**Purchase Specification**

**for a**

**Solar Cabinet-Based School Zone Flasher (SZF)**

1. **Overview**

Each SZF shall consist of a cabinet-based solar engine. The industry-standard cabinet will house the charge controller, flash controller, on-board user interface, optional wireless communications, optional third-party time switch, and battery. The SZF shall be compatible with a manufacturer-approved time switch and cellular-enabled time switch. The solar panel will be mounted separately from the cabinet and shall be available in top-of-pole and side-of-pole options. Each SZF shall include one, two, three or four 8” or 12” LED modules and signal housings. The SZF shall conform to all applicable provisions of the MUTCD Chapter 4L, including flash pattern, and shall have the capability of meeting ITE intensity requirements for vehicle traffic signals. The SZF shall be pre-wired to the maximum extent possible. The manufacturer shall also offer a smaller self-contained solar version of SZF that is fully compatible.

1. **Mechanical Specifications**

The control cabinet shall be constructed from aluminum with a lockable industry standard #2 lock and tamper-proof hinged door. The battery shall be mounted inside the cabinet with no external control cabinet or battery cabinet required. The control cabinet shall be vented to provide air circulation and cooling of the battery and electronic system. The vents shall be screened to prevent ingress by insects and debris. Interior space and mounting methods shall be provided for third-party time switches such as RTC and Applied Information.

The overall weight of the control cabinet shall not exceed 90lbs (41 kg) with the battery installed and shall have the approximate dimensions: 24” H x 16” W x 8” D (61cm H x 41cm W x 21 cm D).

For top of pole mounting, the solar panel shall be supplied with a fixed tilt angle of 45 degrees and shall be able to be oriented toward the equator with no additional mounting hardware.

For side of pole mounting, the solar panel shall be supplied with an adjustable tilt angle and shall be able to be oriented toward the equator with no additional mounting hardware. Solar simulations for side-of-pole solar panel mounting shall assume 45-degree angle.

Fasteners shall be stainless steel.

1. **Fixtures**

**3.1 Circular Beacons**

The LED beacons shall conform to the mandatory specifications chromaticity and beam shape of: ITE Vehicle Traffic Control Signal Heads, Light Emitting Diode (LED) Circular Signal Supplement as required by the Manual of Uniform Traffic Control Devices 2009 with May 2012 Revisions 1 and 2.

The SZF shall be capable of driving beacons at ITE-compliant intensities if solar conditions and programming configuration permit it.

The beacons shall be current-driven LED strings without active electronics. The LEDs shall be driven by pulse-width modulated fixed current.

The SZF shall support one, two, three, or four LED beacons. The SZF shall support 12” (305mm) and 8” (203mm) LED signal modules. The LED signal modules must be yellow.

The LED beacon optics shall be premium, UV-resistant polycarbonate.

LED Beacon wiring harnesses shall be included.

**3.2 LED Enhanced Signs**

The SZF shall be able to optionally operate flashing LEDs in the border of a sign.

1. **Signal Housing**

The signal housing shall meet the equipment standard of the Institute of Transportation Engineers (ITE) Vehicle Traffic Control Signal Heads (VTCSH) Chapter 2.

The signal head’s bracket assembly shall be constructed such that the signal head can be removed easily in the field.

The signal housing must be able to rotate independent from the solar engine or bracket for lens alignment.

The signal housing shall be constructed from a choice of UV-resistant polycarbonate or aluminum. The signal housing shall be available in yellow, green or black.

The beacon(s) shall also be capable of being mounted to a post or pole using a separate bracket assembly to facilitate mounting multiple beacons in either vertical, horizontal, or back-to-back (bi-directional) arrangements.

The signal housing shall open for access to the wiring connections for the LED beacons. The signal housing shall be rated to NEMA 3R.

1. **Mounting**

Mounting adapter hardware for the SZF cabinet shall be available for 4” – 4.5” round poles or square posts. The solar panel shall be available in the following configurations:

4.5” Diameter Round Top-of-Pole Mount

4.5” Diameter Round Top-of-Pole Heavy Duty Mount

4” – 4.5” Side-of-Pole Mount

Side-of-Pole mounting shall offer banding as standard with an option for Z-bar and U-bolts. The signal housing shall be able to mount directly to the above supports using C-brackets. Signal housing shall be able to mount in a single or dual (vertical, horizontal or back-to-back) configuration. LED-enhanced signs shall be able to mount in a single or back-to-back (bi-directional) configuration.

Mounting configurations shall not require specialized tools.

1. **Configuration**

The SZF cabinet shall house an auto-scrolling LED on-board user interface that provides on-site configuration adjustment, system status and fault notification, built-in system test, and programming of optional internal calendar settings. The SZF shall have an optional USB interface for programming the internal calendar, and an optional pole-mounted programming junction box for housing the USB interface.

The user interface shall provide a display of four (4) alphanumeric characters and three (3) control buttons to navigate and change settings and activate functions.

When editing the configuration, the user interface will flash the display indicating it is ready to accept editing and will flash the display rapidly 3 times to indicate the setting change has been accepted.

The SZF shall be provided with an optional built-in internal calendar function that allows users to program multiple on/off sequences every day for at least one calendar year. The calendar shall be programmed via USB connection made available to users within the solar engine. An optional external weather-proof box and harnessing shall be made available for programming of the SZF from the base of the mounting structure.

The beacons will flash when activated either by an optional internal calendar within the controller or by contact closure provided by a third-party device. Flashing will continue until either the internal calendar discontinues it or contact closure from a third-party device is removed. Contact closure control by third-party devices shall be offered as “Normally Open” or “Normally Closed”.

The SZF shall provide configurable nighttime intensity settings ranging from 10% to 100% of daytime intensity.

The SZF shall be capable of enabling or disabling ambient brightness auto-adjustment. This feature allows the system to provide optimal output brightness in relation to ambient light levels. If enabled, the ambient brightness auto-adjustment shall adjust output to a range between 50% and 100% of daytime intensity.

The User Interface shall provide viewing and/or programming access for the following:

* Digital output that is active during the flashing cycle that allows the notification or control of external devices such as overhead illumination. Digital output shall be configurable for night operation only or operation day or night
* 6 Flash Patterns
* Radio Channel (Choice of 1 to 14) if equipped
* Radio Status if equipped
* Calendar On/Off Control
* Calendar Master/Slave control of calendar broadcast via radio if equipped
* Night Intensity Setting
* Adjustment for Ambient Daytime Brightness
* Intensity (20 mA to 1400 mA)
* Self-Test / BIST (Built-In Self-Test) including the detection of shorts or open circuits in the fixture outputs
* Battery Status – General description and actual battery voltage
* Day or Night Status (as determined by dedicated photosensor not solar panel output)
* Solar Panel Voltage
* Automatic Light Control. If this safety feature is enabled, it allows the SZF to temporarily reduce the intensity of the beacons to maintain energy equilibrium. The user interface shall report the amount of dimming being applied in the range of 10% to 100%
* Firmware Version number

On/off activation, night intensity setting and adjustment for ambient daytime brightness shall be automatically broadcast to all radio-equipped SZFs in the system when changed in one radio-equipped SZF.

1. **Solar Panel System**

The SZF shall be offered with one 20-watt, 50-watt, or 80-watt 18-volt solar panel supplied with mounting hardware and bypass diode. Nominal voltage of the SZF shall be 12 volts.

Electrical connections on the back of the solar panel shall be contained within an enclosure that prevents accidental contact with either of the power leads.

The solar charging system shall use maximum power point tracking (MPPT).

1. **Battery System**

The control cabinet shall house one 33 Ah, 75 Ah or 100 Ah sealed 12-Volt valve-regulated AGM lead-acid maintenance-free battery. The battery shall be equipped with a fast-acting 7-Amp cartridge fuse on the positive lead.

The battery charging system shall be 3-stage and incorporate temperature-compensation to prevent battery overcharging in hot weather.

The battery, in conjunction with recommended SZF performance, shall be designed for a demonstrable service life of 5 years.

The operating temperature range of the battery shall be -40 to 161˚ F (-40 to 72˚ C)

Batteries shall have quick connections to facilitate installation and be readily available from multiple suppliers and non-proprietary.

Batteries shall be supported from the sides by rubber bumpers and shall be secured in place with straps.

1. **Operational Specifications**

The SZF shall conform to all applicable provisions of the MUTCD and shall provide configurable intensity settings up to and including the ITE VTCSH LED circular signal supplement requirement.

The SZF shall offer an MUTCD-compliant flash pattern and activation including alternate, unison and quick-flash

The SZF shall conform to the provisions of the MUTCD 2009 Edition Chapter 4L. Flashing Beacons standard of a flash rate of not less than 50 or more than 60 times per minute, where the illuminated period of each flash shall be a minimum of 1/2 and a maximum of 2/3 of the total cycle.

The SZF shall use a dedicated light sensor to detect night and day states and apply any optionally-enabled intensity adjustments.

The SZF, including the approved third-party time switch, shall have the capacity to operate at an agency-specified number of hours per day, and a specified number of days per week using the available solar radiation at the installation location.

The controller shall be able to support up to 1.4 amps combined current through the SZF fixtures simultaneously.

1. **Radio System**

The SZF shall have an optional 2.4GHz radio that allows one “Master” SZF equipped with internal or external calendar system to remotely command multiple “Slave” SZFs within range to turn ON or OFF in synchrony with the Master SZF.

The SZF shall have the capability to activate other SZFs by wireless communications within 1,000 feet (304 meters).

The SZF shall have a minimum of 14 unique channels that can be configured on-site to avoid inadvertent activation of nearby SZFs.

The antenna shall be a low-profile “button” shape that cannot be bent or broken by vandals

All SZFs in the system shall initiate activation simultaneously within 150ms of activation.

1. **Activations**

The SZF shall be activated by one of the following four methods:

1. A manufacturer-approved third-party time switch with or without remote monitoring and/or remote control
2. The internal calendar function of the EMS
3. Optional override switch
4. Wireless activation from a Master R829-G operating with calendar control

All SZFs in a wireless system shall initiate activation simultaneously within 150ms of activation.

1. **Solar Simulations**

Detailed solar simulations shall be provided as evidence that the SZF is capable of the claimed performance at a specific location. Solar Simulations shall be composed of three calculations: Energy Balance, Array-to-Load Ratio (ALR), and Autonomy. The manufacturer or bidder shall provide a detailed analysis of these three calculations in an “Energy Balance Report”.

Monthly average sunlight (insolation), night length and temperature data for a specific, declared location shall be from recognized public sources such as the NASA Atmospheric Sciences Data Center. All sources shall be cited exactly and accessible online without cost to allow verification of the data.

**Energy Balance**

During a normal 24-hour cycle of operation, a SZF will take energy in from the sun and consume energy through the flashing of the beacons, radio communication (if equipped), and general quiescent power draw. Energy Balance refers to the evaluation of these energy values to determine overall system sustainability and resistance to variances in sunlight and activation load.

Energy Balance compares Energy-In and Energy-Out. Calculations shall be performed for the “Worst Month” of the year where worst month is determined by the lowest value of Energy-In divided by Energy-Out.

**Energy-In**

Energy-In is the total amount of sunlight energy in watt-hours *available* to the SZF over a 24-hour period. Energy-In is available to operate the SZF, charge the battery, or both. Energy-In shall be determined as follows:

Insolation X Panel Wattage X Shading X charging efficiency X Battery charge acceptance

* The energy from the solar panel shall be based on available solar radiation at the installation location for the panel’s inclination angle. The solar radiation (insolation) values used shall be for the worst-case month of the calendar year.
* Shading from nearby trees, buildings or other structures unique to a particular location are to be factored-in and the calculations shall clearly show and justify the de-rating of the solar panel energy input. A photograph showing the sun’s path and obstructions it encounters shall be included.
* Batteries shall be returned to full charge by sunset at the end of each day.

**Energy-Out**

Energy-Out is the total amount of energy in watt-hours consumed by the SZF in a 24-hour period of normal operation.

Energy-Out is the sum of quiescent and operating loads, measured in watt-hours, in all circuitry over 24 hours with an operating capacity of 600 20-second activations, including:

* Controller quiescent draw (daytime and between flashes)
* Wireless quiescent draw (if equipped) calculated over 24 hours;
* Operating load of LED beacons including pedestrian indicators at rated intensity per activation. The number of LED beacons and their electrical load details (voltage, current and power when lit) shall be clearly indicated;
* Energy adjustments due to LED drive circuit efficiency.
* The simulations shall clearly detail the flash pattern being used and calculate the duty cycle of the pattern.
* Calculations shall assume the 90% of flashing occurs during daytime.

**ALR (Array-to-Load Ratio)**

System Array-to-Load (ALR) ratio shall be calculated as: Daily Available Energy-In divided by Daily Energy-Out as defined above.

SZF Solar Simulations shall be calculated demonstrating a minimum Array-to-Load (ALR) ratio of 1.2:1 (1.2)

**Autonomy**

Autonomy is the number of days that the SZF can continue to operate normally in the absence of any solar charging. Autonomy shall be calculated as follows:

(Nominal Battery Capacity de-rated for Temperature minus battery capacity unavailable due to Low Voltage Disconnect) divided by (Daily total energy consumption for the specified total hours of operation)

SZF autonomy shall be a minimum of 5 days.

1. **Environmental Testing**

The SZF cabinet and beacons shall be rated to a minimum of NEMA 3R.

1. **Packaging**

Packaging shall consist of only recyclable corrugated cardboard and soft plastic bags.

1. **Qualifications**

The SZF shall be FCC certified to comply with all 47 CFR FCC Part 15 Subpart B Emission requirements.

The SZF shall be manufactured in the USA and shall be Buy American compliant.

Manufacturer shall provide a 5-Year Limited Warranty.

The Manufacturer shall be ISO 9001 certified.

Manufacturer: Carmanah Technologies Inc.

Model: R829-G\_Solar Solar School Zone Flashing Beacon

Toll-Free: 1-877-722-8877

www.carmanah.com