Louisiana

Department of Transportation And Development

Traffic Control Standard

Number 14

Battery Back-up System for Traffic Signals

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1.0 GENERAL

This specification establishes the minimum requirements for a complete emergency battery back-up system for use at traffic signals utilizing Light Emitting Diode (LED) signal heads; blank out no turn signs, and pedestrian signal heads. The Battery Back-up System (BBS) shall include, but not be limited to the following:

- Cabinet (SAP# 50550)
- Integrated Power Transfer Switch (SAP# 50551)
- Batteries (SAP# 50552)
- Inverter/Charger (SAP# 50553)
- Mounting hardware
- Wiring

The BBS shall provide emergency power to a traffic signal in the event of a power failure or interruption.

2.0 OPERATION

2.1 General

The BBS shall provide the following operational modes when operating on battery power:

- Full operation of all traffic signal devices
- Flash operation
- Combination of full and flash operation

2.2 Run Time

The BBS shall be programmed to provide a minimum of 450 watts for 6.0 hours of full time operation for a traffic signal utilizing LED only vehicle and pedestrian indications. The minimum battery size requirement is listed in section 7.1, Battery Type.

2.3 Compatibility

The BBS shall be compatible with LADOTD NEMA type TS1 cabinet and TS2 type 2 controller and all cabinet components for full time operation.

2.4 Output Capacity

The BBS shall provide a minimum of 1100W/1100VA@25°C active output capacity with 80 % minimum inverter efficiency with 30% loading.

2.5 Output Voltage

When operating in backup mode, The BBS output shall be 120VAC±5VAC, pure sine wave output, ≤3%THD, 60Hz ± 0.05 Hz. No square or stepped wave shapes are acceptable.

2.6 DC System Voltage

The BBS DC system voltage shall be 48VDC.

2.7 Transfer Time

The maximum transfer time allowed, from disruption of normal utility line voltage to stabilized inverter line voltage from batteries, shall be a maximum of 65 milliseconds (ms). The same maximum allowable time shall also apply when switching from the inverter line voltage to utility-line voltage. Transfers to and from battery operation shall not interfere with the operation of the other equipment in the intersection.

2.8 Operating Temperature

The BBS and all components shall operate without performance degradation over a temperature range of -37°C to +74°C. Additionally, all components and parts used shall, at the minimum, be rated for this temperature range.

2.9 Feedback Level

In the event the AC service feeding the BBS is severed, or there is a utility blackout, the AV voltage measured at the AC inputs to the BBS (line to neutral) shall be less than 1 VAC.

2.10 Surge Protection

The BBS shall have lightening surge protection compliant with IEEE/ANSI C.62.41 and must be able to withstand 2000 volt surges applied 50 times across line and neutral. These surges shall not cause the BBS to transfer to Backup mode.

2.11 Power and Control Connections

The BBS shall be easily installed, replaced, or removed by using easily removable cables for AC input, AC output, DC input, external transfer control and battery temperature sense.

2.11.1 AC Connection

The AC input and output shall be panel mounted plug/receptacles or hard wired connections that allow no possibility of accidental exposure to dangerous voltages. If utilizing plug/receptacles the AC Input shall be a male receptacle and the AC output shall be a female receptacle. The receptacles shall utilize some form of locking mechanism or hold down clamps that prevent accidental disconnects.

2.11.2 DC Connection

The DC connection shall be a recessed one (1) or two (2) piece Anderson Style receptacle.

2.11.3 Relay/Temperature Probe Connections

The Power Transfer relay control and the battery temperature sense inputs shall be heavy duty panel-mounted style connectors.

2.12 General Connections

All connections shall provide mechanically and electrically secure connections without the use of a screwdriver. The only exception is the Relay Terminal Block for alarms and the hardwired AC input and output terminals for the power connections.

2.13 Unit Failure

In the event of inverter/charger failure, battery failure or complete battery discharge, the power transfer switch shall revert to a Normally Closed (NC) (and de-energized) state, where utility line power is connected to the cabinet.

2.14 Overload

The BBS must be able to shutdown in order to protect against internal damage in the event of an overload at the output.

2.15 AC Feedback

The BBS shall prevent a malfunction feedback to the cabinet or from feeding back to the utility service. In the event of BBS failure (inverter/charger or battery) or complete battery discharge, the power transfer relay shall revert to a Normally Closed (NC) (and de-energized) state where utility line power is connected to the cabinet.

2.16 Automatic Shutdown

The BBS shall initiate an automatic shutdown when battery output reaches 42VDC.

2.17 Destructive Discharge or Overcharge

The BBS shall be equipped with an integral system to prevent the battery from destructive discharge or overcharge.

3.0 POWER TRANSFER SWITCH (SAP# 50551)

3.1 Rating

The BBS shall include a Power Transfer Switch rated at 120VAC/30 amps minimum.

3.2 Manual Bypass Switch

The Power Transfer Switch shall include a manual bypass switch. Placing the manual bypass switch in the "Bypass" mode shall transfer the intersection load from the Uninterruptible Power Supply (UPS) output directly to commercial power. An inverter input breaker shall be provided and located on the Bypass Switch so to shut off commercial power to the UPS input, allowing safely disconnecting and removing the inverter. With the inverter turned off, the batteries can be safely disconnected from the system.

3.3 Indicator Light

The Power Transfer Switch shall include a bypass indicator light that automatically notifies the user when the Manual bypass switch is in Bypass position. The indicator light may be illuminated when in UPS mode and off when in bypass mode.

3.4 Status Relay

The Power Transfer Switch shall include a bypass status relay with normally open, dry contacts that automatically close when the Manual bypass switch is in Bypass position.

3.5 Power Transfer Relay

The Power Transfer Switch shall include a 30 Amp power transfer relay controlled by the inverter to cause the Power Transfer Switch to switch between AC power from the utility and battery power from the inverter.

3.6 Integrated Switch

The manual bypass switch and the power transfer relay shall be integrated together within the Power Transfer Switch allowing the manual bypass switch to be rated at 15 Amp and to be integrated with the bypass indicator light and bypass status relay.

3.7 Terminal Block

The Power Transfer Switch shall have terminal blocks capable of accepting #6 AWG wiring for the AC input with #10 AWG internal to the Power Transfer Switch as required for 30 Amp operations.

4.0 INVERTER/CHARGER FUNCTIONALITY (SAP# 50553)

4.1 Buck/Boost Mode

The BBS shall include Buck/Boost Functionality.

4.1.1 Range

The Buck/Boost Mode shall have a minimum range of 90-150 VAC

4.1.2 Regulated Voltage

Whenever Buck/Boost Mode is selected the output of the system shall be regulated between 108-130VAC. When the output of the system can no longer be maintained with this range, the BBS shall transfer to Backup Mode.

4.2 Line Quality Time

The BBS shall have a user definable line qualify time. The user shall be able to select a minimum of three (3) possible settings. The minimum setting shall be 3, 20, and 30 seconds. The default line qualify time shall be 3 or 30 seconds.

4.3 Battery Charger

The BBS shall have an integral charger. The charger shall be a 3-step charger using bulk, absorption and float charging techniques, appropriate for the battery type.

4.3.1 Temperature Compensation

The integral 3-Step Charger shall use temperature compensation. The charging system shall compensate over a range of 2.5-4.0mV/°C per cell.

4.3.2 Temperature Sensor

A temperature probe which plugs into the front panel of the BBS shall be used to monitor the internal temperature of the batteries. The Temperature sensor shall be of sufficient length to properly reach the center battery and yet not too long to cause an inaccurate reading.

4.3.3 Battery Temperature

The batteries shall not be recharged whenever the battery temperature exceeds 50°C.

4.3.4 Recharge Time

The recharge time for the batteries from "protective low-cutoff" to 80 percent or more of full charge capacity shall not exceed twelve (12) hours.

5.0 USER INTERFACES AND DISPLAYS

5.1 Inverter/Charger Display

The BBS inverter/charger unit shall include a backlit LCD display for viewing all status and configuration information. The screen shall be easily viewable in both bright sunlight and in darkness.

5.1.1 Screen Size

The screen shall be large enough to display the following information with the use of menu scrolling buttons to read required information:

- Operating Mode (Standby, Buck/Boost)
- Utility input voltage
- BBS output voltage
- Charger status
- BBS Status (Standby, Backup, Buck/Boost)
- Any alarms and faults

5.1.2 Relay status information Keypad

The BBS inverter/charger unit shall include a keypad for configuring system parameters and navigating system information.

5.2 Web-based Interface

The BBS shall be provided with a web-based-interface for user configuration and management through a web browser.

5.2.1 Minimum Capabilities

The BBS shall allow the user to do the following through the web browser:

- View Logs
- Change modes of operation
- Configure email alarms
- Adjust line qualify time
- Program relay contacts
- Configure network parameters

5.3 Status LEDs

The BBS shall have discrete status LED indications on the front of the inverter/charger.

5.3.1 Green Output LED

This LED will be ON any time that the output of the BBS is in Normal Mode. When the output is modified, either by Backup Mode or by Buck/Boost Modes the LED will change state, color or blink Green.

5.3.2 Red Fault LED

This LED will be Full ON any time that there are any faults in the system

5.3.3 Yellow or Red Flashing Alarm LED

The LED will be Full ON Yellow or Red Flashing any time that there are any alarms in the system.

5.3.4 Event Log

The BBS shall maintain an event log containing a minimum of 100 of the most recent events recorded by the BBS. At a minimum, the Event Log shall record the following:

- Date/Time Stamp
- Current operating mode
- What the event was

These events shall be down loadable remotely via Ethernet. The Event Log shall be viewable through the LCD display, EIA-232 port, and the Ethernet Interfaces.

5.3.5 Counters

The BBS shall keep track of the following:

- The number of times that the unit was in Backup, Buck and Boost Modes
- The total number of hours and minutes that the unit has operated in those modes since the last reset.

5.4 Programmable Relay Contacts

The BBS shall provide the user six (6) programmable dry relay contacts. As a minimum, the programmable options shall be On Battery, Low Battery, Timer, Alarm, Fault, and Off.

5.4.1 Relay Contact Terminals

The relay contacts shall be made available on the front panel of the BBS via an 18-position, screw hold-down, printed circuit board mounted terminal block.

5.4.2 Contacts

Each relay shall have their own common and their own set of Normally Open (NO) and Normally Closed (NC) terminals. The terminals for each relay shall be oriented as NO-C-NC on the terminal block.

5.4.3 Labeling

The contacts on the terminal block shall be labeled 1-18, left to right. Additionally, each set of contacts shall be labeled with the NO-C-NC designation, as well as C1…C6 from left to right. All additional contacts on the terminal block shall be labeled as "spare".

5.4.4 Rating

The relay contacts shall be rated at a minimum of 1 amp @125 VAC.

5.4.5 Display

When a relay is energized, it shall be displayed on the LCD screen.

5.4.6 On Battery Relay Contact

The dry relay contacts that are configured for "on battery" shall only energize when the Inverter is operating in Backup Mode.

5.4.7 Timer Relay Contact

The BBS shall include a timer that will energize the "timer" configured dry relay contact after the user configured time has elapsed. The timer is started when the BBS enters Backup Mode. The user shall be able to configure the timer from 0 – 480 minutes in 15 minute increments.

5.4.8 Low Battery Relay Contact

The BBS shall have an adjustable low battery relay setting. This setting shall be adjustable so that the user can set the point at which the low battery relay contact is energized.

6.0 COMMUNICATIONS

6.1 Serial Interface

The BBS shall be equipped with an industry standard RS-232 serial connection for user configuration and management. The serial port shall be a EIA-232 (DB9-Female) connector.

6.2 Ethernet Interface

The BBS shall have an Ethernet communication interface for user configuration and management. The Ethernet Port shall be an RJ-45, EIA 568B Pin Out Connector.

6.3 Remote Monitoring

The BBS shall include remote monitoring & alarms transmission capabilities. These should communicate through the Ethernet RJ45 IP Addressable Port, using SNMP protocol. Other means of communication will be considered.

6.4 User Configurations Menus

All BBS configuration and System menus shall be accessible and programmable from the RS-232 and Ethernet Port.

6.5 Communications Protocols

The BBS shall support TCP and UDP over IP protocol communications.

6.6 Application Layer Protocols

The BBS shall support FTP, Telnet, and HTTP.

6.7 SNMP (Simple Network Management Protocol)

The BBS shall be SNMP compliant.

7.0 BATTERIES (SAP# 50552)

7.1 Battery Type

The battery shall be comprised of extreme temperature, float cycle, GEL VRLA (Valve Regulated Lead Acid). Individual batteries shall meet the following specifications:

- - Voltage Rating: 12V
- - Amp-hour Rating: 100 to 109AH, at the 20 hour rate, to 1.75 Volts per cell, minimum battery rating. Larger AH batteries are acceptable; however they must not exceed the Battery Council International (BCI) group size listed below.
- - Group Size: BCI Case 31, maximum

Batteries shall be commercially available off the shelf.
Batteries shall be replaceable without shutting down power to the entire intersection.

7.2 Battery String

The battery system shall consist of one (1) or more strings of extreme temperature, float cycle, GEL VRLA (Valve Regulated Lead Acid) batteries. Batteries used for the BBS shall consist of four (4) batteries configured for a 48 VDC battery buss system. Paralleling multiple strings in order to provide the supplied amp-hour requirements in this specification shall not be acceptable. It shall be an acceptable means for LADOTD to increase the available amp-hours as deemed necessary by paralleling battery banks.

7.3 Operating Temperature

Batteries shall be certified to operate at extreme temperatures from –40°C to +74°C.

7.4 Construction

Battery construction shall include heavy-duty, inter-cell connections for low-impedance between cells, and heavy-duty plates to withstand shock and vibration.

7.4.1 Top Cover

The top cover shall use tongue and groove construction and shall be epoxied or heat-sealed to the battery case for maximum strength and durability.

7.4.2 Ability to Function

The battery shall be designed to function if laid on its side without leakage of chemicals. An integral lifting handle must be provided on the batteries for ease of removal/installation.

7.5 Interconnect Wiring

All batteries shall be provided with the appropriate interconnect wiring.

8.0 BBS CABINET (SAP# 50550)

8.1 General

8.1.1 EIA Standard
The unit shall be shelf mounted or meet the EIA standards.

8.1.2 Inverter/Charger Mounting
The Inverter/Charger Unit shall be shelf or rack mounted on a standard EIA19" rack.

8.1.3 Power Transfer Switch Mounting
The Power Transfer switch shall be shelf mounted or EIA Rail.

8.1.4 Interconnect Wiring
All interconnect wiring shall be provided and shall be UL Style 1015 CSA TEW.

8.2 BBS Replacement
Replacement of the BBS equipment and batteries shall not require any special tools for removal or installation.

8.3 Hot Swappable
The BBS inverter and batteries shall be hot swappable. There shall be no disruption to the Traffic Signal when removing the inverter or batteries for maintenance.

8.4 Quick Disconnects
All inverter and battery connections shall be of the quick disconnect type for ease of maintenance.

8.5 Ancillary Installation Hardware
All necessary installation hardware (bolts, fasteners, washers, shelf angles, racks, etc.) shall be included.

8.6 Cabinet Light

8.6.1 Cabinet shall have an internal white LED light that is wired to come on when the cabinet door is open..

8.6.2 Cabinet shall have an external "on-battery" red LED indicator light

8.7 Cabinet Sizing
The external cabinet shall be capable of housing batteries, inverter/charger unit, power transfer switch, control panels, wiring, wiring harnesses, and all other ancillary equipment.

8.8 Additional Cabinet Features
- Enclosure shall be made of .125" thick traffic grade aluminum. Aluminum alloy shall be 5052, 6061 or equivalent.

- Neoprene gaskets are to be furnished on all doors to prevent dust and moisture from entering the cabinet.
- Cabinet shall include a three (3) point latching mechanism with Corbin type 2 lock or Best Lock.
- Cabinet door shall be constructed of stainless steel with a 180 degree piano hinge and two (2) locking open positions.

8.9 Rating

All external cabinets shall be NEMA 3R rated.

8.10 Ventilation

The external cabinet shall be ventilated through the use of louvered vents, a filter, and one thermostatically controlled fan.

8.10.1

The External fan cabinet shall be AC or DC operated from the same line output of the Power Transfer Switch that supplies power to the traffic controller cabinet. A 2-postion terminal block shall be provided on the fan panel.

8.11 Ancillary Hardware

The external cabinet shall come provided with all bolts washers, nuts, cabinet-cabinet coupler fitting, shelves, wiring, and all other hardware necessary for mounting and connecting the external cabinet.

9.0 MAINTENANCE

9.1 Probe Jacks

The BBS shall provide voltmeter standard probe input-jacks (+) and (-) to read the exact battery voltage drop at the inverter input.

9.2 Circuit Breakers

The BBS shall be equipped with an AC input circuit breaker that protects both the UPS and the loads connected to the output. Should the AC input breaker feeding power to the UPS trip, it shall allow the UPS to go to inverter mode to power the intersection off of batteries. Should an overload condition still exist when the inverter is energized, the inverter will revert to its internal electronic protection, preventing damage to the inverter due to the overload or short circuit condition on the output. Once this overload condition is cleared the inverter will energize and power the intersection utilizing the available battery power. If the condition does not clear itself, the inverter will stay in the standby mode until manually cleared by a technician. An AC output breaker that would prevent the inverter from powering the load from batteries when tripped shall not be utilized.

9.3 Accessibility

All components, terminations, terminal blocks, relays, etc. shall be fully accessible.