

## Battery Backup System for Traffic Intersections

- 1 **Description.** Furnish an Outdoor Hardened Battery Backup System to be mounted to the side of a traffic controller cabinet or installed as a Pad Mount Stand-Alone Battery Backup System.
- 2 **Materials.** Furnish, assemble, fabricate, or install new corrosion resistant materials in accordance with specifications. Supply a “rack mounted” UPS unit, including a front panel with indicators and control switches.
3. **Functional Requirements.** This specification is for establishing the minimum requirements for a complete emergency battery backup system for use with Light Emitting Diode (LED) Traffic Signal Modules at intersections with NEMA, 170 or 2070 cabinets. The Battery Backup System (BBS) shall include, but not be limited to the following: Inverter/Charger, Batteries, a separate automatic and manually operated Bypass Switch and all necessary hardware and interconnect wiring. The BBS shall be capable of providing power for full run-time operation for an “LED –only” intersection (all colors: red, yellow, green and pedestrian heads) The BBS shall be designed for outdoor applications.
4. **Enclosure Construction:**

**Enclosure.** The BBS Enclosure shall be capable of being a Side Mount and Pad Mount. The enclosure will house the batteries, UPS and bypass switches. The cabinet must meet the requirements for NEMA 3R enclosures. The housing must have the dimensions so that it may easily be attached the side of a M, P or 332 Type cabinet. Dimensions of the enclosure shall not exceed 50”H x 17” W x 17” D. The UPS enclosure must not interfere with the opening of the traffic cabinet door.

A eight (8) inch Riser option shall be available for Stand-Alone Pad Mount installations.

The complete enclosure and door must be made from .125” thick aluminum. All external seams must be continuously welded. The door opening must have a double flange for weather sealing purposes.

- a. **Door:** The cabinet must have a door to provide access to the complete cabinet interior. The door must include a continuous piano hinge made of 14-gauge stainless steel and a .120” diameter stainless steel hinge pin. The hinge must be attached to the enclosure and the door with close end pop rivets. The door must have a three (3) point locking mechanism with rollers at the ends for the latch rods. The key lock must be a Corbin cylinder lock with a #2 key. When the door is opened it must have stops at 90, and 130 degrees. A continuous neoprene gasket must be used to weatherproof the enclosure when the door is closed.

- b. **Ventilation Fan:** A fan must be mounted in the air baffle at the top of the cabinet with an air outlet built into the overhang. The fan must be thermostatically controlled. The bottom of the door must be louvered to allow airflow. A removable dust filter must be located behind the vent.
- c. **Finish:** The enclosure shall be part #26-026-053-80 and painted PFJ-407-A5 Statuary Bronze.
- d. **Features:** An “On Battery” factory installed high impact red light option shall be available for the enclosure. The “On Battery” LED shall operate off of the DC voltage of the UPS to notify that the UPS is on batteries without opening of the door. The light will be wired to and controlled by the UPS power module. The enclosure shall be designed to rack mount the UPS and Fail Safe ATS transfer switch. When the UPS is mounted into the enclosure it must be mounted to accommodate straight-on horizontal viewing of the LCD screen on the UPS.
- e. **Generator Connection:** An optional factory installed flush mount generator compartment with neoprene gaskets for weatherproofing shall be available for the enclosure. The generator compartment shall include a locking 30 amp plug, L5-30FI, for connecting of a portable AC generator. A manual transfer switch shall be mounted within the generator compartment to allow for transferring from utility power to generator power. The generator door will provide a cable slot to allow for closing of the door when the generator is plugged in and to lock the cable inside of the compartment. The door will include a Corbin Type 2 lock.
- f. **Mounting:** The cabinet will be mounted to the traffic control cabinet with six 6 hex head bolts, 1/4” x 20”. All holes will be field drilled by the Contractor to accommodate the specific situation. A grommet must be supplied to protect the cable in a field drilled 1.5” to 2” hole for cable connection to the existing traffic controller. The Contractor will supply all the mounting hardware, bolts, washers, nuts, gaskets, bushings, grommets, caulking, etc., necessary to install the cabinet in a safe and weatherproof manner.  
An optional eight (8) inch Riser shall be available for Pad Mount Stand-Alone Installations.

## 5. Battery System:

- a. Individual batteries shall be:
  - Voltage rating: 12V type
  - Amp-hour rating: 109 amp-hour minimum
  - Group size: 31 minimum
  - Batteries shall be easily replaced and commercially available off the shelf.
- b. Batteries used for BBS shall consist of 4 batteries. All batteries must meet their specifications out of the box immediately after the initial 24-hour top off charge. Batteries that require cycling to meet the AH rating specifications are not acceptable.

- c. Batteries shall be deep discharge, sealed prismatic lead-calcium based GEL/VRLA Gelled Electrolyte/ Valve Regulated Lead Acid). Batteries designed for Cycle applications, such as Solar, are not acceptable. The battery must be designed for Standby Applications.
- d. Batteries shall have a discharge operating temperature range of  $-40\text{ }^{\circ}\text{C}$  to  $+71\text{ }^{\circ}\text{C}$ .
- e. Batteries shall have a Manufactures Warranty of 4 Years Full Replacement plus 1 additional year when an AlphaGuard is used. The warranty shall cover any battery that does not meet 70% of its original reserve capability during the warranty period.
- f. The batteries shall be provided with appropriate interconnect wiring and corrosion-resistant mounting trays, shelf's and/or brackets appropriate for the cabinet into which they will be installed.
- g. Batteries shall indicate maximum recharge data and recharging cycles.
- h. Battery Harness
  - 1) Battery interconnect wiring shall be via two-part modular harness.
  - 2) Part I shall be equipped with red (+) and black (-) 30.48 cm (12") cabling that can be permanently connected to the positive and negative posts of each battery. Each red and black pair shall be terminated into an Anderson style Power Pole connector or equivalent.
  - 3) Part II shall be equipped with the mating Power Pole style connector for the batteries and a single, insulated Power Pole style connection to the inverter/charger unit. Harness shall be fully insulated and constructed to allow batteries to be quickly and easily connected in any order to ensure proper polarity and circuit configuration.
  - 4) Power Pole connectors may be either one-piece or two-piece. If a two-piece connector is used, a locking pin shall be used to prevent the connectors from separating.
  - 5) All battery interconnect harness wiring shall be UL Style 1015 CSA TEW or Welding Style Cable or equivalent, all of proper gauge with respect to design current and with sufficient strand count for flexibility and ease of handling.
  - 6) Battery terminals shall be covered and insulated with molded boots so as to prevent accidental shorting.
- i. Battery Balancer: The AlphaGuard shall be provided that automatically balances the battery charge voltage on all batteries in the string to within  $\pm 100\text{mV}$  between any two batteries. The AlphaGuard shall allow for any single 12V battery within the battery string to be replaced without having to replace the entire battery string.

## 6. BBS Operation:

- a. The BBS shall provide a minimum four (4) hours of full run-time operation at 500 watts with an additional nine (9) hours of Red Flash operation at 125 watts. Typical values for a “LED-only” intersection. The inverter, when on batteries, shall operate with a minimum efficiency of 84% with a load ranging from 25% to 90% of the BBS total output rating. The BBS shall operate at 98% or higher when operating under normal condition (utility power is available).
- b. The BBS, for safety and efficiency shall operate with a nominal 48 VDC buss. A DC level higher than 56 VDC shall be considered unsafe and not acceptable.
- c. The maximum transfer time allowed, from disruption of normal utility line voltage to stabilized inverter line voltage from batteries, shall be 5 milliseconds. The 5 milliseconds maximum allowable transfer time shall also apply when switching from inverter line voltage to utility line voltage.
- d. The BBS shall include a rack mounted Fail Safe Automatic/Manual Bypass Switch for bypassing the UPS for maintenance. The FS-ATS bypass switch will be a 3-stage configuration, UPS Normal mode, bypass UPS On and bypass UPS Off. The FS-ATS Bypass Switch shall mount in a 19” rack inside of the BBS side mount enclosure.
- e. The BBS shall provide the user with 6-sets of normally open (NO) and normally closed (NC) single-pole double-throw (SPDT) individually programmable dry relay contact closures, available on a front panel-mounted terminal block, rated at a minimum 120V/1A, and labeled so as to identify each contact.
  - 1) One set of NO and NC contact closures shall be energized whenever the unit switches to battery power. Contact shall be labeled or marked “On Batt.”
  - 2) A second and third set of NO and NC contact closures shall be energized whenever the battery approaches approximately 40% of remaining useful capacity. Contact shall be labeled or marked “Low Batt.” This setting must be adjustable from 10% to 90% via the RS232 connection.
  - 3) A fourth set of NO and NC contact closures shall be energized two hours after the unit switches to battery power. Contact shall be labeled or marked “Timer.” This setting must be adjustable from 1 Min. to 8 Hours via the RS232 connection.
  - 4) A fifth set of NO and NC contact closures shall be energized in the event that an Alarm condition occurs. Contact shall be labeled “Alarm”.
  - 5) A 48 VDC output shall be provided for operating an external fan. This output can also be factory configured as a dry contact
  - 6) Relay contact activation shall be annunciated on the front panel via a visual indication. This can be either discreet LED, or part of LCD screen, etc.
- f. The BBS shall have (2) independently programmable timers 0 to 8 hours with (2) times-of-day restrictions on each timer.

- g. The BBS shall provide 3 user inputs to support Intrusion Alarm, Emergency Power Off (EPO) and external Self Test (Battery Test).
- h. Operating temperature for both the inverter/charger, and manual bypass switch shall be  $-37\text{ }^{\circ}\text{C}$  to  $+74\text{ }^{\circ}\text{C}$  with a load of 850 watts.
- i. The Fail Safe ATS Bypass Switch shall be rated at 240VAC/30 amps, minimum
- j. The BBS shall use a temperature-compensated battery charging system. The charging system shall compensate over a range of  $2.5 - 6.0\text{ mV}/^{\circ}\text{C}$  per cell. The temperature sensor shall be external to the inverter/charger unit. The temperature sensor shall come with 2 meters (6'5") of wire.
- k. Batteries shall not be recharged when battery temperature exceeds  $50\text{ }^{\circ}\text{C} \pm 3\text{ }^{\circ}\text{C}$ .
- l. BBS shall bypass the utility line power whenever the utility line voltage is outside of the following voltage range: 85VAC to 175VAC ( $\pm 2\text{VAC}$ ). During a utility input from 85 VAC to 175 VAC the UPS shall utilize its internal double buck, double boost regulation to maintain a 108 to 131 VAC output to the controller cabinet, without the use of the batteries. The BBS shall go into Boost Mode 1 when the AC Line voltage reaches below 110 VAC,  $\pm 2$ volts. When the AC line drops below 96 VAC,  $\pm 2$  volts the BBS shall go into Boost Mode 2. When the AC line voltage reaches 131 volts,  $\pm 2$ volts the BBS shall go into Buck Mode 1. When the AC Line voltage reaches 150 volts the BBS shall go into Buck Mode 2.
- m. When utilizing battery power, the BBS output voltage shall be between 112 VAC and 128 VAC, pure sine wave output,  $\leq 3\%$  THD,  $60\text{Hz} \pm 3\text{Hz}$ .
- n. BBS shall be compatible with NEMA, 170 or 2170 Controllers, and cabinet components for full time operation. All loads to the maximum rating of the BBS shall be powered through the BBS system to utilize the UPS internal Buck/Boost regulation.
- o. In cases of low (below 85VAC) or absent utility line power, when the utility line power has been restored to normal for more than 3 seconds, the BBS shall transfer from the Boost Regulation Mode or the battery backed inverter mode back to utility line mode.
- p. In cases of high utility line power (above 175VAC), when the utility line power has been restored to normal for more than 3 seconds, the BBS shall transfer from the Buck Regulation Mode or battery backed inverter mode back to utility line mode
- q. BBS shall be equipped to prevent a malfunction feedback to the cabinet or from feeding back to the utility service. For conformation the UPS module must be UL/CSA approved and labeled. "Tested to" or "Built to" UL/CSA is not acceptable.

- r. In the event of inverter/charger failure, battery failure or complete battery discharge, the Fail Safe Transfer Switch shall revert to the NC (and de-energized) state, where utility line power or generator power, if available, is connected to the cabinet.
- s. Recharge time for the battery, from “protective low-cutoff” to 90% or more of full battery charge capacity, shall not exceed eight (8) hours, unless limited by the Temperature Regulated charger due to excessive battery heat that could damage the integrity of the battery string.
- t. Batteries shall be Deep Discharge Gel Type Valve Regulated Lead Acid Battery and compatible with the Battery charger.

**7. Maintenance, Displays, Controls and Diagnostics:**

- a. The BBS shall include a display and /or meter to indicate current battery charge status and conditions.
  - 1) The BBS shall provide voltmeter standard probe input-jacks (+) and (-) to read the exact battery voltage drop at the inverter input.
- b. The BBS shall have lightning surge protection option.
- c. The BBS shall be equipped with an integral system to prevent battery from destructive discharge and overcharge.
- d. The BBS and batteries shall be easily replaced with all needed hardware and shall not require any special tools for installation.
- e. The BBS shall display via an LCD panel to indicate the number of times the BBS was activated and the total number of hours the unit has operated on battery power. The LCD display shall show the UPS mode, Alarm status, Input and output voltages, Output current, Battery voltage, battery charger current and last event. It shall allow for programming of the battery charger from 3, 6 and 10 amp charger setting.
- f. The BBS shall include a RS-232 port for local serial communications on the front panel of the UPS. An optional factory installed internal Ethernet port for SNMP/WEB communications shall be available.
- g. The BBS shall include a Microsoft Windows<sup>®</sup> Graphical User Interface for programming and monitoring the BBS. This must be provided in addition to the use of Hyper Terminal and provided at not cost.
- h. Manufacturer shall include a set of operator’s manuals with each BBS.
- i. The BBS shall provide the ability to manage daylight savings time automatically.
- j. The BBS temperature reporting shall be selectable, Celsius or Fahrenheit.
- k. The BBS shall have the ability to update the firmware via the Web Pages.

- l. The BBS shall be capable of reporting the date in either number or text format in any order of day, month and year.
- m. The BBS shall have battery runtime reporting integration based on the current rate of consumption via a selectable collection of common batteries and via generic configuration with editable Peukert's number.
- n. The BBS shall display the MAC address locally and remotely.
- o. The BBS shall display the unit serial number locally and remotely.
- p. The BBS shall display the record the power consumed by the load. (KW)
- q. The BBS shall have a user input selectable alarm. An alarm shall be sent via SNMP when activated.
- r. The BBS shall have a remote shutdown / reboot via SNMP feature.
- s. The BBS shall have up to 255 COM ports available on the RS-232.

#### **8. Acceptance:**

Each BBS shall be manufactured in accordance with a manufacturer Quality Assurance (QA) program. The QA program shall include two Quality Assurance procedures: (1) Design QA and (2) Production QA. The Production QA shall include statistically controlled routine tests to ensure minimum performance levels of BBS units built to meet this specification and a documented process of how problems are to be resolved. The manufacturer, or an independent testing lab hired by the manufacturer, shall perform Design Qualification Testing on new BBS system(s) offered, and when any major design change has been implemented on an existing design. A major design change is defined as any modification, either material, electrical, physical or theoretical, that changes any performance characteristics of the system, or results in a different circuit configuration.

Production Quality Control tests shall be performed on each new system prior to shipment. Failure to meet this requirement shall be cause for rejection. Each system shall be visually inspected for any exterior physical damage or assembly anomalies. Any defects shall be cause for rejection.

#### **9. Materials Warranty:**

Manufacturers shall provide a two (2) year factory-repair warranty for parts and labor on the BBS from date of acceptance but not more than 6 months from ship date. Batteries shall be warranted for full replacement for four (4) years from date of purchase with an additional 1-year added when a battery balancer is installed at time of initial installation. A battery shall be considered bad should it not deliver 70% of its original capability within the stated warranty period.

The warranty shall be included in the total bid price of the BBS.