

**TEXAS DEPARTMENT OF TRANSPORTATION
TO-4051
SOLAR-POWERED (PHOTOVOLTAIC) FLASHER ASSEMBLY**

1.0 SCOPE

The purpose of this specification is to describe the minimum acceptable requirements for a solar/battery-powered school zone/24 hour Advance Warning flasher assembly. The assembly shall be complete and include all components necessary for installation (except poles, clocks and signs). The beacons shall be twelve-inch (12") LED, color as indicated in the invitation for bids.

2.0 SOLAR GENERATOR

2.1 The system solar generator shall be sized according to Figure 1 below. The system average state of charge shall be ninety percent (90%) or greater throughout the entire year. The system loss of load probability shall remain zero percent (0%) throughout the entire year. The system shall be designed and made available in two (2) different configurations:

- 1) school zone/ 24 hour advance warning assembly with two (2) red 12" LED beacons
- 2) school zone/ 24 hour advance warning assembly with two (2) yellow 12" LED beacons

The configuration shall be specific in the invitation to bid. A system sizing report shall be provided detailing the photovoltaic array, battery bank, array to load ratio analysis, system availability analysis, battery state of charge report, battery depth of discharge (DOD) and monthly insolation information for that specified region.

Minimum Panel Sizing

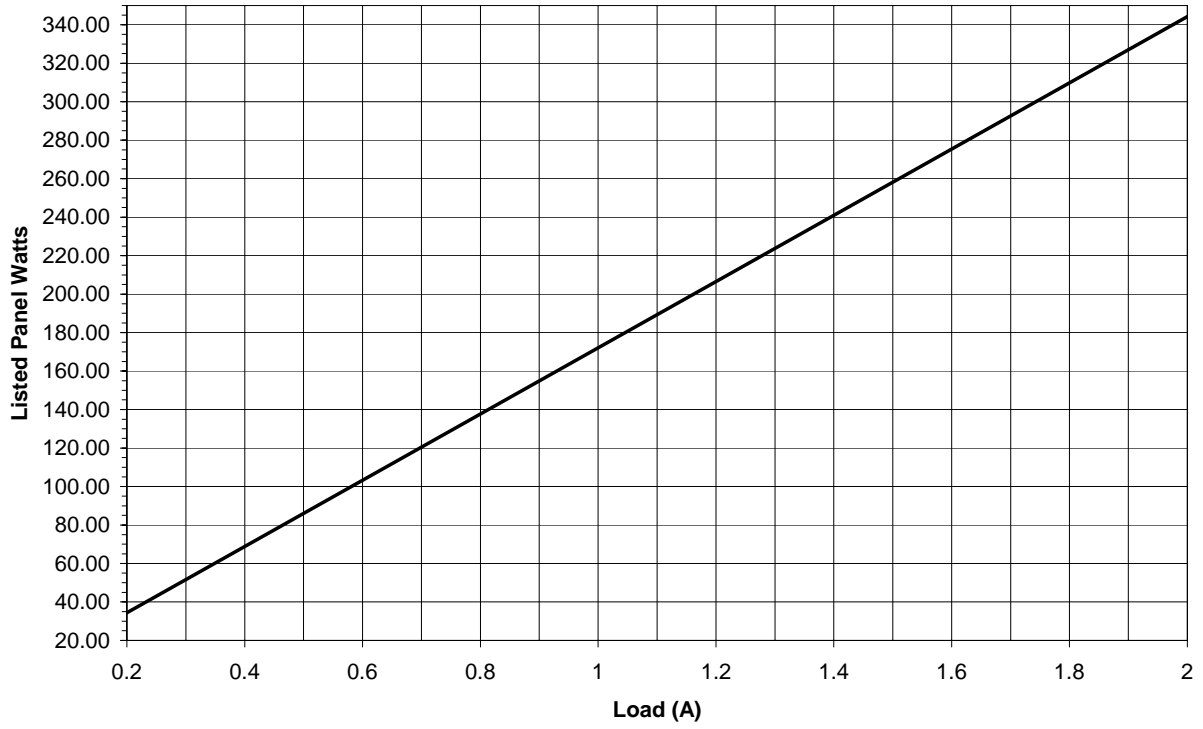


Figure 1 Panel Sizing Chart

- 2.2 The photovoltaic module shall be sized according to Figure 1. The panel size shall be rounded up to the nearest commonly available size. The photovoltaic module shall provide 12 VDC and be capable of recharging the system to full capacity, after 6 hours of continuous operation, in three (3) hours +/- .5 hours during optimum sun conditions. The solar modules shall be industrial grade, polycrystalline type with a minimum twelve year warranty. Modules deemed to be of consumer grade will not be acceptable. Solar modules must have a power output rating of +/- 5% or better. Electrical termination will take place in a single, conduit capable, junction box. Solar modules should be available to TxDOT in a graduated product line from 40 to 120 watts per module. Each solar module, regardless of wattage size, shall share common mounting holes for mounting such that a single mounting structure will accommodate the entire module line. Each solar module will incorporate six inch square polycrystalline cells and have at least two bypass diodes installed at the factory. Module construction will utilize low iron tempered glass surface with an industrial grade anodized aluminum frame that completely surrounds and seals the module laminate. Construction should be consistent with the demands of installation near humid salt air environments. The mounting bracket shall have no less than (4) - .750 inch stainless steel bolts, lock washers, and hex head nuts to secure the PV module to the frame. An ultra violet (UV) resistant, weatherproof junction box providing wire termination for up to #8 AWG wiring shall be provided with the PV module.
- 2.3 The photovoltaic module mounting assembly shall be constructed of galvanized steel (ASTM A-153 Class A) or aluminum, of adequate design and strength to provide a means of securely attaching the PV module frame to a pole at a permanent angle of 45 degrees. The pole mounting hardware shall accommodate poles ranging from a minimum 4 1/2" O.D. steel pole to a wood pole. The bracket shall be capable of 360 degree horizontal orientation with a means of locking the bracket at an inscribed angular position about the pole.
- 2.4 The photovoltaic harness shall not exceed 1% total voltage drop between the solar module and the charge control circuit.

3.0 CONTROL CABINET

- 3.1 The control cabinet shall be manufactured of sheet aluminum with a minimum thickness of 0.125 inches, or cast aluminum alloy. The cabinet shall be sized to provide adequate space for the control electronics and desired number of batteries. The cabinets shall have louvers for ventilation and to prevent the accumulation of gasses. There shall also be rubber mats installed on the bottom of the cabinets and two 1/8" drain holes located in the bottom at opposite corners.

- 3.2 The door and its opening shall encompass and constitute the entire area of the face of the cabinet. It shall be hinged via a continuous hinge which shall be riveted to the door and to the cabinet. The door shall be tightly secured via a latching device which pulls the door snugly against a neoprene gasket affixed to the cabinet body forming a weather-tight seal. The latching device shall be equipped with a standard police door locking device.
- 3.3 The cabinet shall be equipped with the necessary hardware to provide rigid top and bottom mountings to a pole with band on post hubs, or 4-1/2" O.D. pole clamps as specified in the invitation for bids.

4.0 CONTROL COMPONENTS

- 4.1 The back panel shall be mounted to the inside of the cabinet. All electronic components within the cabinet shall be mounted to the back panel. The electronic components shall be easily installed or removed with simple hand tools. Located on the back panel shall be a eight position 8-32 x 5/16" binder head screws design terminal strip, with shorting bars Available on the terminal strip will be the following functions:
1. Solar Panel +
 2. Solar Panel - / Battery -
 3. Battery +
 4. Switch Common
 5. Switch N/O
 6. Output Circuit 1
 7. Output Circuit 2
 8. Output Common
- 4.2 The controller shall have an on-board, solid state, charge control circuit to insure proper charging on the system battery bank. The charging circuit shall incorporate a blocking diode for reverse current protection. The charge control circuit shall incorporate thermal compensation to adjust the battery charge rate to variances in temperature with an adjustable voltage swing above and below the ambient set point as defined by the battery manufacturer. The battery float voltage calibration shall be at a voltage defined by the battery manufacturer at 25° C ambient temperatures. A LED/LCD shall be provided to indicate solar panel charging.

- 4.3 The controller shall contain a low voltage disconnect (LVD) circuit. This circuit shall disconnect the battery bank when the battery voltage reaches a voltage that is deemed critical by the manufacturer of the battery. The LVD shall be user adjustable. An LED shall be provided and illuminated when the LVD circuit is active.
- 4.4 The controller shall incorporate automatic night dimming. The night dim level shall be calibrated to reduce the power of the LED lamp by a maximum of 75% where ambient light levels are 5-foot candles or less.
- 4.5 The unit shall be supplied with a color coded harness and a complete wiring diagram. Wires shall be a minimum 16 gauge stranded. Termination of the harness wiring to components mounted to pedestal poles, photovoltaic module, and signal beacons shall be accomplished via connectors. Female connectors shall be terminated for ease of installation and male connectors are to be supplied with each harness. Battery terminals shall be 3/8 inch diameter round crimp terminals. Flasher termination shall be spade terminals. Regulator/charger terminations shall be spade terminals. The harness shall be installed in the controller cabinet using chassis tie downs and riveted to the harness bracket. The harness shall have spiral tubing to protect wires from the control cabinet to the door. **The total voltage drop of any branch of the harness shall be no greater than 1%.**
- 4.5 The flashing operation of the unit shall be initiated and terminated by toggle switch.

The flasher shall be:

1. 12 volts DC
2. Solid-state with no relays or electro-mechanical devices.
3. 2-circuit with 50% duty cycle (per circuit) and shall provide 55 flashes per minute (+/- 5 flashes per minute) to each circuit in accordance with M.U.T.C.D. standards.
4. Constructed so that each component may be readily replaced if needed.

5.0 SIGNAL BEACONS

- 5.1 The school zone/24 hour Advance Warning flasher assembly shall operate with two (2) twelve inch (12") LED signal beacons. The signal beacons (signal heads and LED lenses) and mounting hardware shall be supplied as part of the bid. The color of the indications shall be specified on the invitation for bids.

- 5.2 The solid state amber or red 12" LED signal lamp shall be easily retrofitted into standard polycarbonate signal closures using the existing lens gasket. The supplied LED lamp shall incorporate the use of AllnGap technology LED's. The LED's used shall be of uniform frequency and conform to the chromaticity limits outlined in I.T.E. Standards for Vehicle Traffic Control Signal Heads (Section 8.04 **ITE 98 Interim Specification, Limits of Chromaticity Coordinates**). The power rating of any lamp shall not exceed **15 watts** maximum. The lamp lens shall be either a clear or tinted UV stabilized acrylic which shall be easily removed and replaced. The lamp shall have a TOP mount position which is clearly identified. The lamp shall be self regulating with input voltages of 10.5 to 35 VDC. The lamps shall have a 24" minimum DC color coded wiring harness (Red for positive and Black for negative). The wiring harness shall have strain relief at the lamp housing. All LED lamps must be pre-qualified by TxDOT prior to bid.
- 5.3 The supplied signal beacons shall result in an optical system which conforms to I.T.E. Standards for flashing beacons (Section 4-E-5, General Design and Operations of Beacons of the I.T.E. Standards) and to the Texas M.U.T.C.D. for all operating voltages above the manufacturers designed cut off voltage.

6.0 **BATTERY**

The batteries shall be group 27 AGM batteries specified in the system sizing report. The valve regulated, AGM-electrolyte batteries must be rated for a minimum of 2000 cycles with ten percent (10%) capacity withdraw. The batteries shall be 12-volt D.C. nominal. The plate alloy shall consist of lead calcium. The element post shall be a T881 type terminal designed for 1/4" bolt termination. The container/cover shall be polypropylene. The AGM electrolyte shall contain sulfuric acid, fumed silica, pure demineralized and deionized water, and a phosphoric acid additive. The AGM battery shall be spill proof and should have the ability to be installed in any position. The batteries shall be sized to allow twelve (12) days autonomy at 25 ° F (-4° C). **Depth of Discharge (DOD) for the system shall not exceed 80%.**

7.0 **WARRANTY**

Photovoltaic modules shall have a limited warranty for a minimum period of 12 years. **The LED lamp shall warranted for a period of 5 years. The batteries shall have a 5 year warranty.** The balance of the equipment described herein shall be warranted for 5 years.

8.0 TESTING

Solar-powered school zone/24 hour Advance Warning flasher assemblies shall meet or exceed all applicable Texas M.U.T.C.D. and/or I.T.E. Standards and these specifications. The Solar-powered school zone/24 hour Advance Warning flasher assemblies shall have an operating temperature range of -30° F to 165° F (-34° C to +74° C). In addition to testing of preshipment samples, complete testing of school zone/24 hour Advance Warning flasher assemblies may be required at any time prior to acceptance.

9.0 DOCUMENTATION REQUIREMENTS

Each solar-powered flasher assembly shall be provided with two each of the following documentation:

1. Complete accurate schematic diagrams.
2. Complete parts list including names of vendors for parts not identified by universal part numbers.
3. Full report on system analysis, to include all manufacturers supporting documentation.
4. Complete user's manual for the system.