OWNER'S MANUAL

Solar LED Airfield Sign Light

CONTENTS

1.0 Introduction

The Carmanah Solar LED Airfield Sign Light is completely power-autonomous and designed to operate reliably with no scheduled maintenance for up to five years except for routine cleaning. The Solar LED Airfield Sign Light includes a remotely mounted solar engine, one high-efficiency white light LED luminaire, all mounting accessories, and a connector cable. If required, you have the option of installing a second luminaire.

1.1 *Precautions*

Use extreme caution when handling the batteries as they are capable of generating hazardous short-circuit currents. Remove all jewelry (bracelets, metal-strap watches, rings) before handling the batteries.

Electrostatic Discharge (ESD) Precautions and Proper Handling Procedures

- Dissipate static electricity before handling any system components by touching a grounded metal object, such as bare metal on the solar engine.
- If available, use an antistatic wrist strap.
- Avoid touching the electrical contacts and circuit board components (other than the switches for adjusting intensity and operating profile) in the Energy Management System (EMS).
- Take care when connecting or disconnecting cables. A damaged cable can cause a short in the electrical circuit.
- Failure to observe proper ESD handling procedures can void the warranty.

1.2 *Patents*

US Patent No. 6,573,659

2.0 Standards and Precautions for Solar Installations

Installation and wiring must be completed in strict conformance with relevant codes and regulations. Non-adherence to code may void the warranty. Qualified, licensed professionals should perform all installation work.

NOTE

This owner's manual is provided to assist your qualified installation professional. As the use of this manual and the conditions or methods of installation, operation, use, and maintenance of the equipment are beyond the control of Carmanah Technologies Corporation, Carmanah does not assume responsibility and expressly disclaims liability for loss, damage, or expense arising out of, or any way connected with, such installation, operation, use, or maintenance.

- Before lifting any heavy or bulky equipment, ensure that the load is secured so moving parts do not shift and the load can be lifted as far as needed without back strain, over extension, or loss of grip. It is recommended that two or more persons perform the installation.
- Batteries are shipped fully charged in separate packaging. Do not short-circuit the terminals of individual batteries or battery strings.
- When in storage, batteries should be charged every 2 months to maintain voltage levels.
- Solar panels produce direct current electricity when exposed to light and can therefore produce an electrical shock or burn. If proper installation is followed, this should not be a concern. If desired, the electrical output of the solar panel can be reduced to zero by removing the solar engine from sunlight, or by covering the solar panels with an opaque material.
- Remove all jewelry before performing electrical wiring or testing.
- Install a system ground for safety and lightning protection.

3.0 Components

3.1 *Luminaire*

The Solar LED Airfield Sign Light ships with one or two luminaires and their associated extension wiring and mounting accessories.

The high-efficiency LED-4SE luminaire includes the following:

- white luminaire housing (dual-axis tilt for precise beam direction)
- tilt locking screws
- luminaire adapter and mounting screw
- frangible coupling
- 19.7 ft (6 m) extension cable (not shown)
- 2 – 8" (20 cm) cable tie (not shown)

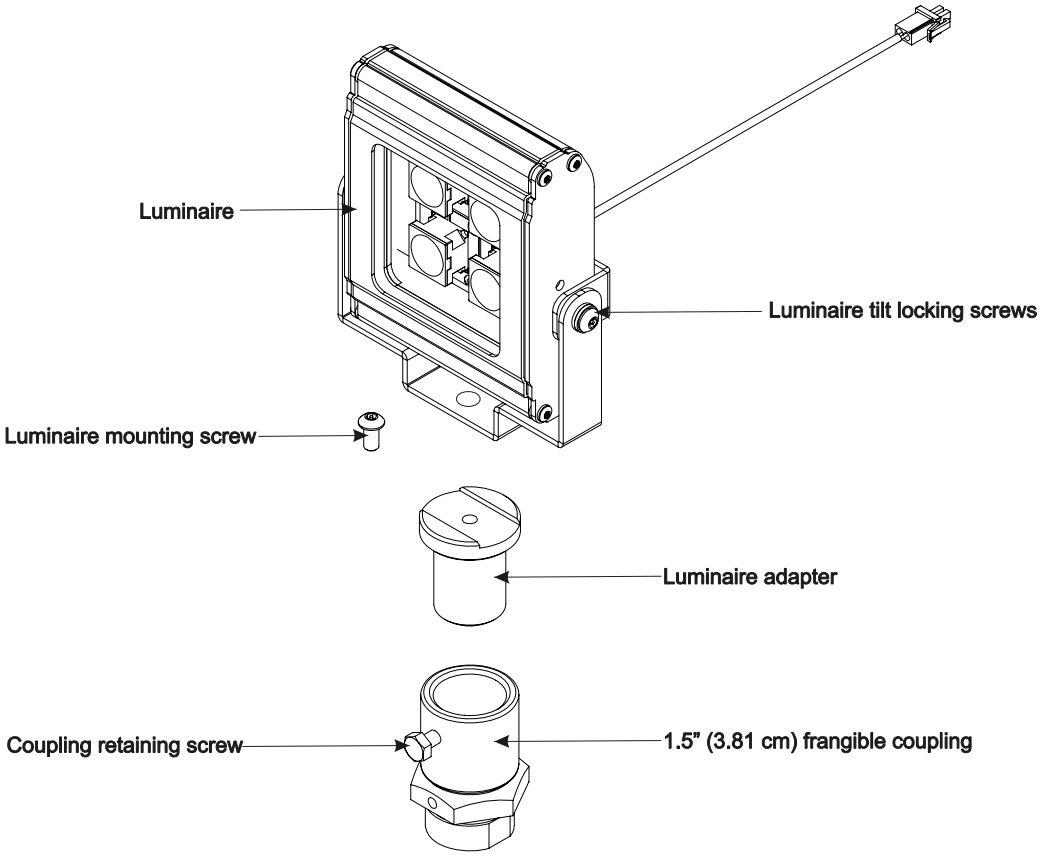


Figure 3-1: LED-4SE luminaire

3.1.1 Luminaire Mounting Options

The luminaire has two mounting options depending on the requirements of your application:

- 1.5" (3.8 cm) floor flange; including ⅜" x 3¾" wedge anchor bolts (4) (not shown)
- 1.5" (3.8 cm) stake mount – length 15" (38 cm)

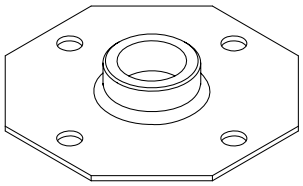


Figure 3-2: Floor flange

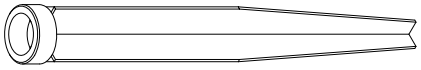


Figure 3-3: 15" (38 cm) stake mount

3.2 *Solar Engine*

The solar engine is aviation yellow and includes the following:

- solar engine housing (Figure 3-4), including:
  - solar panels
  - batteries (shipped separately)
  - EMS
  - wiring harness
- mounting post (Figure 3-5)
- tether cable (Figure 3-4)
- frangible coupling (Figure 3-6)
- base flange (Figure 3-7)
- 2 cable ties (not shown)
- ½" x 5½" wedge anchor bolts (4) (not shown)

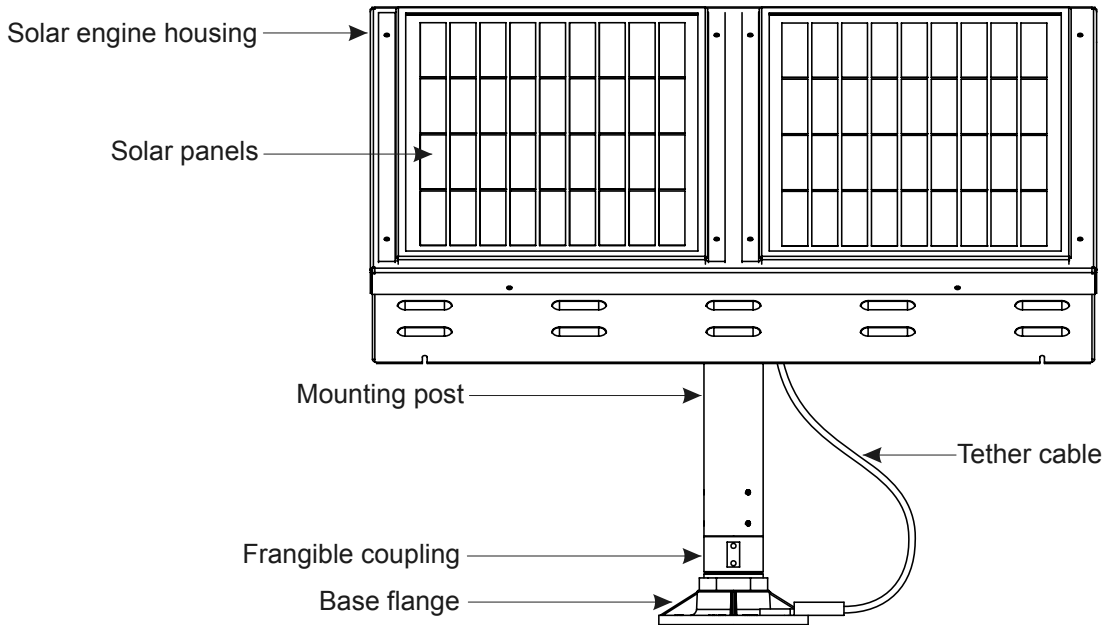


Figure 3-4: Solar Engine

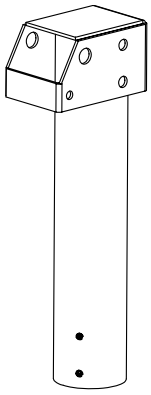


Figure 3-5: Mounting post

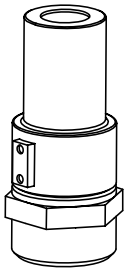


Figure 3-6: Frangible coupling

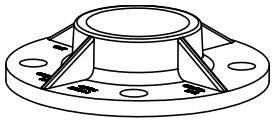


Figure 3-7: Base flange

4.0 How it works

The solar engine uses an onboard EMS to regulate power between the solar panels, batteries and luminaire(s). The solar panels, EMS, and batteries are housed in the solar engine. The batteries are charged by solar energy; therefore no wiring to an external power supply is required.

Solar panels: The solar panel array is connected to the charging circuitry to collect enough solar energy to operate the system throughout the year.

Rechargeable batteries: The battery bank is composed of two 12 V batteries. The batteries are sealed, rechargeable lead-acid, with excellent temperature performance and long life.

Luminaire(s): The luminaire(s) contain four high-power white LEDs.

4.1 *Energy Management System (EMS)*

Carmanah's MICROSOURCE® EMS automatically balances lighting requirements with available energy resources, allowing the solar engine to learn and adapt to its environment. With MICROSOURCE® EMS, lighting characteristics such as automatic on/off times and default light output levels can be customized for maximum efficiency, reliability, and convenience. MICROSOURCE® features include:

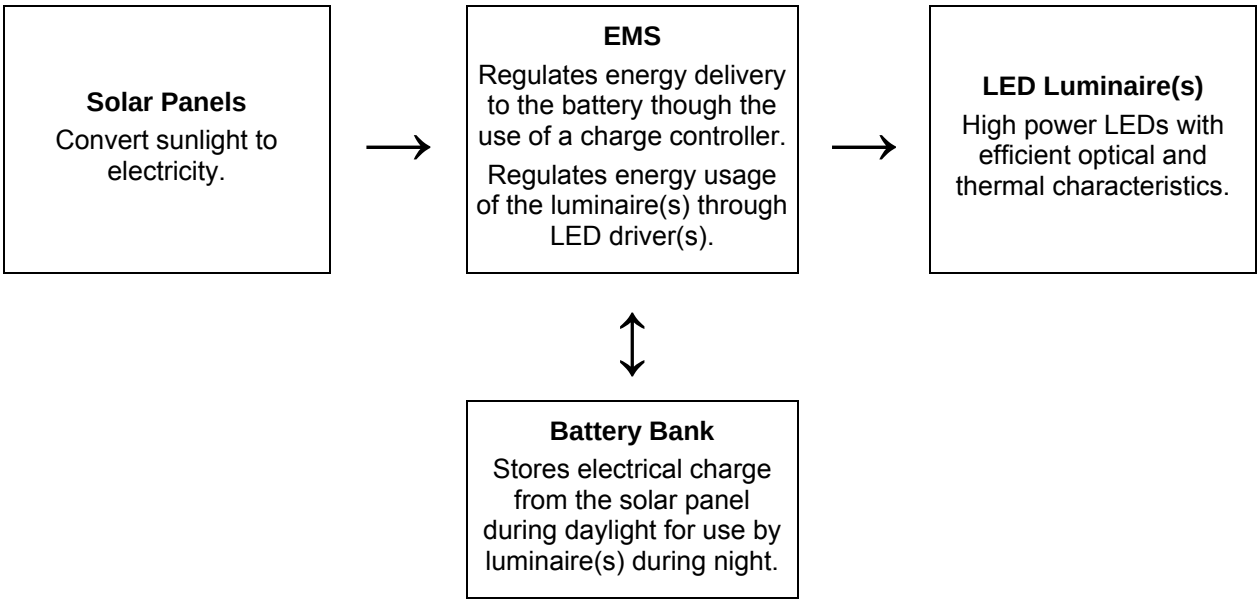
- Automatic Light Control (ALC) monitors the battery bank state of charge and regulates energy delivery to the luminaire(s), thereby preventing the battery bank from being damaged through excessive discharge. ALC ensures system reliability through periods of inadequate sunlight.
- Low battery shutdown prevents the battery bank from being over-discharged in the event that ALC is unable to avoid excessive discharge. Discharging the battery bank to less than 10% capacity will cause permanent capacity loss. The luminaires blink[1] once a second when low battery shutdown is engaged. The system will remain in this state until the battery is recharged to at least 50% capacity.
- 24-hour shutdown engages when the system detects 24 hours of continuous darkness. The system will remain in this state until it detects 10 seconds of daylight. The luminaires blink[1] twice a second when 24-hour shutdown is engaged.

Operating profile is configurable for the application and location in which the system is installed.

[1]Blinking luminaires indicate that the system requires service. The blinking will continue until either the system is serviced or the batteries are depleted.

4.1.1 EMS Diagram

The EMS regulates the energy delivered to the luminaire(s) in the system.



4.1.2 EMS Labeling

There are two labels attached to the EMS. The labels contain the following information:

Label #1

- EMS Model Number
- Date of Manufacture
- EMS Serial Number

Label #2

- Sales Order Number
- Solar Engine Serial Number
- Operating Profile
- Battery Current
- Luminaire Quantity
- Luminaire Model

5.0 Product Assembly and Installation

This section lists the recommended tools and provides the assembly and installation instructions for the luminaire(s) and solar engine.

5.1 *Luminaire*

5.1.1 Recommended Tools

Following is a list of recommended tools to complete the assembly and installation of the luminaire(s).

- Crescent wrench with 2.5" (6.4 cm) opening
- Shovel or trenching equipment; if the extension cable between the luminaire(s) and solar engine is to be buried
- Imperial socket or wrench set ⅜" – ¾"
- Torque wrench (if available)
- Side cutting pliers

Floor flange mounting:

- Hammer drill
- ⅜" concrete drill bit

Stake mounting:

- Large hammer
- Stake hammering block (recommended)

5.1.2 Installing the Luminaire

1. Install one of:
   a. Floor flange using the wedge anchor bolts.
   b. Drive the mounting stake into the ground. Do not hammer directly on the mounting stake threads; use a hammering block or other protection.
2. Thread the frangible coupling into the floor flange or mounting stake and tighten securely using the crescent wrench.
3. Mount the luminaire(s) onto the luminaire adapter using the supplied mounting screw.
4. Tighten the luminaire mounting screw to 65 lbf·in (7.3 N·m).
5. Insert the luminaire adapter into the frangible coupling.
6. Adjust the luminaire(s) so that it is facing in the correct direction.
7. Tighten the coupling retaining screw to 65 lbf·in (7.3 N·m).
8. Adjust the tilt angle of the luminaire(s).
9. Tighten the luminaire(s) tilt locking screws to 65 lbf·in (7.3 N·m).

5.2 *Solar Engine*

5.2.1 Recommended Tools

Following is a list of recommended tools to complete the assembly and installation of the solar engine.

- Imperial socket or wrench set ⅜" – ¾"
- ⅛" hex screwdriver
- #2 Phillips screwdriver
- Side cutting pliers
- Crescent wrench with 2.5" (6.4 cm) opening
- Digital voltmeter
- Compass
- Shovel or trenching equipment; if the extension cable between the luminaire(s) and solar engine is to be buried

Base flange mounting:

- Hammer drill
- ½" concrete drill bit

5.2.2 Installing the Solar Engine

The installation location for the Solar LED Airfield Sign Light should be shade-free and allow for unobstructed solar charging. The base flange, tether, frangible coupling, and mounting post need to be assembled on-site. The solar engine must be assembled and installed before connecting the luminaire(s).

NOTE Ensure that the distance between the solar engine and the luminaire(s) accommodates the length of the luminaire extension wiring; ensure that you account for right angles, trenching depths, and lengths of extension harness inside the solar engine.

WARNING The solar engine is heavy; handle with caution to avoid tipping during assembly and installation.

1. Install the base flange using the supplied ½" x 5½" wedge anchor bolts. Do not install one of the mounting nuts at this time; this mounting nut will be installed in step 11 when the tether is attached.
2. Remove the frangible coupling from the mounting post by loosening the setscrews.
3. Thread the frangible coupling into the base flange and tighten securely using the crescent wrench.
4. Remove the locking bolt, main pivot bolt, and tether from the bracket located on the bottom of the solar engine; see Figure 5-1.

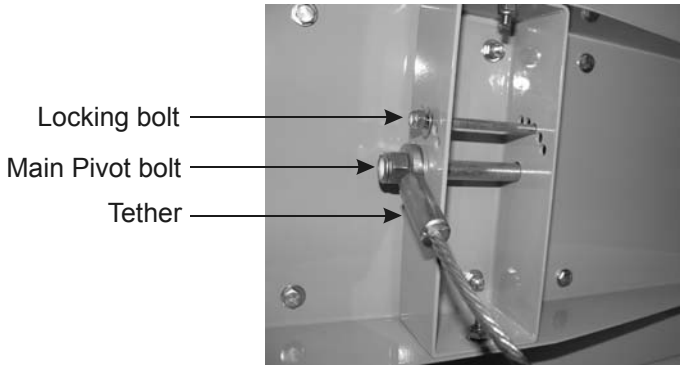


Figure 5-1: Removing bolts and tether

5. Slip the mounting post into the bracket on the bottom of the solar engine, and reinstall the main pivot bolt, locking bolt, and tether; see Figure 5-2.

   Do not tighten the main pivot or locking bolts; they will be adjusted when setting the inclination.

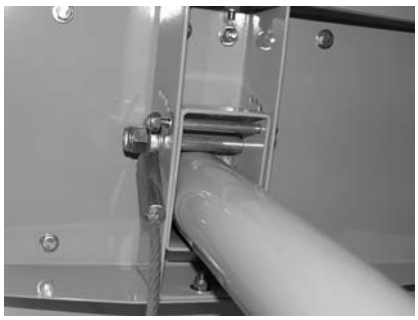


Figure 5-2: Installed mounting post

6. Determine the solar engine inclination. Table 5-1 lists the site latitude and the corresponding pivot mount inclination.

Table 5-1: Inclination settings

Site Latitude	Pivoting Mount
0 – 4°	0°
5 – 8°	15°
9 – 22°	30°
23 – 37°	45°
38 – 90°	60°

7. Remove the locking bolt from the solar engine bracket and adjust the solar engine to the required inclination. You can adjust the solar engine bracket from 0° to 60° in 15° increments. Reinstall and securely tighten the locking bolt and main pivot bolt; see Figure 5-3.

NOTE The solar panels may require more frequent cleaning if the inclination is set to 0°. Optionally, tilt the solar engine to 15° in dusty equatorial environments with low rainfall.

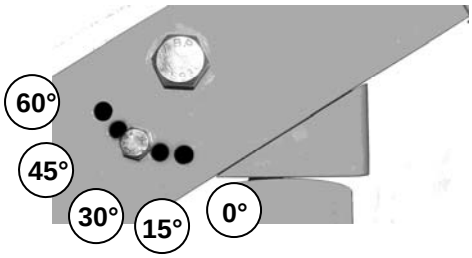


Figure 5-3: Solar engine inclination

8. Carefully lifting the solar engine above the previously installed base, slip the mounting post onto the frangible coupling.
9. Adjust the orientation of the solar engine.

   The solar engine should be installed with the solar panels facing the equator; facing south in northern latitudes and facing north in southern latitudes. Use a compass if you are unsure of the direction of the equator.
10. Securely tighten the six setscrews on the mounting post.
11. Connect the loose end of the tether to the base flange using the retained anchor bolt nut from step 1.

5.3 *Battery Harness*

The batteries for the solar engine are shipped fully-charged in separate packaging.

NOTE Connect the wiring harnesses to the batteries before installing them in the solar engine.

5.3.1 Connecting the Battery Harness

1. Remove the batteries from the shipping box.
2. Connect the harness wiring to the battery terminals; see Figure 5-4 (the batteries will be one of the two terminal options shown):
   a. Connect the red wire to the positive (red) terminal of the battery.
   b. Connect the black wire to the negative (black) terminal of the battery.

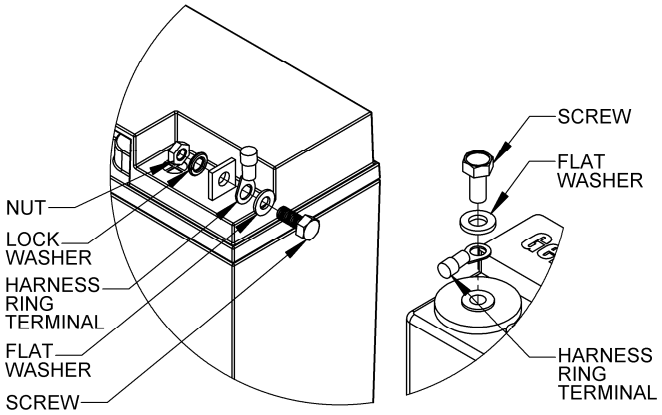


Figure 5-4: Connecting harnessing to the battery terminals

5.4 *System Assembly*

The internal components of the solar engine are shown in Figure 5-5. The batteries are shipped fully charged in separate packaging. Ensure that you have connected the battery harnesses before installing them in the solar engine; see 5.3 Battery Harness for the procedure to connect the harnesses.

Use the following procedure to connect the wiring from solar engine to the installed luminaire(s) engine, connect the wiring to the luminaire(s), and install and connect the batteries.

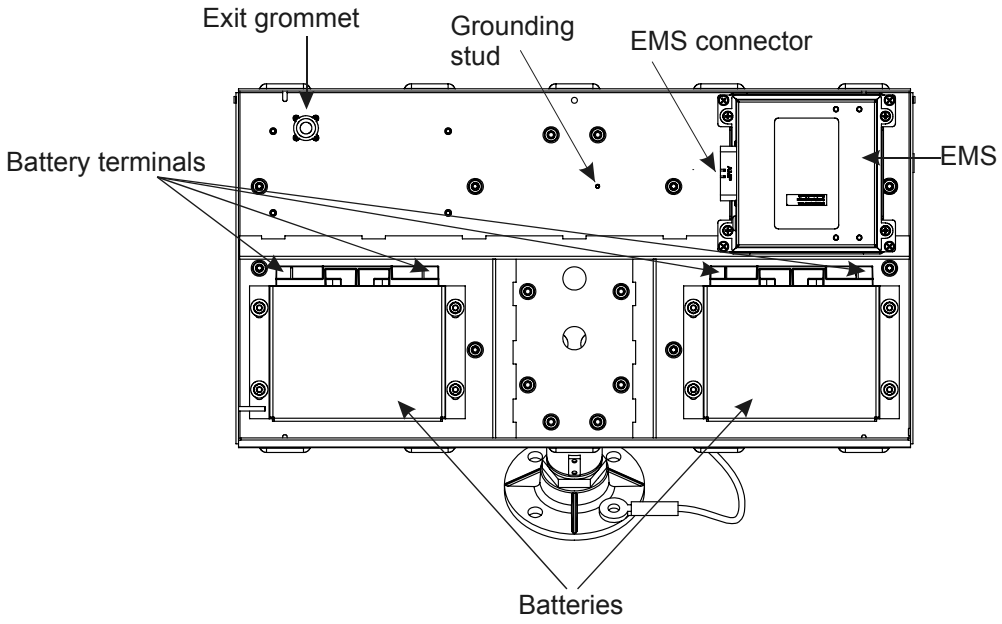


Figure 5-5: Solar engine internal components

NOTE

If you plan to trench and bury the luminaire extension cable between the solar engine and luminaire, dig the trench before installing the extension cable to avoid damaging the cable during digging.

5.4.1 Assembling the System

1. Remove the two retaining screws from the cover of the solar engine.
2. Open the solar engine cover. Use the internal retaining leg to hold the cover open. Figure 5-5 shows the internal components of the solar engine.
3. Connect the luminaire extension cable to the LED 1 lead on the main wiring harness. If you are connecting a second luminaire, then connect it to LED 2 lead on the main wiring harness.
4. Route the luminaire extension cable(s) out of the solar engine through the exit grommet at the back of the solar engine housing.
5. Run the luminaire extension cable(s) to the luminaire(s) and attach to the connector.
6. Secure the extension cable(s) to the luminaire mount(s) using the supplied cable tie(s). Ensure that the cable tie is located between the luminaire adapter and the frangible coupling retaining screw; see Figure 5-6.

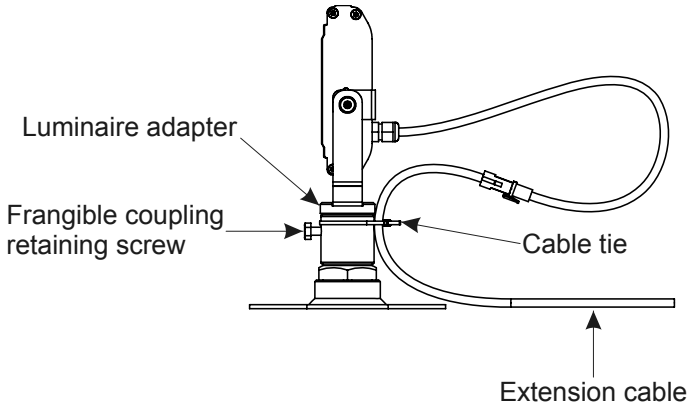


Figure 5-6: Securing the extension cable to the luminaire

7. Secure the extension cable to the solar engine mounting post using the two supplied cable ties.
8. Coil any excess length of the extension cable inside the solar engine.

NOTE Install the batteries only after you have performed the solar engine installation so that the solar engine does not need to be moved with the extra weight of the batteries.

9. Remove the nuts and washers securing the two battery brackets to the solar engine.
10. Remove the battery brackets.
11. Insert the batteries into the solar engine with the terminals up and toward the EMS; see Figure 5-5.
12. Replace battery brackets onto the mounting studs and secure with the previously removed nuts and washers. Ensure the nuts and washers are replaced in the same order that they were removed – flat washer, split lock washer, nut.
13. Connect the battery harness wires to the connectors labeled "Battery 1" and "Battery 2" on the EMS main wiring harness; either battery can be connected as "Battery 1" and "Battery 2".

NOTE When the batteries are connected, power is provided to the EMS and the startup sequence begins. The luminaire(s) will flash during the startup sequence to indicate that the system is operational.

14. Connect the solar panel connectors to the main wiring harness leads labeled "Solar Panel 1" and "Solar Panel 2"; either solar panel may be connected as "Solar Panel 1" and "Solar Panel 2".
15. Close the solar engine cover and reinstall the two retaining screws.

5.5 *System Activation*

Once the system installation and assembly is complete, the following start-up sequence indicates that the system is functioning correctly.

During start-up, the EMS confirms whether or not luminaire(s) are connected to each driver; if not, the drivers are turned off to conserve power. Failure to follow the connection sequence may result in non-operational luminaire(s). In the event the luminaire(s) do not turn on, reset the system by unplugging the main wiring harness connector and plugging the connector back in.

1. The luminaire(s) light up shortly after the batteries are connected.
2. The luminaire(s) turn off after the start-up sequence.
3. The system commences normal operation.

The system start-up sequence is less than 1 minute.

6.0 EMS Configuration

The EMS is factory configured based on the deployment location and selected operating profile at the time of ordering. You can adjust the settings if the installation location or situation changes.

Contact your Carmanah representative before making any changes to the settings of the EMS. Changing the settings may result in system failure and battery damage if the EMS is programmed for unsustainable operation in the available sunlight.

The Solar LED Airfield Sign Light offers configurable options using a set of switches (SW1) and rotary dials (SW2 and SW3) located on the circuit board within the EMS housing. The switches and dials allow control of operating profiles and light levels.

Prior to adjusting the brightness or operating profile, the harnesses MUST be disconnected from the Energy Management System (EMS) in the following sequence:

Harness Disconnection Sequence

1. Disconnect the solar panels.
2. Disconnect the batteries.
3. Disconnect the luminaire(s).

This sequence minimizes any potential safety hazard.

Once the brightness or operating profile is adjusted reconnect the harnessing in the following sequence:

Harness Reconnection Sequence

1. Connect the luminaire(s).
2. Connect the batteries.

   If the batteries are charged and the EMS is connected, the luminaire(s) will begin to flash.
3. Connect the solar panels.

6.1 *Adjusting the EMS*

1. Remove the two retaining screws from the cover of the solar engine.
2. Open the solar engine cover. Use the internal retaining leg to hold the cover open.
3. Disconnect the following from the EMS main wiring harness:
   a. Solar panels
   b. Batteries
   c. Luminaire(s)
4. Disconnect the main wiring harness connector from the EMS; see Figure 6-1.

Figure 6-1: Disconnecting the main wiring harness connector

Follow ESD precautions when handling the EMS; see section *1.1 Precautions* for more information. Failure to observe proper ESD handling procedures can void your warranty.

5. Remove the four fasteners securing the EMS to the solar engine housing; see Figure 6-2.

Figure 6-2: Removing EMS fasteners

6. Remove the EMS and turn it over.

Follow ESD precautions when handling the EMS; see section *1.1 Precautions* for more information. Failure to observe proper ESD handling procedures can void your warranty.

On the circuit board within the EMS housing, there is a plastic block with eight small switches on it (SW1) and two rotary dials (SW2 and SW3); see Figure 6-3.

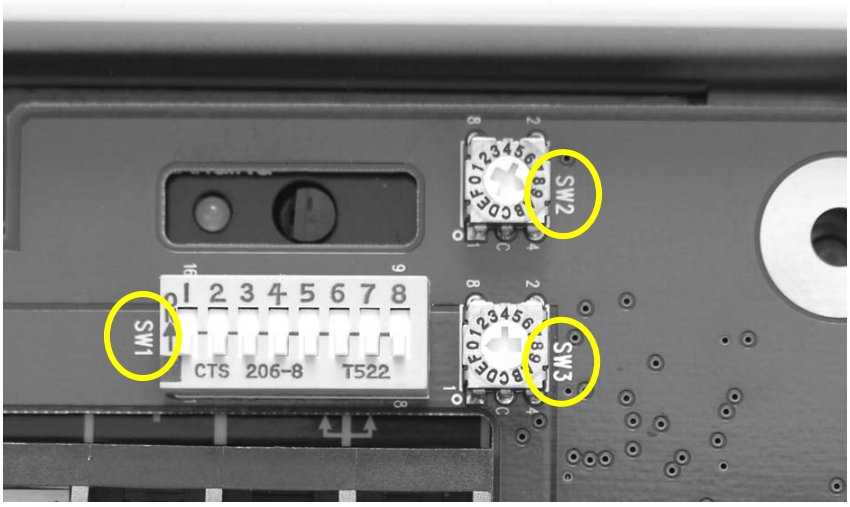


Figure 6-3: EMS switches

7. Adjust the luminaire(s) current or operating profile. Use a small, flat-headed screwdriver to flip the switches on SW1 or turn the SW2 and SW3 dials to the desired settings. See Table 6-1 to adjust the SW1 operating profile settings and Table 6-2 to adjust the SW2 and SW3 brightness settings.

Set the LED-4SE luminaire(s) to a maximum of 350 mA. The luminaire(s) will be damaged if set to more than 350 mA.

Table 6-1: SW1 Operating Profile Settings (Switches 7 and 8 not used)

SW1 Switch Positions								Operating Profile
1	2	3	4	5	6	7	8	
0	0	0	0	0	0	0	0	Not applicable
1	0	0	0	0	0	0	0	Dusk to Dawn
0	1	0	0	0	0	0	0	Dark + 2
1	1	0	0	0	0	0	0	Dark + 4
0	0	1	0	0	0	0	0	Dark + 6
1	0	1	0	0	0	0	0	Dark + 7
0	1	1	0	0	0	0	0	Dark + 8
1	1	1	0	0	0	0	0	Dark + 9
0	0	0	0	1	0	0	0	Dark + 10
1	0	0	1	0	0	0	0	Dark + 11
0	1	0	1	0	0	0	0	Dark + 12
1	1	0	1	0	0	0	0	Split night, dark + 5, dawn – 2, 33% of peak power
0	0	1	1	0	0	0	0	Split night, dark + 5, dawn – 3, 33% of peak power
1	0	1	1	0	0	0	0	Split night, dark + 5, dawn – 4, 33% of peak power
0	1	1	1	0	0	0	0	Split night, dark + 6, dawn – 2, 33% of peak power
1	1	1	1	0	0	0	0	Split night, dark + 6, dawn – 3, 33% of peak power
0	0	0	0	1	0	0	0	Split night, dark + 6, dawn – 4, 33% of peak power
1	0	0	0	1	0	0	0	Split night, dark + 7, dawn – 2, 33% of peak power
0	1	0	0	1	0	0	0	Split night, dark + 7, dawn – 3, 33% of peak power
1	1	0	0	1	0	0	0	Split night, dark + 7, dawn – 4, 33% of peak power
0	0	1	0	1	0	0	0	Split night, dark + 8, dawn – 2, 33% of peak power
1	0	1	0	1	0	0	0	Split night, dark + 8, dawn – 3, 33% of peak power
0	1	1	0	1	0	0	0	Split night, dark + 8, dawn – 4, 33% of peak power
1	1	1	0	1	0	0	0	Split night, dark + 9, dawn – 3, 33% of peak power

Notes:

1. 1 = On
   0 = Off
2. All DIP switch settings not shown are not applicable and should not be used.

Set the LED-4SE luminaire(s) to a maximum of 350 mA. The luminaire(s) will be damaged if set to more than 350 mA.

Table 6-2: SW2 and SW3 Brightness Settings

Position	SW2	SW3
	Coarse Current Adjustment	Fine Current Adjustment
0	0 mA	0 mA
1	100 mA	10 mA
2	200 mA	20 mA
3	300 mA	30 mA
4	Do not use.	40 mA
5	Do not use.	50 mA
6	Do not use.	60 mA
7	Do not use.	70 mA
8	Do not use.	80 mA
9	Do not use.	90 mA

8. Once the brightness and or operating profile is adjusted, re-install the EMS to its location in the solar engine.
9. Secure the four fasteners.
10. Reconnect the main wiring harness.
11. Reconnect the luminaire(s).
12. Reconnect the batteries.
13. Reconnect the solar panels.
14. Close the solar engine cover and reinstall the two retaining screws.

7.0 Maintenance and Product Care

Although the solar engine is designed to be maintenance free, optimum performance can be achieved by cleaning the solar panels and luminaire(s) lenses as required. Clean on a regular basis or whenever the panels and or luminaire lenses are visibly dirty. Use water and a soft sponge or cloth for cleaning and a mild, non-abrasive cleaning agent for more stubborn residue. Rinse well. In the event of heavy snowfall, clear the solar panels as soon as possible to allow maximum charging efficiency.

Pressure washers should **not** be used.

Following this check list will help to ensure the solar engine performs optimally:

1. Clean the solar panels more frequently during drier months, as they may become soiled more quickly. Dust, if allowed to accumulate, will reduce the power output of the solar panels.
2. Ensure that the vents and drain holes in the solar engine are free of debris.
3. Check the exterior of the solar engine for cracks, missing or broken hardware, or other potential problems.

7.1 *Battery Lifetime*

The solar engine battery lifetime depends on the ambient temperature in the location it is installed. Typical battery lifetimes for the solar engine are listed in *Table 7-1: Battery lifetime*.

Table 7-1: Battery lifetime

Average Annual Ambient Temperature	Approximate Expected Battery Lifetime
68 °F (20 °C)	3.0 – 5.0 years
77 °F (25 °C)	2.0 – 3.0 years
86 °F (30 °C)	1.1 – 1.7 years
More than 86 °F (30 °C)	1.1 years or less

Use extreme caution when handling the batteries as they are capable of generating hazardous short-circuit currents. Remove all jewelry (bracelets, metal-strap watches, rings) before handling the batteries.

The 12 V batteries are sealed, rechargeable lead-acid. Consult your local municipal bylaws for information on recycling the batteries when replacing. Do not discard these batteries in the garbage – please recycle!

8.0 Troubleshooting

If your system does not operate according to its specifications, check the following:

- Ensure that the solar panel is not obscured, shaded, or dirty – all these factors greatly affect charging capacity.
- Check that the solar panel is not being illuminated by an external light source.
- Check the system externally for any obvious signs of damage.
- Check the connection sequence; see section *5.0 Product Assembly and Installation*. Try resetting the system by unplugging the main wiring harness connector and then plugging it back in.
- Check the battery voltage. If the voltage is less than 12 V contact Carmanah customer support; see section *9.1 Customer Service*.

The system can be tested during the daytime by covering the solar panel with an opaque material for more than 1 minute – the luminaire(s) should turn on. Uncover the solar panel and the luminaire(s) should then turn off after approximately 1 minute.

If the unit is still inoperable, contact Carmanah for customer support; see section *9.1 Customer Service*.

Prepare the following information prior to contacting Carmanah:

- Model
- Serial #
- New installation. Yes/No
- Battery voltage (for both batteries)
- Description of problem
- Geographic location (ideally with latitude and longitude)
- Any other information available on the EMS labels

9.0 Service and Additional Products

9.1 *Customer Service*

Warranty

This product is covered by the Carmanah warranty. Visit www.carmanah.com/content/products/warranty/ for additional information or to register your product online.

Customer Service

Before contacting Carmanah's customer service department, please have the serial numbers of your Solar LED Airfield Sign Light system available, a brief description of the problem, as well as all details of the installation.

To contact Carmanah's Customer Service Department:

Mail: Carmanah Technologies Corp.
Building 4 – 203 Harbour Road
Victoria, BC Canada V9A 3S2

Phone: 1.250.380.0052
1.877.722.8877 (Toll Free, U.S. and Canada)

Fax: 1.250.380.0062

Email: customerservice@carmanah.com

Website: carmanah.com

9.2 *Additional Products*

Carmanah offers a variety of solar-powered and energy-efficient LED lighting products. For aviation applications, Carmanah also manufactures solar LED runway lights, as well as LED General Illumination products. For more information, please visit our website at: www.solarairportlights.com.

www.carmanah.com

Technical Support: customerservice@carmanah.com
Toll Free in Canada and the U.S.: 1.877.722.8877
International: 1.250.380.0052 | Fax: 1.250.389.0040

Number: Airfield_Sign_Light_55657_Manual_vB

55657