and must be observed:

- A service disconnect switch containing overcurrent protection devices such as circuit breakers or fuses with appropriate AIC (amperes – interrupting capacity) rating should be placed between the AC utility source and the service entrance device for the power supply. Where used, the disconnect switch must be installed in compliance with all national, state and local codes as required.
- For outdoor installations, the AC utility conductors connected to the power supply service entrance device shall be physically protected through an appropriate restraining device and conduit, consistent with local codes and practices.
- When the power supply enclosure is located on a utility pole, suitable lifting equipment shall be employed during installation and service activities.
- Permission to mount the power supply enclosure at any site shall be made in accordance with all legal requirements and local practices of the area.

This power supply is designed for use in both existing and new enclosures of either pole or ground-mount configuration. Observe the following procedures during installation of any EB1s Series power supply.

The EB1s Series power supplies have been factory assembled, tested and prepared as a complete product ready for installation within an enclosure. The installer must verify that the correct type of AC power receptacle is installed in the enclosure for the input service and power supply selected for use at any given site. Additionally, the battery strings installed in the enclosure must match the configured EB1s battery voltage. Power supply ratings may be verified from the nameplate on the left side panel near the power cord.

4.2 Grounding

Safety ground and earth ground connections must be in place for the power supply and enclosure for both personal safety and operational considerations. During power supply and/or enclosure installation, the following grounding connections must be provided or verified.

CAUTION

Failure to provide and connect adequate safety and earth grounds at each installation site may result in improper power supply operation or permanent damage to the power supply itself. Grounding facilities and connections must conform to appropriate national codes and/or local practices.

The AC utility conductors installed in the service entrance box must contain a safety ground conductor. The power supply installer should verify that this grounding conductor is in place, having been installed along with the AC utility input.

A separate enclosure ground wire must be connected between the enclosure ground lug and an earth ground connection provided by a ground rod installed at the power supply site. In most cases, one copper or copper-clad steel ground rod of 2.5 meter (8 feet) length driven into the earth will be sufficient to provide the ground connection required. In some instances, a more elaborate grounding method (such as a ring ground) may be required; however, this may be dictated by state or local codes and depends on conductivity of the soil within the installation area.

The dead metal of the service entrance box must be bonded to the metal enclosure that houses the power supply. Additionally, the ground bar within the service entrance box should be bonded to the metal enclosures; however, this requirement may be subject to local codes and practices.

The grounding wire connected between the power supply enclosure and the earth ground rod should be no smaller in area than 13 mm^2 (6 AWG) copper. Both ends of the ground wire should be sealed with an appropriate anti-oxidation compound.

A separate bonding wire of the same size as specified in Step 4 above should be connected between the ground lug at the left side of the power supply chassis and earth ground where such connection enters the external system enclosure.

4.3 Placement in the Enclosure

This power supply has been designed primarily for use within a cabinet or enclosure offering protection from outdoor weather, entry of excessive dust, dirt or moisture, and from unauthorized contact by untrained personnel. If used in a controlled environment, the power supply may be located within an indoor equipment cabinet or may be mounted on a rack shelf.

The power supply should be mounted on a ventilated shelf that allows free air circulation, especially through the right and left side panels of the power supply cabinet. Clearance of at least 51 mm or 2 inches must be maintained around all surfaces of this power supply for unobstructed airflow. Temperature of the air entering the power supply should not exceed 65°C (149° F).

Fig. 4-1 Power Supply Front Panel

4.4 Wiring

Connect input, output, control and monitor wiring to the power supply according to the following procedure. Refer to Figs. 3-1 and 4-1 for control and connector positions.

Operate the AC line circuit breaker in the service entrance box to the OFF position. If the power supply is located at a head end or other customer premise site, ensure that the branch circuit breaker chosen to protect the AC receptacle for the power supply is operated to the OFF position.

Operate the BATTERY CIRCUIT breaker on the front panel of the power supply to the OFF (O) position.

NOTE

Power supply output wiring to the load(s) will be connected in the following steps. For safety of installation personnel and ease of wiring, two-piece terminal blocks containing the wiring contacts may be unplugged from the stationary portion in the power supply.

Apply the system loads to the OUTPUT connectors on the front panel of the power supply as follows:

If a single load only will be operated from the power supply, connect output wiring to the OUTPUT 1 terminals, line (L) and neutral (N). Wire size of 4-mm^2 area or 12 AWG is recommended. Use a wire with a temperature rating of at least 105°C.

If multiple loads will be operated from the power supply, connect the highest priority load to OUTPUT1 terminals, line (L) and neutral (N). Connect remaining loads in order of their priority to the terminals of OUTPUT2, line (L) and neutral (N). Use appropriate wire sizes based on the anticipated current draw of each load.

CAUTION

Do not load the power supply to a level greater than its total rated output. Ensure that a minimum load of greater than 1 ampere is applied. Subjecting the power supply to long-term overloads or no load conditions can result in permanent damage.

Connect the AC line cord from the power supply to the appropriate AC receptacle.

Insert the battery plug from the battery wiring harness into the mating BATTERY INPUT receptacle on the front panel of the power supply.

Insert the temperature sensor plug into the mating TEMP PROBE receptacle on the front panel of the power supply. The body of the temperature sensor probe should be placed between two of the battery cases in the enclosure.

If desired and so equipped, the cabinet tamper switch may be connected to the TAMPER SWITCH receptacle on the front panel.

If desired and so equipped, the cabinet status lights may be connected to the CABINET INDICATOR receptacle on the front panel.

If remote monitoring of the power supply is desired, connect the RF cable to the status monitor transponder or an external transponder to the SERIAL receptacle on the front panel of the power supply and connect the RF cable to external transponder.

Initial installation and wiring is now complete.

4.5 Battery Placement and Wiring

Proper installation and wiring of the batteries is critical to the long-term backup capability of any power supply system. Gelled electrolyte, valve regulated batteries are recommended for use in broadband power supply applications. All batteries should be tested and fully charged prior to installation. Interconnecting wiring must be no smaller than 8 mm^2 in area or 8 AWG. Longer run times and improved efficiency may be realized using battery wiring of 13 mm^2 in area or 6 AWG.

In light of the specialized handling and connection requirements for batteries, only trained personnel should install batteries in an enclosure. Personnel must always employ appropriate safety equipment (goggles or face shields, insulated gloves, etc.) and only use fully insulated tools for tightening hardware on the battery terminals. Additionally, proper lifting tools and techniques must always be used during battery installation to avoid personal injury or equipment damage.

4.6 Battery Installation Procedure

Place the batteries on the lower shelf of the enclosure, positive terminal facing out.

Route the terminal connector ends of the battery cable from the power supply compartment at the top of the enclosure to the battery compartment.

Wire the batteries in series, connecting negative post of one battery to positive post of the next. Battery cables and terminals are color coded to aid in correct wiring. Black terminal is negative (-); red terminal is positive (+). Use of an anti-oxidation compound, such as NO-OX-ID "A-Special"
, is recommended at each battery termination including ring lugs and threaded hardware. Use fully insulated tools only when tightening battery connections.

After completing all connections to the battery terminals, use a digital multimeter (DMM) to verify proper voltage and polarity at the battery cable connector that terminates to the power supply DC input port. For 3-battery systems, indicated voltage should be approximately 36 volts or slightly higher. In a 4-battery system, indicated voltage should be approximately 48 volts or slightly higher. When the red and black meter probes are connected to the corresponding colored terminals of the battery harness connector, the meter should indicate positive (+) voltage, assuming proper connections at the meter itself.

WARNING

If voltage and polarity indications do not correspond to those described above, determine the cause before mating the battery connector to the power supply. Incorrectly wired batteries can cause personal injury or permanent damage to equipment.

Space the batteries approximately 25-mm (1 inch) apart to provide adequate airflow.

Attach the body of the temperature sensor probe to the side of the center battery using self-adhesive tape rated for use in wide temperature ranges. Depending upon battery construction, it may be necessary to hang the sensor in close proximity to the side of the battery instead of attaching it directly.

4.7 Care and Maintenance of Batteries

Once installed and connected batteries must not be allowed to sit idle without receiving a charge. The power supply must be started, even if at minimum load, and allowed to charge the batteries. Initial charging to ensure full reserve time may require as long as seven days to accomplish. Batteries connected to an idle system without receiving a charge can be irreparably damaged, thereby requiring replacement before the system can be fully commissioned into service.

NOTE: The charging requirement becomes a special consideration when the accessory Battery Balance Manager is integrated into the cabinet installation. The Battery Balance Manager may be connected only when the power supply is fully operational and capable of charging the battery.

Startup and Operation

Section 5: Startup and Operation

5.1 Startup

The power supply is ready to be placed into operation after it has been installed in its enclosure and all input and output connections have been made. Ensure that AC input power is available to the power supply receptacle then perform the following steps in sequence.

CAUTION

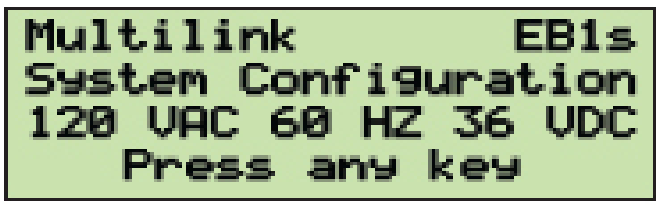
The following steps in the startup procedure MUST be performed exactly as presented; otherwise, permanent damage to the power supply may result. Observe the LED indicators and the LCD display as a guide in performing the startup procedure.

1. Ensure that the BATTERY CIRCUIT breaker has been operated to the OFF (O) position. All connections and initial wiring must be in place as previously outlined and described. Plug the power supply into the AC receptacle.
2. Operate the utility AC circuit breaker serving the power supply to the ON position. The LCD display should illuminate, and be indicating that the power supply is initializing.

CAUTION

Do not start the power supply without a minimum load connected. Once started, do not disconnect the load from the power supply while it is operating. An unloaded output can result in an unstable operating condition that will permanently damage your power supply.

3. The LED indicators on the front panel of the power supply should be illuminated as follows upon startup from the AC utility line:
   - OUTPUT STATUS: Green
   - OUTPUT CURRENT: Green (without overload)
   - INPUT STATUS: Green
   - BATTERY STATUS: Off (with BATTERY CIRCUIT breaker off)
   - CHARGER STATUS: Off
   - COMM STATUS: Off (without communications link); Green (with communications link established)
4. After a pause, the initial status screen should now be on the LCD display and should look similar to this:



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5. The BATTERY CIRCUIT breaker on the front panel of the power supply may be placed to the ON (I) position at this time. The BATTERY STATUS indicator should be illuminated green after closing the circuit breaker.
6. The power supply is now operating in its normal mode, assuming application of appropriate AC line power and loads. All status LED indicators should be illuminated Green, with these exceptions: The CHARGER STATUS may go on and off depending on power supply operation. The COMM STATUS indicator may flash occasionally as the status monitor circuits communicate with the external transponder, if connected. Note that if no external transponder is connected, the COMM STATUS indicator will remain Off.

5.2 Cold Start Mode

1. Cold Start is a way to start the power supply with batteries only in order to produce an output voltage in
2. the absence of line voltage. The inverter will run from the system batteries until line voltage is restored or the batteries are depleted.
3. Ensure that all connections to the power supply are properly installed. Ensure that the batteries are charged and properly connected and the Battery Circuit Breaker is OFF. Ensure that the load is correctly sized and properly connected.
4. Turn ON the Battery Circuit Breaker.
5. The power supply display backlight will illuminate and the display will show startup information.
6. If the display backlight goes off within a few seconds, and the inverter fails to start, turn OFF the Battery Circuit Breaker.
7. Wait a few seconds for the power supply display to go completely blank, followed by a series of relay click sounds.
8. Turn the Battery Circuit Breaker ON. The inverter will start up, producing an output voltage.

5.3 Front Panel LCD Menus

The status of the power supply is indicated in the various menus available on the LCD display located on the front panel of the power supply. Some of the displayed information may also be transmitted to a remote monitor as part of the data generated by the status monitoring assemblies, if so installed. The menu tree described in this section is that information displayed and visible on the power supply itself.

LCD Controls: Four membrane keys, located below LCD display, provide user control for navigating the various menu items. Functions of these keys are defined in software and will change depending on the operation being performed. Typically, the function of any particular key is indicated by a word or symbol on the LCD display immediately above that key.

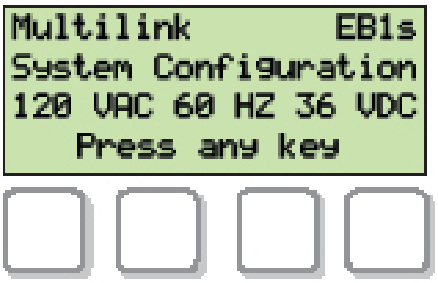
LCD Screen Display: The LCD assembly chosen for the EB1s Series power supplies has been designed for use in a wide temperature range. As such, the characters displayed on the screen should be visible under nearly all temperature conditions. The user may note that under hotter than normal conditions, the characters may fade and become less distinct as compared to those viewed at lower temperatures. The faded characters are temporary and will darken as temperature decreases.

The backlight feature of the LCD display is timed to automatically shut off four minutes after the last push-button is pressed. This auto-shutoff feature extends the life of the backlight.

LCD Menu Tree: The EB1s menu layout allows for easy access to system performance parameters, history statistics, and configuration values.

On startup, the display will default to the Status Display. Keys select the Input Status, Output Status, Alarm Status, and the Menu pages. The displayed page is indicated by the slowly blinking identifier on line 4. The keys for the Input Status, Output Status, and Alarm Status can be pressed to toggle between different aspects of that particular display.

Model name and configuration of powerline, battery, and transformer.



This line is the system name.
This line scrolls the current status item name.
This line displays the current status item value.
This line prompts for a key press to exit the status display.
These are soft keys that can change function depending on the requirements of the displayed menu.

INP: Displays the line voltage and battery voltage. Press the key to toggle between line current and power and between battery temperature and charge/discharge current.

OUT: Displays output voltage and the status of the two output channels. Press the key to toggle between current and power values.

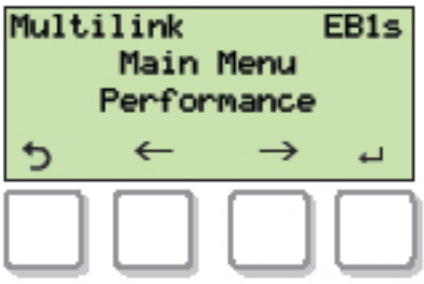
ALM: Displays Alarm status. Press the key to toggle between Major and Minor alarms.

MENU: Accesses the Menu pages as described in the following section.

5.3.1 Main Menu

On pressing the MENU key, the Main Menu is presented.

Model name and configuration of powerline, battery, and transformer.



This line is the system name.
This line is the current menu level.
This line is the current submenu option.
This line defines the function of the soft keys.
The functions of these soft keys are defined by the symbols on the bottom line of the display.

From the Main Menu the user can access these submenus:

Performance: Displays detailed system performance parameters.

History: Displays the Life Timer, Inverter Timer, Event Counter, and event reset.

Battery Status: Displays String Voltage, Individual Battery Voltage, Charger status, and Battery Test mode control.

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Configuration: Allows certain system variables to be modified.

Firmware: Displays firmware version and build data.

Smart Breaker: (Optional, displayed only if installed) Allows configuration of Smart Breaker Module.

User Data: Allows User Data strings to be modified.

The bottom line of the display presents a word or symbol that defines the function of the soft key immediately below that symbol or word. Symbols are selected for their commonality between languages and cultures.

Common soft key definitions:

- ← Step backwards through selections in a menu list.
- → Step backwards through selections in a menu list.
- ↑ Step forwards through selections in a menu list.
- ↓ Step up through specific options in a setup list.
- ↩ Step down through specific options in a setup list.
- ↩ Go back to the previous menu, discarding any changes, or enter the Scrolling Status display.
- ↵ Proceed into the selected menu, or accept the selected setup option change and return to the previous menu, or start a Battery Test.
- ☺ Indicates that a selected item is enabled.
- ✕ Indicates that a selected item is disabled.
- ↕ Toggle between two selection items.
- ■ Stops a running Battery Test.

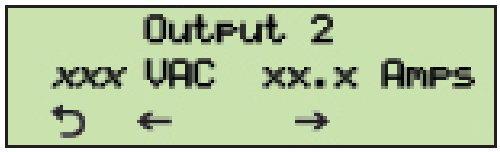
For clarity, only 3 lines of the display are shown in most of the following menu descriptions.

5.3.2 Performance Menu

The Performance Menu displays several detailed system performance parameters. These parameters cannot be modified from this menu. Use the arrow keys to move between items.

Displays the measured value of the AC line voltage and the AC line current.

Displays the measured value of the Output n voltage and the Output n current. There are two of these screens, one forOutput 1 and one for Output 2.



Displays the measured value of the Output 2 voltage and the Output 2 current.

Displays the measured value of the Battery String voltage and the Battery Discharge current.

Displays the Battery Temperature measured by the Battery Temperature Probe. Temperatures below will display a minus(-) before the leading digit.

Displays the Inverter Temperature measured by the circuit board temperature sensor. Temperatures below will display a minus(-) before the leading digit.

Displays the measured AC line Input Power and total measured Output Power in Watts.

Major Alarm display: x is the current displayed alarm and n is the total number of alarms. The text description of the current displayed alarm is on line 3. Multiple descriptions are shown at a 2 second display rate.

Minor Alarm display: x is the current displayed alarm and (Alarm Description) n is the total number of alarms. The text description of the current displayed alarm is on line 3. Multiple descriptions are shown at a 2 second display rate.

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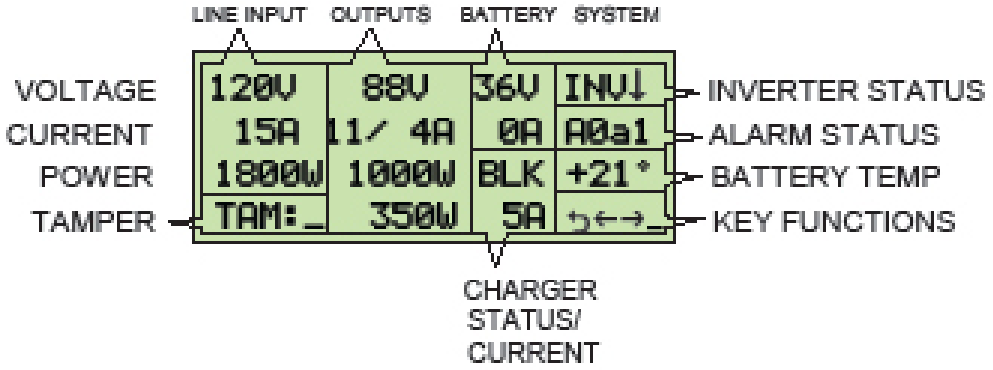
System Status display

The System Status display shows all the major system parameters at once on the same screen.

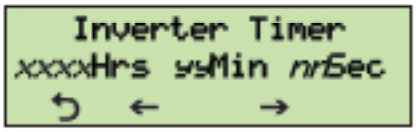


Inverter Status indicators:	↓= Inverter Off ↑= Inverter On **Q** = Line Qualifying
	T = Local Test Running **R** = Remote Test Running
Alarm Status indicators:	**A**= Major Alarm **a** = Minor Alarm
	Numbers indicate the total count of alarms in each category.
Tamper Switch indicators:	_ = Disabled
	O = Switch Open if Active High, Closed if Active Low.
	C = Switch Closed if Active High, Open if Active Low.
Battery Temp indicators:	Will display "**PRB**" if temperature probe is disconnected.
	Temperature is displayed in degrees Celsius.
Battery Status indicators:	Displays battery voltage and discharge current.
Charger Status indicators:	**OFF**= Charger Off **TRK**=Trickle Mode **BLK**= Bulk mode
	EQU= Equalize mode **FLT**= Float mode.
	The Current display shows whole amperes or a single
	decimal place if the value is less than 1. For detailed readings use the Charger Status page in the Battery Status menu.

5.3.3 History Menu

The History Menu Events/Times screen displays the Life Timer, the Inverter Timer, and the Event Counter. There is also a screen to Clear the Event counter and the Inverter Timer.

Displays the total 'ON' time of the power supply as measured in xxx days and nn hours. Cannot be reset.



Displays the total inverter operating time as measured in xxxx hours, yy minutes, and nn seconds. Reset by the Clear Events function.

Displays the total number of transfers and battery tests. This value can be cleared in the Clear Events screen.

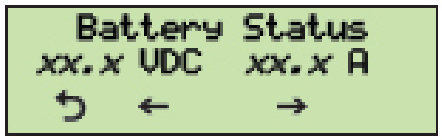
Clear Events

Resets the Event Counter and Inverter Timer.
Yes resets and exits.
No exits without resetting.

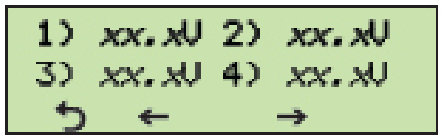
If yes:

5.3.4 Battery Status Menu

The Battery Status Menu displays the Battery String Voltage, the Individual Battery Voltages in each string, and the Charger status. There is also a screen to Start and Stop the Battery Test.



Displays the total Battery Voltage and the Battery Discharge current.



Displays the individual Battery Voltages in each string when the optional Battery Balancer Module is installed. Each configured battery string will have a screen like this.

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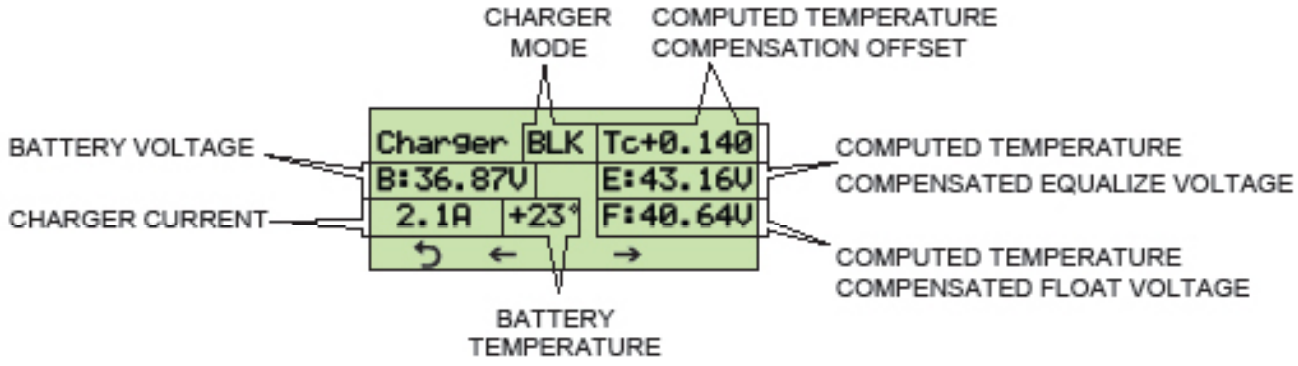
The number of batteries displayed will change depending on system configuration. The Battery Charger Status screen displays several important charger operating values.



The charger mode can be **OFF**, **TRK** (Trickle), **BLK** (Bulk), **EQU** (Equalize), or **FLT** (Float).The computed temperature compensation offset will be positive below +25°C and negative above +25°C.

Charger Operation

The power supply Battery Charger will attempt to charge a deeply discharged battery. Normally the charger checks for at least 1.5 volts per cell on the battery string but the charger can be forced to attempt to charge a battery at as low as approximately 0.8 volts per cell by modifying the Charger Threshold setting in the Configuration Menu. Below 1.5 volts per cell the charger will run in Trickle Mode and charge the battery at a low current, typically 1% or less of the maximum current level.

Above 1.5 volts per cell the charger switches to Bulk Mode, charging the battery at full available current while regulating the voltage output. It remains in this mode until the charge voltage has risen to approximately 95% of the Equalize voltage, at which point the charger switches to Equalize Mode, charging the battery at the constant Equalize voltage. During this mode the charge current will taper off as the battery comes up to full charge. The charger will switch to Float Mode when the charge current drops to approximately 10% or less of the maximum current output. In this mode the charger voltage is held at a constant Float voltage level to maintain a full charge on the battery. The charger will remain in Float Mode until the battery has discharged down to approximately 90% of the Float voltage, at which point the charger will switch back to Bulk Mode.

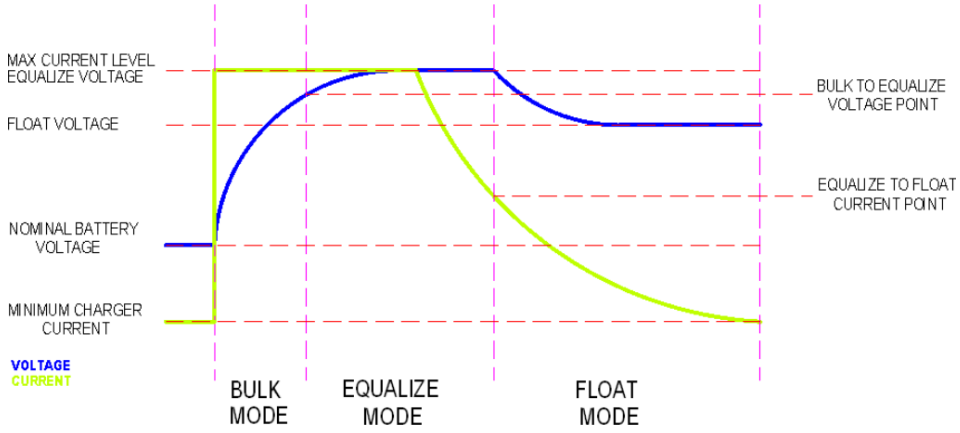
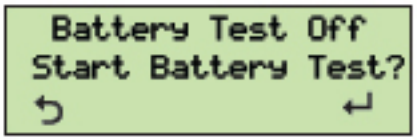


Fig. 5-1 Charger Modes

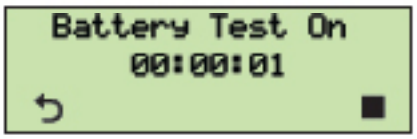
The basic Equalize and Float voltages are selected in the Configuration Menu. The defaults are 2.39 volts per cell for Equalize, 2.25 volts per cell for Float. With a temperature probe connected to the power supply a Temperature Compensation factor will be applied to both voltages. The default Temperature Compensation factor is 3.9 mV per degree Celsius per cell. This value can be selected in the Configuration Menu. See section 5.3.5 for an explanation on modifying these settings.

To prevent power supply damage, the battery charger will shut off if the internal power supply temperature exceeds +65°C. In addition, to prevent excessive line input current draw from tripping external protection devices, the charger will shut off if the input line current exceeds a certain threshold and will turn back on once the line current drops to an acceptable level.

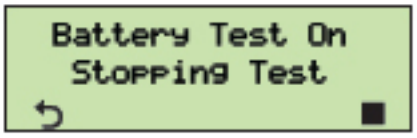
Battery Test



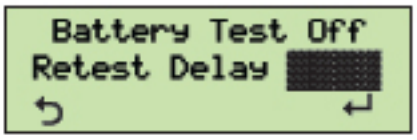
If the Battery Test is not running this screen is displayed. ↵ starts the test, ⮌ exits.



If the Battery Test is running this screen is displayed. ■ stops the test, ⮌ exits. If exiting while the test is running the test will continue to run.



The Battery Test can be stopped from either the keypad, from are remote command, or by the power supply entering standby mode following a power line failure. In each case this screen will be displayed.



After a Battery Test finishes, another test cannot be started for a minimum of 30 seconds. During this delay a bargraph ticks down the remaining time.

5.3.5 Configuration Menu

The Configuration Menu allows for several system performance variables and options to be modified. Use caution when adjusting these values as system operation can be affected by improper settings.

Battery Test Parameters

The Battery Test can be performed in three ways: manually from the Battery Status menu, remotely via an HMS data command, or automatically. The duration of individual tests, the frequency of automatic tests, and the behavior of remote tests are all configurable items.

A test will run for the selected duration unless stopped from the keypad, stopped by a remote command, or interrupted by the power supply entering standby mode due to power line failure.

The arrow keys increase or decrease the Battery Test Durationin 1 minute increments from 1 to 60 minutes. Default: 5 minutes. ↵ accepts changes and exits, ⮌ discards changes and exits.

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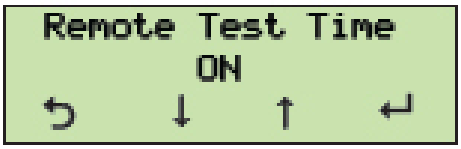
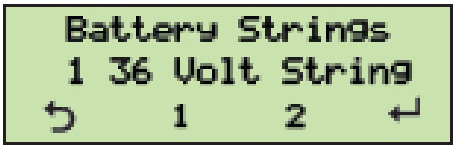
If the Test Frequency is set to OFF automatic tests will not take place, otherwise tests will occur at the selected interval.

Select the time between automatic battery tests. Arrow keys choose between OFF, 14 or 28 days. Default: OFF. ↵accepts changes and exits, ⮌ discards changes and exits.

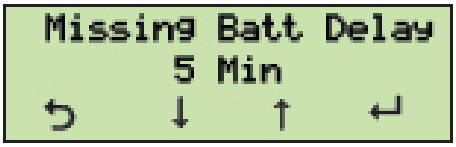


Selects if Remote Tests are timed by the "Test Duration" setting. If ON, tests are timed. If OFF, tests run until stopped manually, they fail, or are interrupted by power loss. Default: ON. ↵accepts changes and exits, ⮌ discards changes and exits.

Battery Selection Parameters

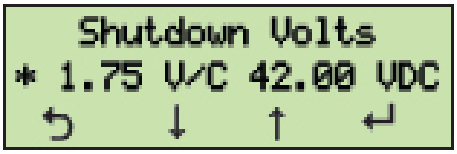


Select the number of Battery Strings. String voltage is set at the factory and is not configurable. Either 1 or 2 strings are selectable. ↵ accepts changes and exits, ⮌ discards changes and exits.

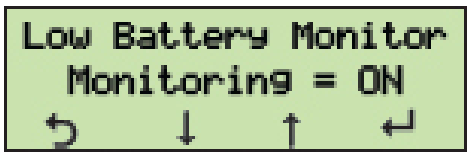


Arrow keys select the interval to test for Missing Batteries from 5 to 30 minutes. Select OFF to disable this feature. Default: OFF. ↵ accepts changes and exits, ⮌ discards changes and exits.

Low Battery Shutdown Parameters



Select the Low Battery Shutdown voltage in volts per cell. The selected value is represented as volts per cell and as the total battery string value. The latter value will change depending on whether a 36 or 48 volt battery string is configured. Arrow keys select from 1.65 volts to 1.80 volts. A * indicates the default value. A down arrow (↓) indicates the lowest allowable setting. An up arrow (↑) indicates the highest allowable setting. Default: 1.75 V/C (1.80 V/C for 18A supply). ↵accepts changes and exits, ⮌ discards changes and exits.



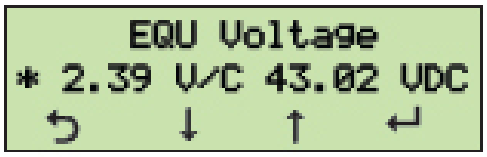
Enable or disable Low Battery Monitoring. This feature works onlywith the installation of a Battery Balancer module. Low Battery Monitoring will shut down the inverter and put the power supply in a safe "Sleep" mode if any single battery voltage drops below the setting in the "Shutdown Voltage" Configuration Menu page. Default: OFF. ↵accepts changes and exits, ⮌ discards changes and exits.

Battery Charger Parameters

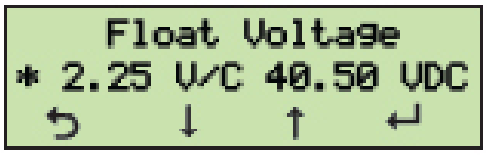
The voltage levels for the battery charger Equalize and Float modes of operation are configurable within a specified range. These two settings are interactive - the Equalize voltage cannot be decreased to a value less than 50 millivolts above the Float voltage and the Float voltage cannot be increased to a value greater than 50 millivolts below the Equalize voltage.

The leftmost character on the third line of the display indicates the status of the indicated value. A * indicates the default value. A down arrow (↓) indicates the lowest allowable setting. An up arrow (↑) indicates the highest allowable setting. If attempting to select a value that would violate the 50 millivolt separation between Equalize and Float mode settings, a letter symbol appears indicating that such a threshold has been reached, an '**F**' in the case of the Equalize setting, or an '**E**' in the case of the Float setting.

The selected value is represented as volts per cell and as the total battery string value. The latter value will change depending on whether a 36 or 48 volt battery string is configured.



Select the Battery Equalize voltage in volts per cell. Arrow keys select from 2.26 volts to 2.44 volts depending on the Float setting. ↵accepts changes and exits, ↵ discards changes and exits.

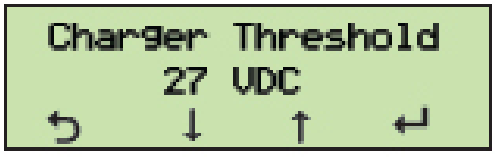


Select the Battery Float voltage in volts per cell. Arrow keys select from 2.10 volts to 2.35 volts depending on the Equalize setting. ↵ accepts changes and exits, ↵ discards changes and exits.

The battery charger will adjust the Equalize and Float voltages in proportion to the battery temperature by the factor set in the Charger Temp Comp menu. At temperatures above +25°C the compensation factor is subtracted from the two voltages and at temperatures below +25°C the factor is added to the voltages. The calculated voltages are limited in software to less than 44.0 VDC and greater than 33.0 VDC for a 36 VDC string and less than 58.0 VDC and greater than 44.0 VDC for a 48 VDC string. **If the temperature probe is disconnected or inoperative the Equalize and Float voltages will return to the default values fixed in hardware and no temperature compensation will take place.**

Select the Charger Temperature Compensation voltage in volts per degree C per cell. Arrow keys select from 2 mV to 6 mV in 0.1 mV steps. Default: 3.9 mV/°C/cell. ↵accepts changes and exits, ↵ discards changes and exits.

The lowest battery voltage at which the battery charger will operate is adjustable from the Charger Threshold menu. The charger will operate in a Trickle Charge mode until the battery voltage exceeds approximately 1.5 volts per cell.



Select the Charger Startup Threshold voltage. Arrow keys select from 15 to 27V for a 36V battery or 24 to 36V for a 48 V battery. Default: 27/36 V. ↵accepts changes and exits, ↵ discards changes and exits.

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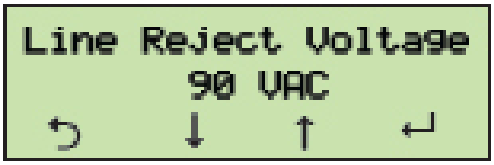
Input/Output Parameters



Select the line voltage at which the power supply transfers to Standby mode. The value can range from 85 to 90 VAC with a 120V line or 170 to 180 VAC with a 240V line. Arrow keys select the voltage. Default: 90/180 V. ↵accepts and exits, ⮌ discards changes and exits.

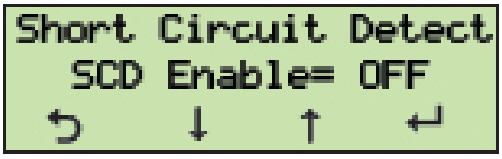
The actual Output Voltage is selected with a hardware jumper. Set the selected voltage in this menu. Arrow keys select 63, 75, or 90 volts. Default: 90 V. ↵accepts and exits, ⮌ discards changes and exits.

Current Alarm Parameters

Select the Current Alarm setting of AC output n, which can be either 1 or 2. Arrow keys set the Current Alarm value between 1 and 22 A depending on the installed transformer. Default: 15 A.

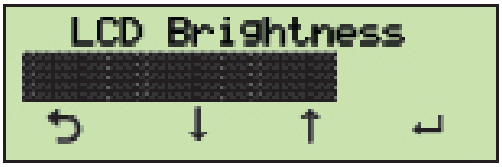
Select the Global Current Alarm setting. This setting affects both outputs. Arrow keys set the Current Alarm value between 1 and 22 A. Default: 22 A. ↵accepts and exits, ⮌ discards changes and exits.

Miscellaneous Parameters



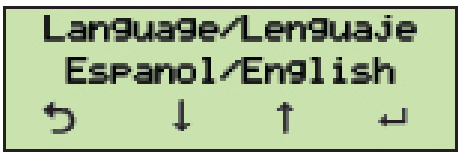
Arrow keys enable or disable the Short Circuit Detect function. See Section 2.1 of this manual for explanation of this feature. Default: OFF. ↵accepts changes and exits, ⮌ discards changes and exits.

Select the system Tamper Switch Monitoring option. The value can be On- Active Low, On- Active High, or Off. Default: OFF. Arrow keys select, ↵accepts and exits, ⮌ discards changes and exits.

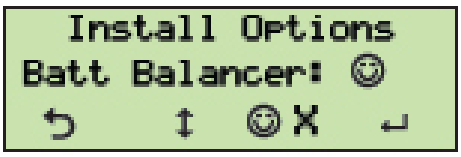


Selects the LCD Display Backlight Brightness. The bar indicates relative brightness steps. Arrow keys increase or decrease, ↵ accepts changes and exits, ⮌ discards changes and exits.

Arrow keys enable the display of the Transponder Menu, ON or OFF. ↵key accepts changes and exits, ⮌ key discards changes and exits.



Selects the language used in power supply displays. Arrow keys select either English or Español. ↵accepts changes and exits. ⮌ discards changes and exits.



Enables or disables power supply options. ↕ key selects either Battery Balancer or Smart Breaker. ☺ indicates the option is enabled, X indicates that the option is disabled. The ☺ X key changes the status. ↵accepts changes and exits. ⮌ discards changes and exits.

5.3.6 Firmware Menu

The Firmware screen displays the Firmware Version and Build. number.

5.3.7 User Data Menu

The User Data strings are five 20 character ASCII strings that can be programmed by the user to hold and display readable information. Strings can hold serial numbers, addresses, times and dates, etc. The characters in each string are programmed using the arrow keys to scroll through a list of available characters.

There are five User String screens, 20 characters each. Arrow keys select the characters, ↵accepts and exits. ⮌ discards any changes and exits.

Power Supply Shutdown

Section 6: Power Supply Shutdown

If power supply shutdown becomes necessary at any time, observe the following procedure:

1. Operate the BATTERY CIRCUIT breaker to the OFF (O) position, then disconnect the battery cable from the power supply.
2. Disconnect the line cord from the enclosure receptacle or operate the circuit breaker serving AC utility power to the supply to the OFF position.
3. If desired, the AC output cable and any accessory cables may be disconnected.

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Section 7: Maintenance and Adjustments

CAUTION

Other than the following Output Voltage Configuration procedure, there are no field serviceable items inside the power supply cabinet. The cabinet cover must not be removed except as described.

7.1 Preventive Maintenance

For optimum performance from your power supply, the following maintenance items should be performed at least every six (6) months, especially in areas where the power supply is subjected to extreme heat or cold.

- Visually inspect the enclosure for signs of damage
- Inspect the external status lamps for proper operation
- Check the LCD display and the status LEDs for any alarm indications
- Check all electrical connections
- Check the batteries for signs of swelling, split cases or other damage
- Check and record individual battery voltages
- Check and clean battery terminals; bolts or wingnuts must be tight
- Measure and record AC output voltage
- Measure and record AC output current
- Measure and record DC battery voltage
- Initiate a 15-minute battery test routine to check battery health
- Record all maintenance performed or parts replaced
- Verify the power supply is in its normal mode of operation as indicated by the LCD display. Most front panel LEDs should be illuminated green to indicate normal operation.
- Close and lock the enclosure

7.2 Analog Adjustments

Several miniature potentiometers are located on the printed wiring boards of the power supply. These potentiometers have been factory adjusted for proper voltage levels and for correct detection and measurement thresholds. Field adjustment of any potentiometer in the power supply must not be attempted; otherwise, degraded power system performance or damage to equipment or batteries may result. If any potentiometer adjustments are suspected as a cause of operational trouble or erroneous reporting, the entire power supply should be changed in the field then returned to a service center or the factory for diagnosis and repair.

7.3 Output Voltage Selection

Power supply output voltage is normally configured for 89-volts at the factory unless a different value output was specified on the order. Voltage selection should normally be accomplished before installing the power supply and should not be attempted at the installation site. Reconfiguration should be done only at a properly equipped repair depot or service shop before the power supply is installed and placed into operation.

Follow this procedure to change the Output Voltage Select jumper:

1. Turn off the Battery Circuit Breaker on the front panel of the inverter
2. Disconnect the Battery Cable from the front panel of the inverter
3. Disconnect the AC Power connector from the power supply
4. Disconnect any other connectors from the front panel of the inverter
5. Loosen the thumbscrews and remove the inverter module from the power supply
6. The output voltage is selected by a jumper located on the main chassis behind the removable inverter. The black jumper can be placed in one of three positions: 89, 75, or 63 volts. See figures 7-1 and 7-2. Pull the black connector straight out and seat firmly in the desired socket. Note: not every model provides a 75 VAC output tap.
7. Reinstall the inverter module and all connectors by the reverse of this procedure. Exercise caution when removing and reinstalling the inverter module.

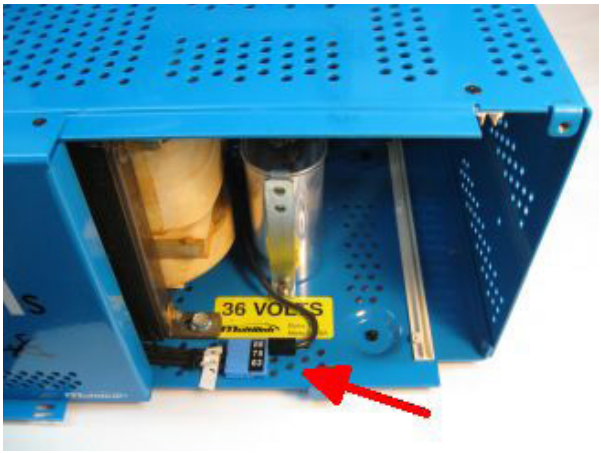

Fig. 7-1 Location of Output Voltage Select Jumper

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Fig. 7-2 Output Voltage Select Jumper Detail

7.4 Troubleshooting

The troubleshooting guide has been designed to help you quickly locate and resolve common power supply problems. If you still cannot solve the problem, replace the power supply with a known good unit.

Condition	Check
No output to load Batteries connected AC line power present	Output connector plugged in Battery voltage within limits AC utility voltage present and within limits
Incorrect output voltage Batteries connected AC line power present	Check output voltage and current displays. Check output connector and connections to cable plant.
Batteries will not charge Batteries connected AC line power present	Battery breaker tripped Battery terminals and connectors Battery failure
Batteries not properly charged Batteries connected AC line power present	Verify connection of battery cable Verify charger mode at front panel Measure charge voltage (Bulk, Equalize, Float)

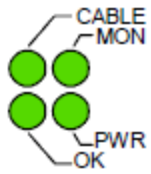
Alarm Conditions

Major Alarms:	Cause	Corrective action
Configuration Fault	System configuration does not match detected operating conditions	Contact Multilink
Inverter Fault	System has detected that the inverter current is too high	Remove cause of overcurrent, restart UPS, replace inverter if damaged
Sleep Mode Fault	In standby, batteries have discharged to the shutdown value	Restore line voltage, charge batteries
High Line Voltage	System has detected that the Line Voltage exceeds specifications	Remove cause of overvoltage
Battery Test Fail	In Test Mode, batteries have discharged to the shutdown value	Recharge or replace batteries
Inverter Overtemp	Inverter temperature exceeds 65**°C**	Place unit in environment that meets factory specifications, replace UPS if damaged
Out 1 Over Current	Output 1 current has exceeded setpoint by more than 1A	Reduce load
Out 2 Over Current	Output 2 current has exceeded setpoint by more than 1A	Reduce load
Missing Batteries	System has detected that the battery string is disconnected	Reconnect batteries
Low Battery Voltage	System has detected that the battery string voltage is too low	Recharge or replace batteries
High Battery Voltage	System has detected that the battery string voltage is too high	Check batteries, replace inverter if damaged
Out 1 Short Circuit	A short circuit has been detected on output 1	Reduce load, check for short circuit
Out 2 Short Circuit	A short circuit has been detected on output 2	Reduce load, check for short circuit
Out 1 Fault Disable	Optional Smart Breaker has shutdown output 1	Reduce load, check for short circuit, clear fault
Out 2 Fault Disable	Optional Smart Breaker has shutdown output 2	Reduce load, check for short circuit, clear fault

Minor Alarms:	Cause	Corrective action
No Temperature Probe	Battery temperature probe is disconnected or inoperative	Connect or replace temperature probe
Line Voltage Fail	Utility line voltage has failed and power supply is in standby	Restore utility line voltage
Out 1 Over Current	Output 1 current has exceeded setpoint by less than 1A	Reduce load
Out 2 Over Current	Output 2 current has exceeded setpoint by less than 1A	Reduce load
Global Over Current	Total output current has exceeded setpoint	Reduce load
Inverter Overtemp	Inverter temperature exceeds 60**°C but is less than** 65**°C**	Monitor condition

7.5 Electroline Transponder LEDs diagnostics and troubleshooting

LEDs Description



Normal Operation: When all LEDs are lit, this indicates that the DHT is properly cabled, the DOCSIS® registration process is complete and communications have been established with the monitored device. The CABLE LED flickers at each data transfer and the MON LED flickers every 5 seconds.

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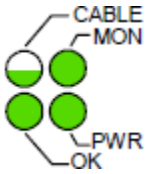
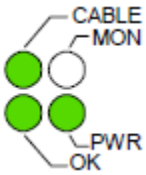
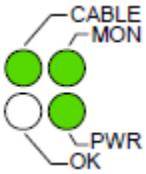


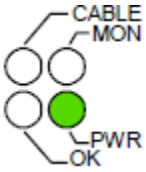
RF problem: If the CABLE LED keeps blinking slowly without ever being lit steadily, there may be a problem with the RF connection. Make sure the coaxial cable is connected to the DHT's RF port. Please note that the CABLE LED blinks at startup while the DHT completes its DOCSIS® registration. This LED should be lit steadily within 30 seconds to 2 minutes, and will flicker at each data transfer. If the condition persists, the DHT resets itself after about 25 minutes.



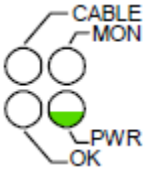
Device communication problem: If the MON LED is off, there may be a problem with the way the DHT is connected to the standby power supply. If this LED is blinking, this means that the DHT is establishing communications with the standby power supply. The LED should be lit steadily within a few seconds and then flicker every 5 seconds as long as the monitoring link is active. If this LED is dark but flickers every 5 seconds, then data communications with the device have been lost. If the LED remains off, and dual IP mode is activated, then there is a provisioning problem with the second IP address. Try resetting the unit.



Setup Error: If the OK LED is off, there may be a problem with the way the DHT is connected to the batteries. Make sure you have connected the correct wires to each battery in each string. If the problem persists, there may be an internal hardware failure.



Initialization Error: If only the PWR LED is on after the unit has been powered for one minute, then the DHT is not initialized. This may be due to an internal hardware fault. Try resetting the unit.



If the PWR LED is blinking slowly and the other LEDs are off, this means that the DHT is in "sleep" mode because one or more of the batteries has dropped below 10.5 VDC. When the DHT is in this mode, it stops monitoring the standby power supply, and thus conserves the power supply's battery power. As soon as the batteries are charged to at least 12 VDC each, the LED will be lit steadily.

Lit steadily or flickering occasionally

Blinking slowly

Off

Section 8: Options

The EB1s Series power supplies support several optional features appearing in the following list. The options and accessories listed enhance the usefulness of your power supply as aids to installation and servicing and are available through Multilink as extra-cost items. Refer to the section 8.6 of this instruction manual for part numbers of the options available

8.1 Battery Cable Kits

Designed for 3, 4, 6, or 8-battery powering applications.

8.2 Output Cable

70 cm unterminated cable adapts the UPS for use in a wide variety of existing enclosures.

8.3 Battery Balance Manager

This accessory, available as an installed option, is designed to maintain identical terminal voltage of each 3 or 4-cell battery in the string within 130 millivolts (0.130 volt) as measured across the entire battery string. Balancing battery voltages will help maintain battery life to maximum attainable time and helps insure longest available reserve time. The Battery Balance Manager is available for either 36-volt or 48-volt applications and for 1 or 2 battery strings. See the connection diagrams at the end of this section.

8.4 Dual Smart Breaker

This accessory, available as an installed option, monitors the output current of both output channels and can disconnect one or both of the channels in the event of an overcurrent. After an interval it will test for the overcurrent condition and will reconnect the channel accordingly. Parameters for this option are set from a menu list.

8.5 Recommended AC Input and Battery Wiring Sizes; 900 and 1350 VA Power Supplies

AC Input Wiring: Not smaller than 4 mm^2 in area (12 AWG), 105°C temperature rating.

AC Input Circuit Breaker: 16-Amp with AIC rating of 10,000 amps

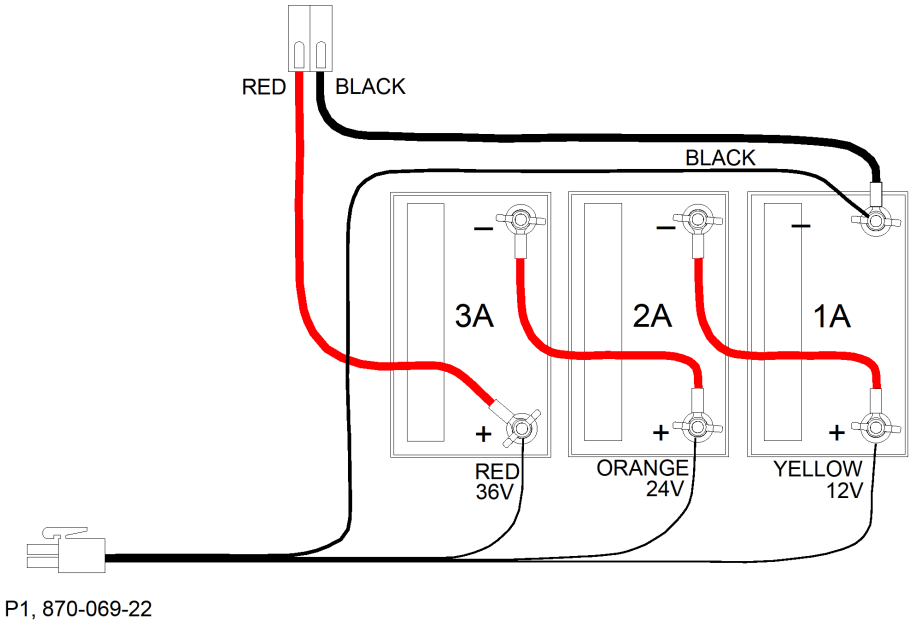
Battery Wiring: Not smaller than 10 mm^2 area (8 AWG); wiring kits of 16 mm^2 area (6 AWG) available

8.6 Available Options: **Part Number:**

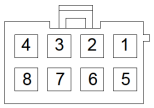
3-Battery Standard-Duty Cable Kit 874-001-23
8-Battery Heavy-Duty Cable Kit 874-031-20
Output Cable (70-cm, non-terminated) 870-009-20
Battery Balancer Module Kit (1 string, 3 or 4 batteries) 741-068-20
Battery Balancer Module Kit (2 string, 3 to 8 batteries) 741-068-21
Dual Smart Breaker Kit ..... 741-___-__

Options subject to further development and/or change without prior notification

LTR.	DATE	REVISIONS	ECN	BY
01	06/20/16	INITIAL RELEASE		RML



P1, 870-069-22



WIRING SIDE VIEW

TABLE 1	
P1 TERM NO.	WIRE COLOR
1	BK
2	Y
3	O
4	R
5	
6	
7	
8	

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ELYRIA, OHIO 44035
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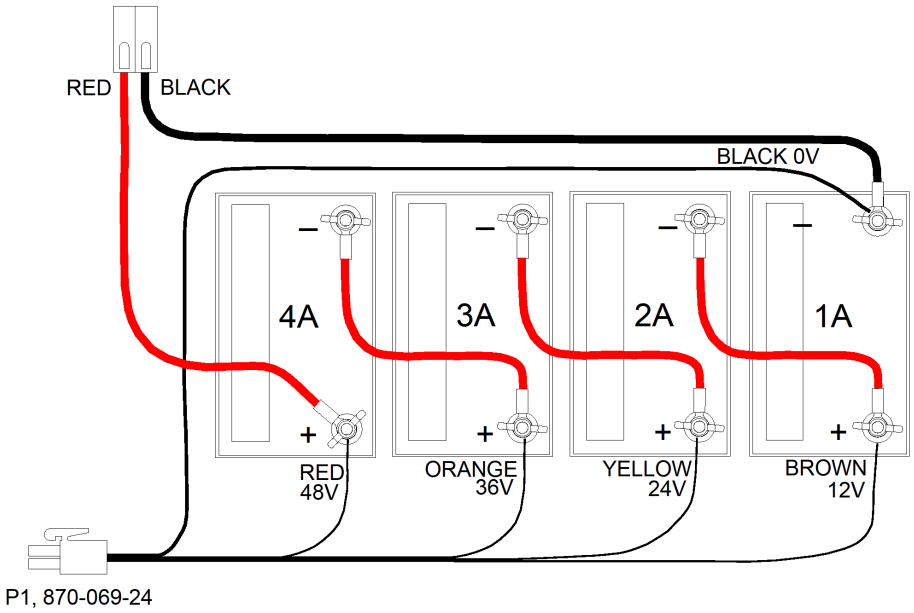
DESCRIPTION: WIRING DIAGRAM EB1S EMBEDDED BBM

DRAWN BY:	M. LIMPACH
DATE:	06/20/16
USED IN MODEL:	EB1S
PART NUMBER:	870-069-22
CAD FILE:	870-069-22-A0
PLOT SCALE:	
REV:	01
DRAWING NUMBER:	870-069-22-A0
PART OF ASSY:	740-068-20
SHEET:	1 OF 1

Fig. 8-1 Battery Balancer wiring, 36V, 3 batteries, 1 string

LTR.	DATE	REVISIONS	ECN	BY
01	06/20/16	INITIAL RELEASE		RML



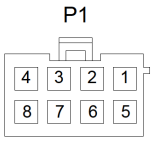


TABLE 1	
P1 TERM NO.	WIRE COLOR
1	BK
2	BR
3	Y
4	O
5	R
6	
7	
8	

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DESCRIPTION:
WIRING DIAGRAM EB1S EMBEDDED BBM

CAD FILE: 870-069-24-A0		PLOT SCALE:	REV: 01	DRAWING NUMBER: 870-069-24-A0
PART OF ASSY: 740-068-20		SHEET: 1 OF 1		

DRAWN BY: M. LIMPACH
DATE: 06/20/16
USED IN MODEL: EB1S
PART NUMBER: 870-069-24

Fig. 8-2 Battery Balancer wiring, 48V, 4 batteries, 1 string

LTR.	DATE	REVISIONS	ECN	BY
01	06/20/16	INITIAL RELEASE		RML

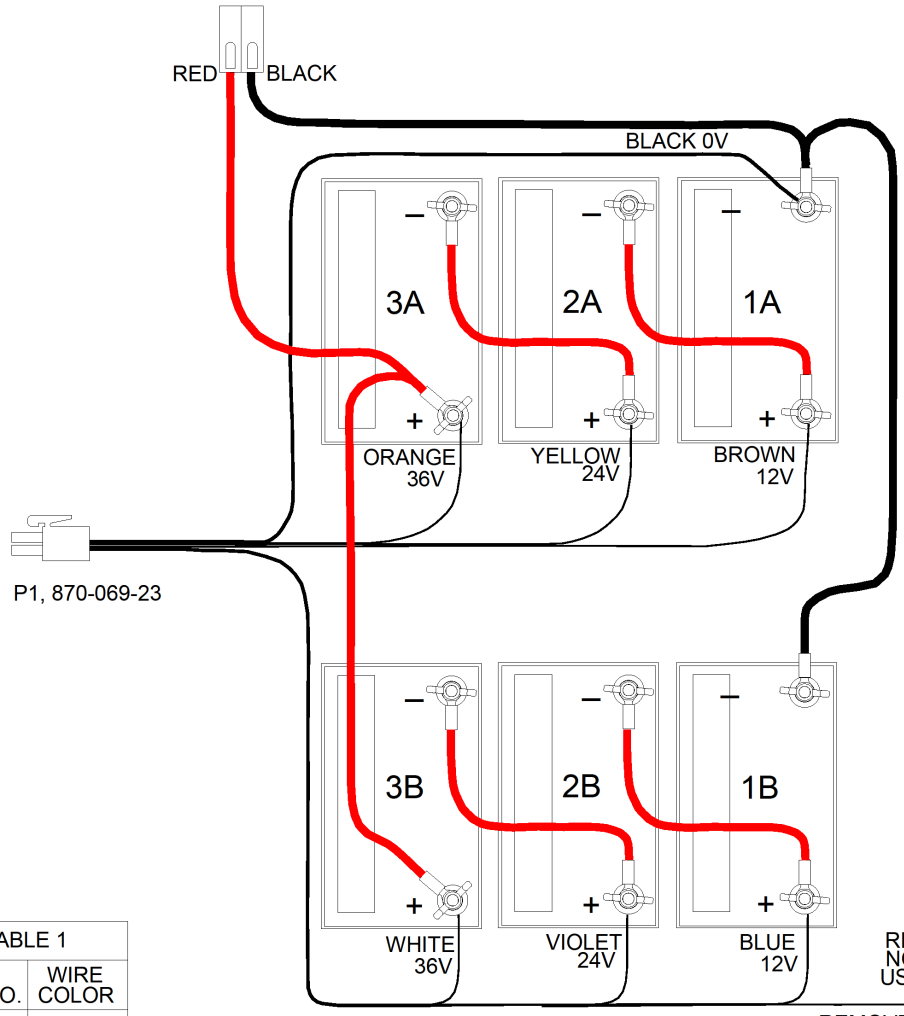

TABLE 1	
P1 TERM NO.	WIRE COLOR
1	BK
2	BR
3	Y
4	O
5	R
6	BL
7	V
8	W

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FAX: (440)366-6802

DESCRIPTION:
WIRING DIAGRAM EB1S EMBEDDED BBM

CAD FILE: 870-069-23-A0-1	PLOT SCALE:	REV:	DRAWN BY: M. LIMPACH	DATE: 06/20/16
PART OF ASSY: 740-068-21	SHEET: 1 OF 2	01	USED IN MODEL: EB1S	
			PART NUMBER: 870-069-23	
			DRAWING NUMBER: 870-069-23-A0-1	

Fig. 8-3 Battery Balancer wiring, 36V, 6 batteries, 2 strings

LTR.	DATE	REVISIONS	ECN	BY
01	06/20/16	INITIAL RELEASE		RML

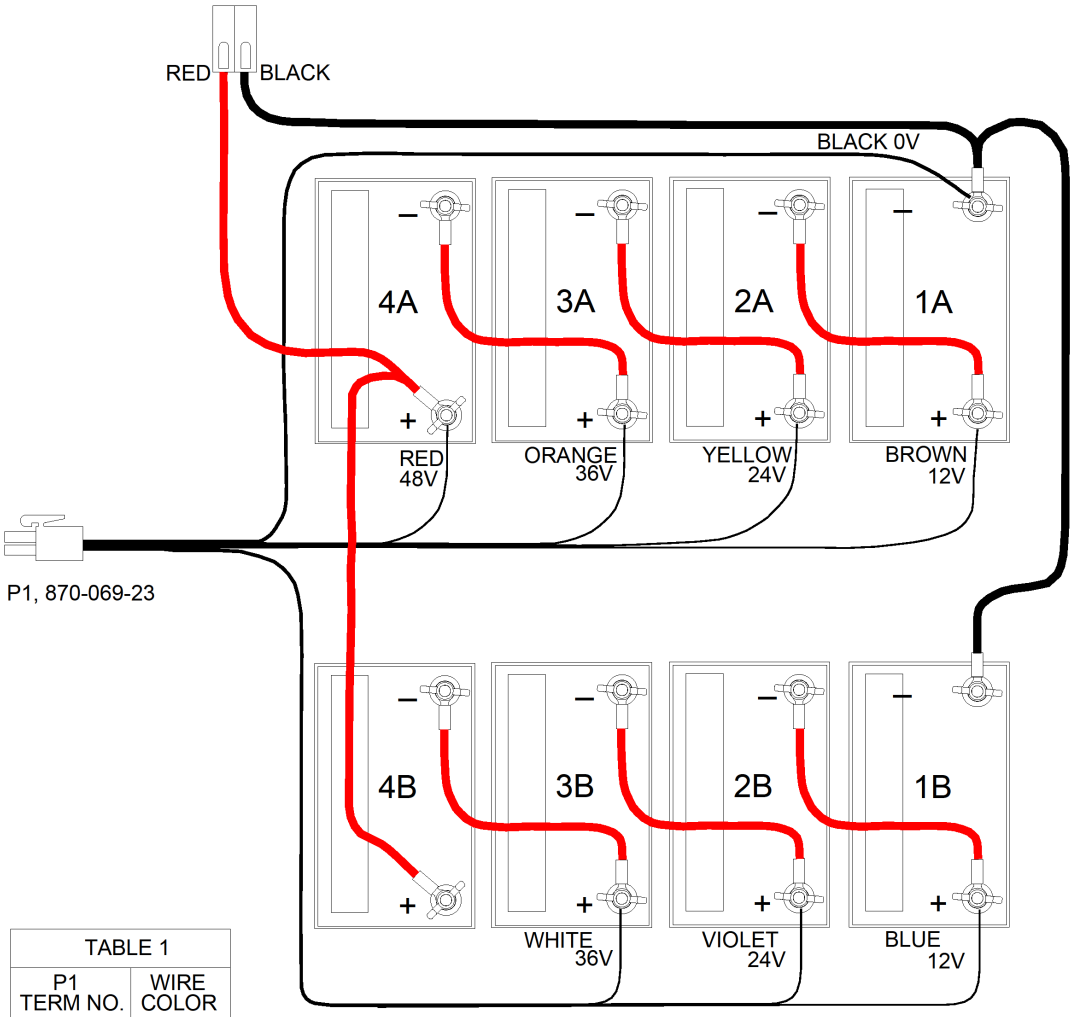
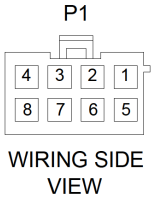


TABLE 1	
P1 TERM NO.	WIRE COLOR
1	BK
2	BR
3	Y
4	O
5	R
6	BL
7	V
8	W



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DESCRIPTION: WIRING DIAGRAM EB1S EMBEDDED BBM

DRAWN BY:	M. LIMPACH
DATE:	06/20/16
USED IN MODEL:	EB1S
PART NUMBER:	870-069-23
CAD FILE:	870-069-23-A0-2
PLOT SCALE:	
REV:	01
DRAWING NUMBER:	870-069-23-A0-2
PART OF ASSY:	740-068-21
SHEET:	2 OF 2

Fig. 8-4 Battery Balancer wiring, 48V, 8 batteries, 2 strings

Section 9: Specifications

Output Power VA	300	500				675					900				1350						1620						2000			
AC Line Input Voltage	120	120		240		120		240			120	240			120	240					120	240					120	240		
AC Line Input Frequency (Hz)	60	60		50		60		60	50		60	50			60	60		50			60	60		50			60	60		
Battery Voltage	36	36	48	36	48	36	48	36	36	48	36	48	36	48	36	48	36	48	36	48	36	48	36	48	36	48	36	48	36	48
Nominal AC Input Current (A)	3.4	5.7	5.7	2.8	2.8	7.6	7.6	3.8	3.8	3.8	10	10	5.1	5.2	18	18	9	9	9	9	20	20	10	10	10	10	23	23	11	11
Max Output Current @ 89V (A)	3.5	5.5	5.5	5.5	5.5	7.5	7.5	7.5	7.5	7.5	10	10	10	10	15	15	15	15	15	15	18	18	18	18	18	18	22	22	22	22
Max Output Current @ 63V (A)	5	8.5	8.5	8.5	8.5	11	11	11	11	11	15	15	15	15	22	22	22	22	22	22										
Max Battery Current (A)	9.3	15.6	11.5	15.6	11.5	21	15.6	21	21	16	28	21	28	21	42	31	42	31	42	31	50	38	50	38	51	38	62	47	62	47
Max Battery Charge Current (A)	3	5	5	5	5	5	5	5	5	5	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8
Inverter Acceptance Voltage	36	36	48	36	48	36	48	36	48	48	36	48	36	48	36	48	36	48	36	48	36	48	36	48	36	48	36	48	36	48
Weight	Approximately 65 lbs., 30 kg. depending on model																													
Cabinet Dimensions	**H**: 7.8" 198 mm **W**: 15", 16.5" w/Handle 380 mm, 420 mm w/Handle **D**: 10", 10.75" w/Handle 254 mm, 273 mm w/Handle																													
Output Voltage	Factory configurable to 63 or 89 VAC; 75 VAC available on some models; 89 VAC only on 1620 & 2000 VA models																													
Minimum Output Current	Not less than 1 amp load required: any output tap																													
Efficiency (Line Mode)	Typically 90% at nominal voltage, at full load																													
Efficiency (Inverter Mode)	Typically 87% at nominal battery, at full load																													
Power Factor	0.9 typical at nominal line input and >25% load																													
Line Frequency Tolerance	±3 %																													
Line Voltage Tolerance	-25% / 120v models: +21% 240V models: +10%																													
Output Voltage Tolerance	-5% / +3% load regulation over input range																													
Low Battery Shutdown	Selectable from 1.65V/cell to 1.75V/Cell. Default is 1.75 V/cell (31.5V for 36 volt string, 42.0V for 48 volt string)																													
Battery Equalize voltage	Selectable from 2.20V/cell to 2.45V/cell. Default is 2.39V/cell (43.0V for 36 volt string, 57.3V for 48 volt string)																													
Battery Float Voltage	Selectable from 2.10V/cell to 2.35V/cell. Default is 2.25V/cell (40.5V for 36 volt string, 54.0V for 48 volt string)																													
Temperature Compensation	Selectable from 2.0 to 6.0mv/°C/cell, default is 3.9mv/°C/cell																													
Charger Acceptance Voltage	Selectable (15 to 27 VDC for 36V string, 20 to 36 VDC for 48V string)																													
Output Waveform	Quasi-Square Wave																													
Short Circuit Protection	< 150% Maximum Current Rating																													
Protection	DC Input: 60-Amp magnetic/hydraulic circuit breaker																													
Usable Battery Types	GEL, AGM, PbC																													
Transfer Characteristic	UPS, < 8 ms typical																													
Operating Temperature Range	-40°C to +65°C @ 5% to 95% relative humidity, non-condensing. Elevation less than 3000 feet (de-rate 2°C per 1000' above 3000), installation in Multilink enclosure with ventilated battery tray, ensure proper cabinet ventilation and proper power supply position within the																													
Liquid Crystal Display	Four-line alpha-numeric display with green backlight 82.5 mm W x 19 mm H																													
Status Monitoring	Embedded HMS status monitor, conforming to ANSI / SCTE 25-3 2002 (HMS-022) Standard																													

Specifications subject to further development and/or change without prior notification

RELEASE HISTORY

Iss. 1A Preliminary Release	CS (03/12/14)
Iss. 01 Initial Release	CS (04/23/14)
Iss. 02 Revised specifications	CS (09/02/14)
Iss. 03 Added Cold Start section	CS (12/15/14)
Iss. 04 Added supported models	CS (06/12/15)
Iss. 05 Revised Specifications	CS (06/19/15)
Iss. 06 Revised supported models	CS (09/23/15)
Iss. 07 Revised menu descriptions, numerous revisions	CS (03/11/16)
Iss. 08 Added Charger Threshold Voltage selection to Configuration menu	CS (04/15/16)
Iss. 09 Added Battery Balancer wiring diagrams	CS (06/24/16)
Iss. 10 Numerous revisions	CS (12/15/16)
Iss. 11 Revised supported models	CS (02/10/17)
Iss. 12 Added FCC compliance statement	CS (03/31/17)
Iss. 13 Revised Available Options and Specifications	CS (11/14/17)
Iss. 14 New Primary and Events /Timers screens, 18V battery support	CS (01/19/18)
Iss. 15 Revised charger operation description	CS (05/21/18)
Iss. 16 Added Transponder Information section	CS (09/10/18)
Iss. 17 Revised supported models	CS (10/15/18)
Iss. 18 Revised supported models	CS (01/31/19)
Iss. 19 Numerous revisions	CS (04/30/19)

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INSTALL AND OPERATION