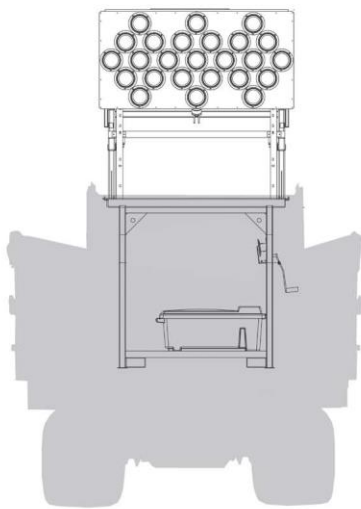


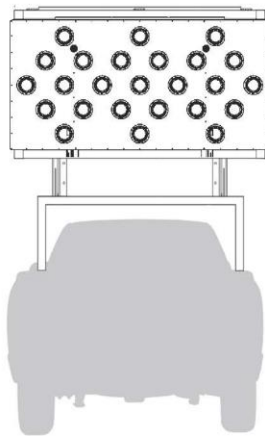
Silent Sentinel

Solar Powered Advanced Warning
Vehicle Mounted

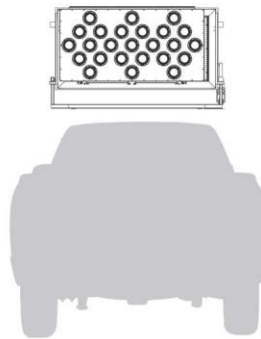
Arrow Panels Procurement Specifications



SKID MOUNT



BED RAIL MOUNT



ROOF MOUNT



As Reliable as the Sun

7620 Cetronia Road, Allentown, PA 18106 n Phone 610-391-8600

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This document presents a detailed specification for vehicle-mounted Type-B and Type-C Advance Warning (Flashing) Arrow Panels. This specification typically requires additions and/or modifications to meet a user's specific requirements.

This specification is subject to periodic revisions as required without notice.

Thirteenth Edition: 01 September 2022

General email: info@solartechnology.com
Technical Support email: techsupport@solartechnology.com
Web site: www.solartechnology.com

1. General

1.1 Product Description

The **SILENT SENTINEL Vehicle Mount Flashing Arrow Panel** is an advance warning (flashing) arrow panel designed for temporary and/or mobile applications. A variety of panel sizes and mounting configurations are available to accommodate different types of common trucks and trailers.

The **SILENT SENTINEL** consists of an arrow display panel, an electronic control console and necessary wiring and cables. Various options and upgrades are available (such as local or wireless control, cabling kits, auxiliary battery packs, solar arrays and panel lifting mechanisms) to suit various applications.

1.2 Design Objectives

- 1.2.1 Maximize reliability by using generally accepted design techniques for outdoor-use electrical and electronic equipment.
- 1.2.2 Minimize operating cost by using a renewable energy source, requiring minimal maintenance.
- 1.2.3 Maximize safety and effectiveness by using a high contrast arrow display panel with long-life expectancy, high-reliability LED lamp technology.
- 1.2.4 Meet or exceed the standards for Arrow Boards as listed in the U.S. Federal Highway Administration (FHWA) Manual on Uniform Traffic Control Devices (MUTCD).

1.3 Performance Objectives

- 1.3.1 Visibility greater than 1 mile.
- 1.3.2 Legibility at 1 mile.
- 1.3.3 Minimal glare from sunlight and headlights.
- 1.3.4 Continuous, uninterrupted operation on vehicle-provided power and/or solar power (if so equipped).
- 1.3.5 One (1) month minimum, three (3) month typical maintenance interval.

1.4 Quality Assurance Objectives

- 1.4.1 All manufacturing shall be carried out in a facility with a completely implemented and properly maintained ISO 9001:2015 certified quality management system.
- 1.4.2 All units shall be tested to ensure that they are neither susceptible to nor produce any electromagnetic interference.

2. Physical

2.1 Environmental

2.1.1 Temperature, operating and storage: -40 to +185F (-40 to +85C)

2.1.2 Relative Humidity: 20% to 98%, non-condensing

2.1.3 Wind

2.1.3.1 Transport position, maximum travel speed - 70 MPH (112 KPH)

2.1.3.2 Operating position, maximum travel speed - 35 MPH (56 KPH)

2.1.4 Electrical Interference - Unaffected by RFI (Radio Frequency Interference) and EMI (Electromagnetic Interference).

3. Vehicle Mounts and Bases

3.1 General Frame Construction

- 3.1.1 All frames shall be designed such that the arrow panel and any optional equipment mounted directly to the frames facilitate quick, easy installation and removal from vehicle.
- 3.1.2 All frames shall be completely assembled with removable fasteners to accommodate quick, easy maintenance and repair.
- 3.1.3 All fasteners shall be rust resistant and equipped with all metal (stover) or nylon-stop lock nuts to prevent loosening of fasteners during normal transportation and operation.
- 3.1.4 Surface Preparation and Finishing
 - 3.1.4.1 Frame structure shall be completely cleaned and deburred prior to finishing. All metal surfaces shall be prepared for finishing using an iron phosphate wash-down process.
 - 3.1.4.2 A polyamide epoxy primer shall be applied to a dry film thickness of 1.5 mils.
 - 3.1.4.3 A matte black aliphatic acrylic urethane finish shall be applied to a dry film thickness of 1.25 mils.

3.2 Vehicle Mount Options

3.2.1 Fixed (Universal) Mount

3.2.1.1 Dimensions

- 3.2.1.1.1 Overall Length (Fixed Mount with Arrow Panel) – 10.5 in (27 cm)
- 3.2.1.1.2 Overall Width (Fixed Mount Frame) – 50 in (127 cm)
- 3.2.1.1.3 Total Weight (Fixed Mount with Arrow Panel)
 - Size B (30" x 60") Arrow Panel – 60 lbs (27 kg)
 - Size B (36" x 72") Arrow Panel – 78 lbs (35 kg)
 - Size C Arrow Panel – 105 lbs (48 kg)

3.2.1.2 Construction or Operation

- 3.2.1.2.1 Arrow panel mounting/support arms shall be constructed from 2 x 2 x 1/8 inch HRS angle.
- 3.2.1.2.2 Fixed mount frame shall have multiple 13/32" diameter mounting holes spaced 6 inches apart to allow for selection and adjustment of the arrow panel mounting height. Fixed mount frame shall be attached to vehicle with a minimum of four (4) 3/8 inch Grade 5 bolts and nuts.
- 3.2.1.2.3 Arrow Panel mounts flush to vehicle and does not fold.

3.2.2 Pivot Mount

3.2.2.1 Dimensions

3.2.2.1.1 Overall Height (Pivot Mount Frame)

Raised Position – 60 in (152 cm)

Lowered Position – 30 in (76 cm)

3.2.2.1.2 Overall Length (Pivot Mount Frame)

Raised Position – 33 in. (84 cm)

Lowered Position – 58.5 in. (149 cm)

3.2.2.1.3 Overall Width (Pivot Mount Frame) – 54 in (137 cm)

3.2.2.1.4 Total Weight (Pivot Mount with Arrow Panel)

Size B (30"x60") Arrow Panel – 220 lbs (100 kg)

Size B (36"x72") Arrow Panel – 257 lbs (117 kg)

Size C Arrow Panel – 260 lbs (118 kg)

3.2.2.2 Construction and Operation

3.2.2.2.1 Arrow panel mounting/support arms shall be constructed from 2 x 2 x 1\4-inch HRS angle.

3.2.2.2.2 Pivot mount frame shall be constructed from a combination of welded 7 Gauge (3/16-inch) and 1/4 inch CNC formed steel plate, 2 x 4 x 1/8 inch structural steel tubing, 2 x 2 x 3/16 inch and 2 x 2 x 1/8 inch structural steel tubing and 2 1/2 x 2 1/2 x 3/16 inch HRS angle as appropriate for the desired installation.

3.2.2.2.3 Pivot mount frame shall have four (4) 17/32" diameter mounting holes for attaching the mount frame to the arrow panel.

3.2.2.2.4 Pivot mount shall be attached to base frame (Skid or Bedrail) with a minimum of four (4) 1\2-inch Grade 5 bolts.

3.2.2.2.5 Pivoting mount support frame shall accommodate the addition of an integrated support frame for mounting the optional solar array. The solar array shall be positioned to accommodate charging in both the operating and transport positions.

3.2.2.2.6 Pivoting mount support shall be designed with either a manually-operated automatic-brake winch and cable mechanism (skid mount option only) or a 12Vdc motor-operated remotely-controlled linear actuator for raising & lowering the sign panel (and solar array, if so equipped) from the transport position into the operating position.

3.2.2.2.7 Arrow panel shall be secured in the operating (raised) position by two (2) stainless steel, spring-loaded, locking pins.

3.2.3 **Over-The-Cab (Roof) Mount** (Available for Type B 30"x 60" Arrow Panels Only)

3.2.3.1 Dimensions

3.2.3.1.1 Overall Height (Over-the-Cab Frame)

Raised Position – 38.5 in (97 cm)

Lowered Position – 13.5 in (34 cm)

3.2.3.1.2 Overall Length (Over-the-Cab Frame)

Raised Position – 34 in (86 cm)

Lowered Position – 34 in (86 cm)

3.2.3.1.3 Overall Width (Over-the-Cab Frame) – 67 in (170 cm)

3.2.3.1.4 Total Weight (Over-the-Cab Frame with Arrow Panel) – 115 lbs (52 kg)

3.2.3.2 Construction and Operation

3.2.3.2.1 Over-the-Cab mount base frame shall be constructed from a combination of 1½"x 1"x 14 Gauge steel tubing, 3/16 inch CNC formed steel plate and 1/4 inch CNC formed steel plate.

3.2.3.2.2 Over-the-Cab mount arrow panel frame shall be constructed from a combination of 2 x 2 x 1/8 inch HRS angle, 1½"x 1"x 14 Gauge structural steel tubing, 3/16 inch CNC formed steel plate, and 7/8 inch OD x 0.182 inch W DOM steel tubing.

3.2.3.2.3 Over-the-Cab mount arrow panel frame pivot points shall be reinforced with welded 3/16 inch CNC formed steel plate

3.2.3.2.4 Over-the-Cab mount frame shall be bolted to the arrow panel with a minimum of four (4) 3/8 inch Grade 5 bolts.

3.2.3.2.5 Over-the-Cab mount panel frame shall have eight (8) 7/16 inch diameter mounting holes to attach mount to vehicle.

3.2.3.2.6 Arrow panel folds compactly into a transport/stowage position. The Over-the -Cab mount is designed with a 12VDC motor-operated remotely-controlled linear actuator for raising & lowering the sign panel from the transport position into the operating position.

3.2.4 **Center Pivot Mount**

3.2.4.1 Dimensions

3.2.4.1.1 Overall Height (Center Pivot Mount with Arrow Panel)

All Arrow Panels, Lowered Position – 37 in (94 cm)

Type B (30" x 60"), Raised Position – 47.5 in (121 cm)

Type B (36" x 72"), Raised Position – 50.5 in (128 cm)

Type C, Raised Position – 56 in (142 cm)

3.2.4.1.2 Overall Length (Center Pivot Mount Frame with Arrow Panel)

- | | |
|--------------------------------------|------------------|
| All Arrow Panels, Raised Position | – 11 in (28 cm) |
| Type B (30" x 60") Lowered Position | – 30 in (76 cm) |
| Type B (36" x 72"), Lowered Position | – 36 in (91 cm) |
| Type C, Lowered Position | – 48 in (121 cm) |
- 3.2.4.1.3 Overall Width (Center Pivot Mount Frame with Arrow Panel)
- | | |
|--------------------------------|-------------------|
| Type B (30" x 60") Arrow Panel | – 71 in (108 cm) |
| Type B (36" x 72") Arrow Panel | – 83 in (211 cm) |
| Type C Arrow Panel | – 108 in (274 cm) |
- 3.2.4.1.4 Total Weight (Center Pivot Mount Frame with Arrow Panel)
- | | |
|--------------------------------|--------------------|
| Type B (30" x 60") Arrow Panel | – 192 lbs (87 kg) |
| Type B (36" x 72") Arrow Panel | – 219 lbs (99 kg) |
| Type C Arrow Panel | – 277 lbs (126 kg) |
- 3.2.4.2 Construction and Operation
- 3.2.4.2.1 Center pivot mount base frame shall be constructed from a combination of 2 x 2 x 3/16 inch steel tubing, 2½ x 2½ x 3/16 inch steel tubing, 1/4 inch CNC formed steel plate, 2 x 2 x 1/8 inch HRS angle, and 1½ inch OD x 1/4 inch W steel tubing.
- 3.2.4.2.2 Center pivot mount panel frame shall be constructed from a combination of 1 x 1/8 inch square steel tubing, 2 x 2 x 1/4 inch HRS angle, 3/8 inch CNC formed steel plate, and 1/4 inch CNC formed steel plate.
- 3.2.4.2.3 Center pivot mount shall be designed to allow the arrow panel to pivot at its center on a crossbar.
- 3.2.4.2.4 Center pivot mount shall be designed to rotate the arrow panel into the operating (raised) and transport (lowered) positions either by manual rotation and a stainless steel, spring-loaded locking pin or by a 12 VDC motor operated remotely controlled linear actuator.

3.3 Base Types

3.3.1 Skid

3.3.1.1 Dimensions

3.3.1.1.1 Overall Height

Skid Mount Base Frame:

Standard Frame (Large)	– 49 in (124.5 cm)
------------------------	--------------------

Low Profile Frame (Small)	– 18 in (46 cm)
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Arrow Panel, Pivot Mount, and Standard Skid Base:

Lowered Position	– 79.5 in (202 cm)
------------------	--------------------

Raised Position	– 109 in (278cm)
-----------------	------------------

Raised Position with Solar Array – 110.5 in (281 cm)

3.3.1.1.2 Overall Width (Skid Mount Base) – 48 in (122 cm)

3.3.1.1.3 Length Overall (Skid Mount Base) – 45 in (114 cm)

3.3.1.1.4 Total Weight (Arrow Panel, Pivot Mount, and Standard Skid Base)

Size B (30" x 60") Arrow Panel – 360 lbs (204 kg)

Size B (36" x 72") Arrow Panel – 412 lbs (187 kg)

Size C Arrow Panel – 415 lbs (188 kg)

NOTE: Solar Array adds 40 lbs (27 kg).

NOTE: Battery box with 2 Batteries adds 170 lbs. (77 kg).

3.3.1.2 Construction and Operation

3.3.1.2.1 Skid mount frame shall be constructed from a combination of 2 x 2 x 1/8 inch steel tubing, 2 x 2 x 1/8 inch HRS angle, 2 x 2 x 1/4 inch HRS angle, 6 x 3 inch rectangular steel tubing and 3/16 inch CNC formed steel plate.

3.3.1.2.2 Standard skid mount base frame shall be designed with four (4), one at each bottom corner of frame, 3 x 6 inch fork lift pockets.

3.3.1.2.3 Skid mount frame shall be attached to either Pivot mount or Over-the-Cab mount frame with a minimum of four (4) 1/2 inch Grade 5 bolts.

3.3.1.2.4 Skid mount frame shall be equipped with eight (8) 1¼ inch tie down points and/or foot pads with four (4) 1/2 inch mounting holes to facilitate securing the mount to vehicle.

3.3.1.2.5 Large skid-mount frame base shall accommodate the addition of enclosure for the optional battery power pack.

3.3.2 Bed Rail

3.3.2.1 Dimensions

3.3.2.1.1 Overall Height (Bed Rail Frame) – 33 in (84 cm)

3.3.2.1.2 Overall Length (Bed Rail Frame) – 46.5 in (118 cm)

3.3.2.1.3 Overall Width (Bed Rail Frame) – 61-79 in (155- 201 cm)

Bedrail base frame width is adjustable during installation to fit any pickup truck bed rail with width 55 to 72 inches

3.3.2.1.4 Total Weight

Arrow Panel, Pivot Mount, and Bed Rail Base

Size B (30" x 60") Arrow Panel – 410 lbs (186 kg)

Size B (36" x 72") Arrow Panel – 442 lbs (200 kg)

Size C Arrow Panel – 450 lbs (204 kg)

Arrow Panel, Over-the-Cab Mount, and Bed Rail Base

Size B (30" x 60") Arrow Panel**– 280 lbs (127 kg)****3.3.2.2 Construction and Operation**

- 3.3.2.2.1 Bed Rail frame shall be constructed from a combination of 2 x 2 x 1/8 inch steel tubing, 3 x 2 x 1/4 inch HRS angle, 3/16 inch CNC formed steel plate, 2 1/4 x 1/8 inch square steel tubing and 2 x 2 x 1/4 inch HRS angle.
- 3.3.2.2.2 Bed Rail frame shall be attached to either Pivot mount or Over-the-Cab mount frame with a minimum of four (4) 1/2 inch Grade 5 bolts.
- 3.3.2.2.3 Bed Rail mount base frame shall be designed with four (4) 1 3/4 x 3/16 inch steel reinforcement bars and eight (8) 1/2 inch mounting holes to facilitate securing then base of the frame to the vehicle.

3.4 Arrow Panel Lifting Mechanism**3.4.1 Manual Winch and Cable Mechanism – (Option for Pivot Mount with Skid Base only)**

- 3.4.1.1 Arrow panel lifting mechanism shall consist of a minimum 1,000-pound capacity, automatic brake type winch with 1/4-inch wire rope capable of holding the arrow panel in any position from full upright to the transport (down) position.

3.4.1.2 Winch shall be zinc-plated to minimize rust and corrosion.

3.4.1.3 Winch shall be designed such that the handle can be removed, for added security, without interfering with the operation of the automatic brake.

3.4.2 Remote-Controlled Motor-Operated Linear Actuator – (Option available for Pivot, Over-the-Cab and Center Pivot mounts)

3.4.2.1 Linear actuator shall be a sealed (weatherproof) lead-screw and ball bearing type drive system with integrated force limiting clutch mechanism to prevent mechanical damage to unit in event of mechanical failure/interference of pivoting mechanism.

3.4.2.2 Linear actuator shall provide a minimum operating force of 1,000 lb. (4,448 N) and a minimum holding force of 3,000 lb. (13,333 N).

3.4.2.3 Linear actuator shall be equipped with a bidirectional brake to hold the arrow panel in any position along with electronic end of stroke (Hall-Effect) limit switches to prevent over-travel in either direction.

3.4.2.4 Linear actuator shall operate from a nominal 12 Volt DC power source.

3.4.2.5 Linear actuator shall be capable of completely raising or lowering the sign panel in less than 25 seconds.

3.4.2.6 The linear actuator control unit shall be equipped with LED indication to denote when the sign panel is in the fully raised, intermediate and fully lowered positions.

4. Arrow Panels

4.1 Dimensions

4.1.1 Height and Width Overall:

Type B Panel – 30 in. height by 60 in. width (76 cm x 153 cm)

Type B Panel – 36 in. height by 72 in. width (92 cm x 184 cm)

Type C Panel – 48 in. height by 96 in. width (122 cm x 244 cm)

4.1.2 Depth Overall – 3 in. (7.6 cm)

4.2 Construction

4.2.1 Arrow panel frame, including internal braces, shall consist of 3 x 1 x 0.1 inch formed aluminum alloy channel, MIG welded at corners and at internal braces.

4.2.2 Front and rear surfaces shall consist of .063 inch aluminum alloy sheet with a baked matte black enamel finish.

4.2.3 Front and rear panels shall be attached to welded aluminum frame with 8-32 x 3/8-inch, black-finish, stainless steel, torx-head, thread-rolling screws located on 6-inch centers. In order to facilitate simple repair, rivets or any other form of non-removable fastener shall not be permitted.

4.2.4 Arrow panel shall be equipped with 2 1/2-inch diameter by 1-inch thick rubber bumpers to support panel when in the transport (down) position - as required per installation configuration.

4.2.5 Arrow panel shall be equipped with a light sensing device to monitor ambient light and provide information to the control module to regulate the intensity of the arrow panel lamps.

4.3 Lamps

4.3.1 Arrow panel shall be equipped with either 15 or 25 lamps, approximately 5 inches in diameter.

4.3.2 Arrow panel lamps shall consist of an array of at least 20 LEDs mounted in a weather resistant high impact polycarbonate housing.

4.3.3 The arrow panel lamp housing shall be sealed to protect the internal components from corrosion caused by harsh environmental conditions.

4.3.4 The outer surface of the lamp shall be convex (diverging) to minimize reflection of incident light and to maximize the contrast of the arrow panel display.

4.3.5 The lamps shall provide an Approximate Initial Maximum Beam Candlepower of 1,000 candela typical, 750 candela minimum, over an operating voltage range of 10.7 to 16 VDC.

4.3.6 The lamps shall produce a field spread (angularity) of 30 degrees horizontal by 6 degrees vertical.

4.3.7 The color of the light produced by the lamps shall be amber (approximate wavelength of

592 nanometers).

- 4.3.8 The lamps shall have a minimum life expectancy of 100,000 hours (200,000 hours typical).
- 4.3.9 The lamps shall be equipped with quick disconnect terminals to accommodate quick, easy replacement of lamps.
- 4.3.10 Arrow panel lamps shall be secured to the arrow panel by a black, molded, impact-resistant shroud, approximately five (5) inches in diameter and approximately four (4) inches high. Lamp shroud shall mount to panel with stainless steel screws through keyholes such that the shroud and lamp can be removed from the panel without the need to remove the screws from the panel.
- 4.3.11 Arrow panel lamps shall be keyed to the shroud and the shroud shall be keyed to the front panel so the lamps are secured to the front panel with proper lamp beam orientation.
- 4.3.12 The rear of the arrow panel shall be equipped with three (3) ultra-bright LEDs, in watertight housings, to indicate the arrow panel pattern currently being displayed. This provides a visual indication to individuals in the work zone that the arrow panel is functioning properly.

4.4 Connectors and Wiring

- 4.4.1 Arrow panel shall be equipped with a watertight connector, AMP CPC Series 2 Receptacle P/N 205843-1 with Peripheral Seal P/N 2267473-3, or equivalent, to permit arrow panel to be removed easily for repair. Arrow panel control cable connector shall be suitable for outdoor use and completely sealed against moisture. Arrow panel control cable connector shall be equipped with gold flashed pins to provide maximum electrical contact reliability.
- 4.4.2 All internal wiring pass throughs shall be fitted with plastic grommets to prevent wire damage and/ or failure.
- 4.4.3 All internal wiring shall be secured to inside of front panel to prevent wire damage and/or failure.

5. Main Control Module

5.1 Physical

- 5.1.1 Control module shall consist of a totally solid state fully integrated device which provides for wired or wireless control of the arrow sign panel, lamp pattern generation, battery status monitoring and indication, solar electric charge control, low battery voltage disconnect, high battery voltage disconnect, reverse battery polarity protection and surge protection and optional remote control and tracking via an integrated cellular/GPS transceiver module.
- 5.1.2 Control module shall be portable and shall be equipped with a mounting bracket for ease of installation, either in the vehicle cab or in a weather resistant, lockable, molded HDPE (High Density Polyethylene) enclosure secured to the skid mount frame.
- 5.1.3 Control module front panel shall be sealed to accommodate operation in all types of weather.
- 5.1.4 Control module shall be constructed of all industrial temperature range components to ensure reliable operation under all outdoor environmental conditions.
- 5.1.5 Control module power and control cables shall be equipped with locking type connectors to provide secure reliable operation while permitting quick, easy removal of the control module for maintenance and repair.

5.2 General Operation

5.2.1 Local Control Operation

- 5.2.1.1 Control module shall be equipped with an array of membrane push buttons to enable an operator to locally select the desired arrow panel pattern with the push of a single button.
- 5.2.1.2 Control module shall be equipped with multicolored LED indicators for local monitoring of battery voltage (charge) level, solar charger activity, and lamp intensity control settings.

5.2.2 Remote Control Operation

(NOTE: Cellular/GPS connection is an optional upgrade)

- 5.2.2.1 Control module shall provide for remote control of the arrow panel, including geographic location monitoring, without the need for additional hardware, software, external computers or hand-held control devices.
- 5.2.2.2 Control module shall provide all necessary hardware and software to operate the arrow panel locally (via array of membrane pushbuttons) and remotely (via integrated cellular transceiver and antenna) control including geographic location monitoring (via integrated GPS module and antenna). Full remote control (including GPS mapping) via internet accessible server based remote control software shall be included free of charge from date of purchase (i.e., cellular service shall be included free from date of original purchase for life of the unit).

- 5.2.2.3 Control module operating processor, firmware and software shall be remotely upgradeable over an IP addressable network connection via the integrated cellular transceiver. Upgrades shall be provided by manufacturer free of charge for life of machine and automatically applied via integrated cellular transceiver and included remote control service from date of original purchase.
- 5.2.2.4 Control module embedded CPU shall incorporate an ARM based microprocessor design to ensure future hardware and software compatibility through upgrades provided by manufacturer free for life of the machine. Operating system shall be Linux based and include multiple watchdog timers to ensure automatic system restarts if any critical function stops working properly or communication with remote control servers is interrupted.
- 5.2.3 Control module shall employ lamp power drivers that provide completely automatic short circuit and over temperature protection. If lamp wire leads are shorted together or to the chassis or if the wrong type of lamp is connected to the lamp wire leads no damage should occur to the lamp power drivers.
- 5.2.4 Control module shall be completely protected against reverse battery and solar array connections.
- 5.2.5 Integrated charge control circuit shall provide for dual slope, temperature compensated control to maximize transfer of energy into the battery while protecting batteries from overcharging, minimizing outgassing and minimizing loss of electrolyte.
- 5.2.6 Control module shall be equipped with a lamp intensity control circuit to automatically adjust arrow panel lamp intensity for changing ambient lighting conditions and to maintain consistent lamp intensity over a wide operating voltage range. A manual override shall be provided for the automatic intensity control circuit so that minimum or maximum lamp intensity can be manually selected. In the event that the lamp intensity control function is inadvertently left in the High or Low setting, the lamp intensity control circuit shall return to the Auto setting upon the occurrence of the first day/night cycle sensed by the light sensing device in the arrow panel. This feature prevents the use of potentially hazardous lamp intensities (low intensity during daylight hours and high intensity at night) and unexpected excess energy consumption.
- 5.2.7 Control module shall provide for the following display patterns:
- | | |
|---------------------|---|
| Right Arrow | - 10 lamps flashing in unison, forming an arrow. |
| Left Arrow | - 10 lamps flashing in unison, forming an arrow. |
| Double Arrow | - 5 lamps in each arrow head, 3 in center of shaft, flashing in unison. |
| Caution Bar | - 7 lamps in center horizontal bar, flashing in unison. |
| Four-Corner Caution | - 4 lamps in outer most corners, flashing in unison. |

Sequential Right Arrow	- 2 lamps in left side of center bar in first phase, plus 3 lamps in middle of center bar in second phase, plus 5 lamps in arrow head in third phase flashing in sequence.
Sequential Left Arrow	- 2 lamps in right side of center bar in first phase, plus 3 lamps in middle of center bar in second phase, plus 5 lamps in arrow head in third phase flashing in sequence.
25 Lamp Panels only:	
Right Sequential Chevron	- 5 lamps on left side of the panel forming a right-hand arrow head in the first phase, plus 5 lamps in the center forming a second right-hand arrow head in the second phase, plus 5 lamps forming a third right-hand arrow head on the right side of the panel in the third and final phase.
Left Sequential Chevron	- 5 lamps on the right side of the panel forming a left-hand arrow head in the first phase, plus 5 lamps in the center forming a second left-hand arrowhead in the second phase, plus 5 lamps forming a third left-hand arrow head on the left side of the panel in the third and final phase.
Sequential Double Arrow	- 1 lamp in the center of the panel in the first phase, plus the two lamps adjacent to the center lamp forming a bar in the center of the panel in the second phase, plus 5 lamps in each arrow head (total 10 lamps) in the third phase.
Alternating Double Diamonds	- 8 lamps in the center of the panel forming a diamond shape in the first phase, dark in the second phase, 16 lamps forming diamond shapes at each end of the panel in the third phase, and dark in the fourth phase.

5.2.8 Control module power consumption, not including lamps, shall be less than 0.5 Watts to optimize overall energy consumption. Power consumption of control modules with cellular and GPS connection option shall be less than 1.3 Watts, not including lamps.

5.2.9 Control module operating firmware shall be field upgradeable.

5.2.10 Control module shall be equipped with positive locking connectors to provide for reliable operation and easy removal for maintenance and repair. Battery bank and solar array power connector shall be rated for a 13-Amp per contact minimum current rating to ensure minimum voltage drop and maximum energy transfer. Arrow panel control connector shall be AMP D-subminiature 37-pin right angle female header AMP P/N 5747847-6, or equivalent, with gold flashed pins for optimum reliability.

6. Power System

6.1 General

- 6.1.1 Operating Voltage - 12 Volts DC nominal
- 6.1.2 Operating Energy Requirement - Single Flashing Arrow, < 6 Amp Hours per day at Spring or Fall Equinox (12 hours of daylight, 12 hours of darkness)
- 6.1.3 Main Power Switch - Main power switch shall be unnecessary. When arrow panel pattern selection switch is in the OFF position, control module shall automatically shut down all unnecessary operations to reduce energy consumption to less than 0.13 Watts (1.3 Watts for control modules with cellular/GPS connected). Solar generator charge controller shall operate automatically, as required, during daylight hours and shut down completely at night.

6.2 Optional Battery Bank

- 6.2.1 Number of batteries – Two (2) standard - upgradeable to Four (4)
- 6.2.2 Battery type - 6-Volt DC, heavy duty, deep cycle – Specify Flooded Lead-Acid, Gel-Cell or AGM
- 6.2.3 Energy capacity - 260 Amp-Hours (2 batteries) Sufficient energy capacity to operate the arrow panel, displaying a single flashing arrow for more than 30 days, without any energy input from the solar array. Upgradeable to 520 Amp-Hours (4 batteries).
- 6.2.4 Battery / Equipment Compartment
 - 6.2.4.1 Battery / Equipment Compartment shall be constructed of molded HMWPE (High Molecular Weight Polyethylene), color impregnated with Federal Safety Orange with 0.5% UV stabilizer added to prevent fading.
 - 6.2.4.2 Compartment shall be designed to completely contain spills from a failed or damaged battery case.
 - 6.2.4.3 Compartment shall be capable of supporting an operator standing on top of the battery / equipment compartment to service unit.
 - 6.2.4.4 Compartments shall be designed such that the lid automatically latches in the closed position and holds the batteries in place. Lid shall be equipped with a locking hasp capable of being locked in the closed position with a standard padlock.
 - 6.2.4.5 Lid shall be secured to compartment by an integral hinge that permits the lid to be completely removed from the compartment for service.
 - 6.2.4.6 Compartments shall be designed to provide adequate ventilation for the batteries during charging yet prevent the ingress of water during use or transport.
 - 6.2.4.7 Compartments shall be capable of housing two (2) or four (4) BCI Group GC-2 batteries.

6.3 Optional Solar Array

NOTE: Solar Array option is available for Pivot Mount and Fixed Mount

- 6.3.1 Photovoltaic module type - Single crystal (monocrystalline) silicon

6.3.2 Number of solar cells per module - 36

6.3.3 Solar array power output - 50 Watts peak

NOTE: Solar energy system performance charts are available to assist in selection of appropriate solar array power output requirements

6.3.4 Solar array energy output shall be sufficient to operate the arrow sign, under normal operating conditions, with the solar array in a flat, horizontal position. It shall not be necessary to tilt or rotate the solar array to provide sufficient energy output from the solar array to operate the arrow panel continuously.

6.3.5 Photovoltaic module junction boxes shall be equipped with watertight strain reliefs at all cable entry points.

6.4 Wiring and Cabling

6.4.1 All external wire and cable shall be covered with a weatherproof jacket, rated for outdoor use, and secured to superstructure with UV resistant cable ties and anchors.

6.4.2 All wire and cable fittings shall be sealed at bulkheads or enclosure entry points.

6.4.3 All wiring shall be marine grade, multi-strand, tin-plated copper with PVC insulation rated for outdoor use.

6.4.4 All power system wire terminals shall be tin or silver-plated copper to minimize the effects of galvanic corrosion.

6.4.5 Main power wiring shall be 16 AWG minimum.

6.5 Charge Controller

6.5.1 Solar power system shall include a solid state charge controller.

6.5.2 Charge controller shall monitor battery voltage and ambient temperature.

6.5.3 Charge controller shall regulate energy flow from the solar array into the battery bank to avoid over charging of the batteries and minimize the consumption of electrolyte.

7. Documentation

7.1 Operation and Maintenance Manual – available online at www.solartechtechnology.com

- 7.1.1 Installation and Operation
- 7.1.2 Maintenance
- 7.1.3 Service, Repair & Troubleshooting
- 7.1.4 Wiring Diagrams
- 7.1.5 Parts Lists & Assembly Drawings
- 7.1.6 Specifications

7.2 Supplement - Truck Mount Specific Documentation

- 7.2.1 Configuration Sheet
- 7.2.2 Wiring Diagram
- 7.2.3 Assembly Diagrams and Parts Lists

7.3 User Guide – Hard Copy – attached to unit with Nylon lanyard

- 7.3.1 Pre-transport checklist.
- 7.3.2 Job site setup checklist.
- 7.3.3 Basic programming instructions.
- 7.3.4 Basic system status evaluation.
- 7.3.5 Weatherproof card attached to unit with 5/32- inch diameter nylon lanyard.

7.4 Integration Support Documentation – Per request from customer support (1-800-475-5442)

- 7.4.1 Proprietary Protocol Documentation for Custom System Integrators
- 7.4.2 NTCIP Support Documentation for NTCIP System Integrators
- 7.4.3 Web-Server Protocol Documentation for Web Based Application System Integrators

8. Maintenance

8.1 Scheduled Maintenance

- 8.1.1 Solar Array - Clean with water and mild detergent as needed.
- 8.1.2 Battery Bank - Check electrolyte level once each month and add distilled water as needed. (NOTE: Not required with AGM or Gel-Cell Batteries.)

8.2 Preventive Maintenance

- 8.2.1 Battery Bank - Clean and tighten battery electrical terminals.

9. Warranty

9.1 Standard Warranty

9.1.1 Limited Bumper to Bumper – Five (5) years – consult factory for terms & conditions

9.1.2 LED Lamps - Ten (10) years

9.1.3 Solar Panels - Ten (10) years

10. Options**10.1 Battery Charger (for use with optional battery pack)**

10.1.1 Charger type - Switching regulator, constant voltage with automatic switch to maintenance or trickle charge.

10.1.2 Input Voltage - 110 VAC 50/60 Hz

10.1.3 Available models with typical recharge times.

45-Amp: 20 hours (4 batteries)

10.1.4 Battery charger unit shall install in the field with minimum effort.

10.2 Cellular Transceiver & GPS Receiver Module

10.2.1 Integrated into Control Console – proprietary