carmanah®

Owner's Manual

Model A704-5 Wireless Aviation Lighting System

Contents

1.0 Introduction

Congratulations on purchasing the Carmanah Model A704-5 Wireless Aviation Lighting System. Using LED illumination, these solar-powered lights are designed to operate reliably with no scheduled maintenance for up to five years.

Combining advanced electronics, software and wireless communication with solar power and LED technology, the Model A704-5 Aviation Lighting System is an advanced, portable, self-contained aviation lighting solution. The system is designed to operate reliably under extreme environmental conditions.

This manual describes the increased functionality of v3.00 firmware, released October 2007. Some of the features described in this manual are not available in older systems.

For your convenience, both the Model A704-5 light and wireless controller have quick start instructions that can be found in the following sections:

- Model A704-5 Light: section *4.2 Model A704-5 Light Quick Start Guide*
- Wireless Controller: section *5.3 Wireless Controller Quick Start Guide*

2.0 Precautions

Observe the following precautions for your safety and the safety of your A704-5 Wireless Lighting System.

2.1 Viewing Precautions

Infrared Light Emitting Diode (LED) Viewing

Do not view a Model A704-5 actively emitting infrared or visible light from the side of the light (close to or on beam) from a range of less than 4 feet (1.2 meters). Please see the following diagram for further details.

A safe limit for near-infrared viewing, established by the American Conference of Governmental and Industrial Hygienists (ACGIH), is 65mW/in^2 (10mW/cm^2) as the maximum exposure limit for viewing for up to 16 minutes. This power density can be produced by a Model A704-5 at the lens surface when actively emitting infrared light. High-power visible-spectrum LEDs also pose an eye safety risk if viewed inappropriately.

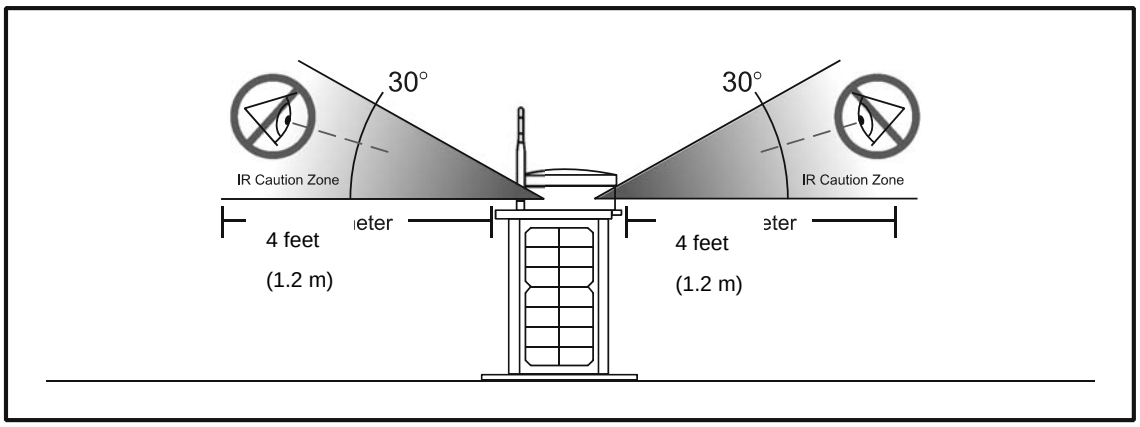

Figure 2-1: LED Viewing Precautions

2.2 Battery Precautions

Use extreme caution when handling the light. This product is capable of generating enormous short-circuit currents. Remove all jewelry (bracelets, metal-strap watches, rings) before attempting to handle or remove the batteries.

Take care when connecting or disconnecting cables. A damaged cable can cause problems with the electrical circuit. For instructions on disconnecting and reconnecting the batteries within the light, see Appendix A: Battery Replacement.

2.3 Electrostatic Discharge (ESD) Precautions

If performing maintenance procedures:

- Before performing any light maintenance, dissipate static electricity by touching one of the four head plate screws.
- When possible, use a properly grounded antistatic wrist strap.
- Prevent damage to the connectors by aligning connector pins carefully before you connect the cable. Misaligned connector pins can cause damage to system components at power-on.

2.4 Storage Precautions

When in storage, the A704-5 light will require periodic recharging to maximize the life expectancy of its batteries. The interval between recharging is dependent upon the temperature where the light is stored. *Table 2-1: Recharge Intervals* provides the recommended maximum storage interval between charging as it relates to storage temperature.

The rate of battery self-discharge is very dependent upon temperature. The warmer the temperature, the faster the batteries will discharge. Specifically, for every rise in temperature of 16 degrees Fahrenheit, the battery storage life is reduced by one-half. Storage in a cool area (under 68 degrees Fahrenheit) is recommended.

Table 2-1: Recharge Intervals

Storage Temperature		**Recharge Interval [Months]**
˚C	**˚F**	
20 or lower	68 or lower	3
20 to 40	68 to 104	1
40 or higher	104 or higher	Twice Monthly

See section *9.0 Maintenance and Product Care* for information on recharging the A704-5 light.

2.5 Wireless Precautions

- Keep the controller at a distance of at least three feet (one meter) from the antennas of lights or other controllers. The controller sends out a powerful radio signal that could damage sensitive receiver circuitry if operated at close range.
- Ensure the antenna is attached to the wireless controller and light before operating. Failure to do so can result in damage to the product and voiding warranty.
- Firmly tighten the light and controller antennas by hand. Do not use tools.

2.6 Other Precautions

- Do not lift the light by the top solar panel; use the handle.
- Do not clean any part of the light with abrasive cleaners; use a soft cloth with mild soap and water.
- Do not install antennas or other connectors when there is dirt, moisture, or debris on the connectors. The contacts can be cleaned with a jet of compressed air or an ozone-friendly gas.

3.0 Component Identification

3.1 Model A704-5 Light

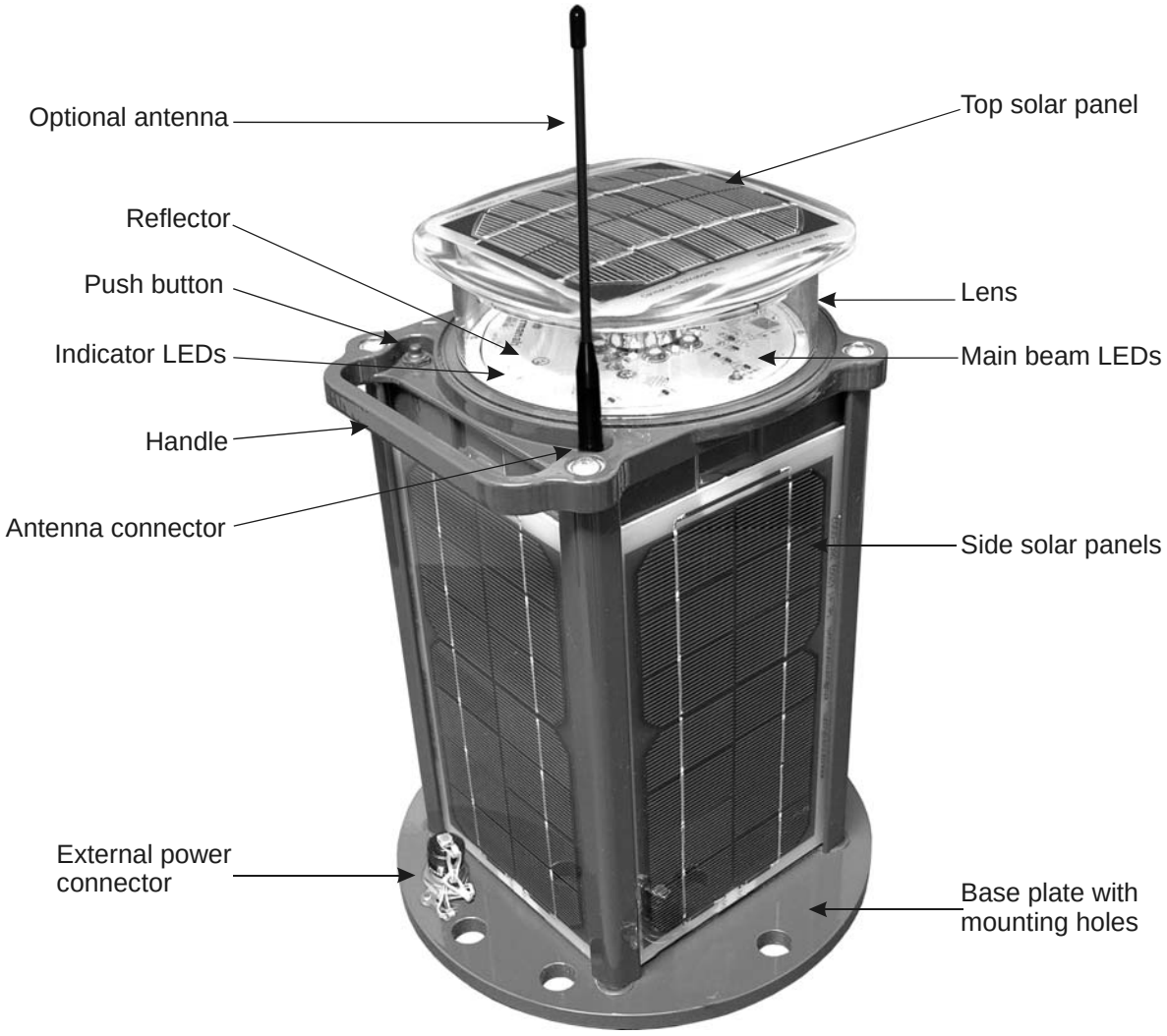

Figure 3-1: Model A704-5 Light Component Identification

3.2 Wireless Controller

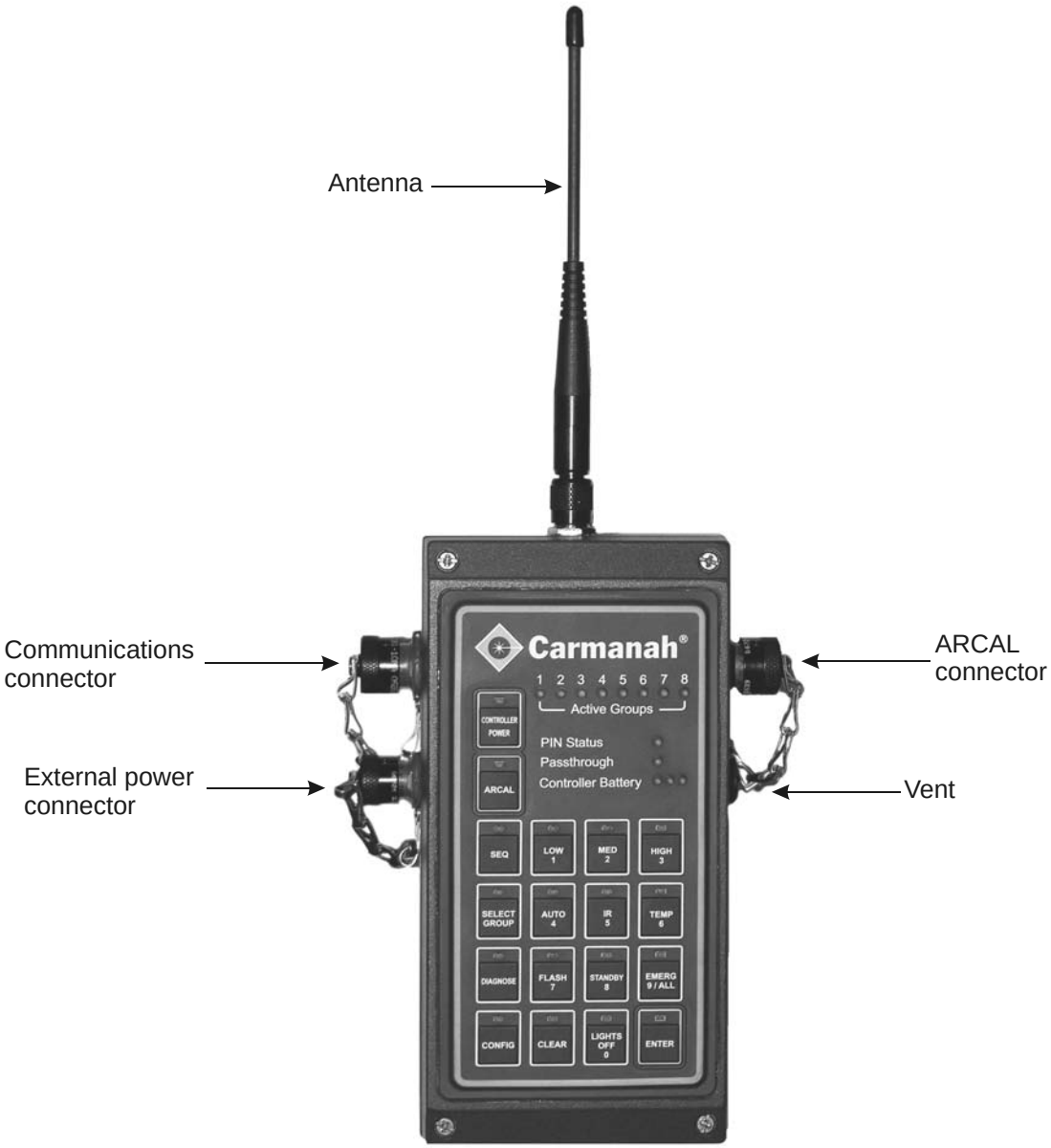

Figure 3-2: Wireless Controller Component Identification

4.0 Model A704-5 Aviation Light Operation

4.1 Understanding the Product

The model A704-5 aviation light is available in wireless and non-wireless models. This manual refers primarily to the wireless version.[1]

The Model A704-5 Aviation Light does not require an external power supply. It operates using solar-charged replaceable batteries that are typically maintenance-free for up to five years. The main body of the Model A704-5 consists of a rugged aluminum housing that contains the batteries, an external power connector (for attaching an external DC charger), and four solar panels mounted on the sides. The top head/lens assembly consists of:

- a push button for control of light functions
- electronics
- light emitting diodes (LEDs) and optics all enclosed within a clear polycarbonate lens
- a top solar panel, and
- an antenna (optional)

Installing the light requires no special training and can be done easily and quickly.

Unlike conventional airfield lights, the Model A704-5 Aviation Light offers six distinct output modes:

- Three 'Autonomous' output modes for continual sustained dusk-to-dawn operation
- Three 'Temporary' high-intensity output modes for short-term operation

Each output mode can be selected by pressing a push button on the light itself or by using the optional wireless controller. If the light needs to be extinguished immediately, a single press of the push button places the light into Standby Mode. When in Standby Mode the Model A704-5 will not illuminate until the next nightfall.

During the day, the Model A704-5 charges from sunlight. The capacity of the Model A704-5's battery ensures that even with poor levels of sunlight over extended periods, the light has enough reserve power to continue to perform reliably. The Model A704-5 is completely power-autonomous; wiring to an external power supply is not required in most cases. This independence allows the Model A704-5 to be deployed in locations where external power is hard to access or unavailable. If continuous high-intensity output is desired, external power can be supplied via the power connector in the light's base. On models equipped with the IR option, infrared LED operation can also be selected.

If the Model A704-5 does not detect daylight for twenty-four hours, it will automatically turn itself off and go into Ship Mode. For more information, see Ship Mode in section *4.3.2 Push Button Operation*.

4.2 Model A704-5 Light Quick Start Guide

This guide provides instructions to follow upon initial receipt of the Model A704-5 lights. Detailed operational and programming instructions are described later in this owner's manual.

1. Upon receiving the Model A704-5 light, follow these steps:
2. Unpack the light from the box it was shipped in and remove the warranty card. Keep the shipping box intact and organized – do not discard the box or cardboard inserts.
3. If the A704-5 lights are equipped with the optional wireless control system, remove the dust cap on the antenna connector, and thread on the removable antenna. Firmly tighten the antenna by hand. Store the dust cap for later use by fitting it snugly on the tip of the antenna.

[1] Note: The wireless A704-5 does not transmit, but rather receives transmissions.

4. Place all the lights physically close together – preferably in a dark place that is dark enough to observe the LED operation and so that the light thinks that it is night.
5. The lights will all be in Ship Mode. To get the lights out of Ship Mode, quickly press the small black push button switch on the top of the light (to the left of the handle) twice. Quick presses are required – do not hold the button down for more than half a second. (If the lights are in a dark location, they will turn on in the Autonomous Low setting shortly after the button presses.)

The lights are now ready to accept further programming commands using either the push button, or the wireless controller (for lights with the wireless control system). The lights can now be deployed, and will operate in the equipped mode (Autonomous Low) from dusk until dawn.

For further information on programming and advanced operation see section *4.3 Programming Options*.

4.3 Programming Options

There are two options for programming the Model A704-5 light:

Push Button: The black push button on the top of the Model A704-5 allows manual programming of the Model A704-5 features and operation.

Wireless Controller: The wireless controller is capable of performing all push button operations as well as several advanced operations. See section *5.0 Wireless Controller Operation*.

4.3.1 Indicator LEDs

Located near the push button inside the lens are three small indicator LEDs that light up as either green, amber or red. (See section *3.0: Component Identification*).

Indicator LEDs are used to:

- Guide push button operation (for more detail, see section 4.3.2 Push Button Operation)
- Indicate diagnostic information such as battery state of charge
- Indicate operating state after the button has not been used for 10 seconds:
  - The green indicator LED flashes once every 2 seconds when the light is not in Ship Mode or optional Infrared Mode.
  - The amber indicator LED flashes once every 2 seconds when the light is charging, using its solar panels, or once every second when charging via the external power connector.
  - When the light is in Ship Mode, no indicator LEDs will light unless the light is charging.
  - When the light is in Infrared Mode (optional), no indicator LEDs will light or flash.

4.3.2 Push Button Operation

The two types of button presses that will be accepted by the light as programming commands are:

Hold: Pressing and holding the button down for several seconds cycles through the Model A704-5 command levels (see *Table 4-1: Overview of Command Levels and Modes*). Each command level is indicated by the number of flashes from the amber indicator LED; one blink indicates the first level, two blinks indicates the second level, etc. The amber indicator LED indicates acceptance of a command for a button hold by flashing one to five times depending on the command level. Once the desired command level has been reached, release the push button.

Press: Pressing the button for a fraction of a second enters the command within that level. The green indicator LED indicates acceptance of a button press by flashing the same number of times afterwards. The red indicator LED flashes three times if the command has not been accepted due to button lockout. You must press the push button within 10 seconds of releasing the hold, otherwise the light will exit the Programming Mode.

Table 4-1: Overview of Command Levels and Modes illustrates the order of commands and modes for programming the Model A704-5. This table is followed by a description of the light's operation in each mode. Read this table from left to right.

Table 4-1: Overview of Command Levels and Modes

Step 1: Choose Command Level		**Step 2: Choose Command – Action (Response)**				
	Command Level	1 press (1 Green Indicator LED Flash)	2 presses (2 Green Indicator LED Flashes)	3 presses (3 Green Indicator LED Flashes)	4 presses (4 Green Indicator LED Flashes)	5 presses (5 Green Indicator LED Flashes)
(No Amber Flash)	0: Autonomous	Standby Mode[2]	Autonomous Low	Autonomous Med	Autonomous High	Flash Toggle
(1 Amber Flash)	1: Temporary	Temp Low	Temp Med	Temp High	No action	No action
(2 Amber Flashes)	2: Ship	Ship Mode	**Do Not Use**[3]	**Do Not Use**[4]	No action	No action
(3 Amber Flashes)	3: Infrared	Infrared Toggle	No action	No action	No action	No action
(4 Amber Flashes)	4: Diagnostics	Battery Check	UCS Status	No action	No action	No action
(5 Amber Flashes)	5: Configuration	No action	Button Lock Toggle	Temp Timeout Toggle	No action	Factory Reset

[2] If the light is switched directly from Standby Mode to Autonomous mode, the light will remain off until the next time it detects a day-to-night transition. When this is done in low lighting conditions such as an office or warehouse, the light will NOT turn on because it considers it to be nighttime and is awaiting the next day-to-night transition before illuminating. If you would like to force the light to turn on in Autonomous mode to verify the light illuminates, place it in a Temporary mode first and then into an Autonomous mode. The light will now illuminate immediately in low lighting conditions.

[3] For engineering test purposes only. Use may result in unpredictable behavior of the light.

[4] For engineering test purposes only. Use may result in unpredictable behavior of the light.

Some finer points of button usage include:

To more quickly cycle through the command levels, try releasing the button briefly when each amber flash occurs, and then pressing it down again (e.g. for command level 3: hold the button until the amber LED flashes once, then release it briefly and hold it down again until the amber LED flashes twice, release briefly and hold down until it flashes three times).

Example: To set the Model A704-5 to Ship Mode, follow these steps:

1. Hold the push button down. The amber indicator LED will blink once after approximately two seconds and twice after approximately four seconds.

Release the push button.

Immediately press the button once. The green LED will blink once to confirm one press. The red LED will then briefly flash as the light enters Ship Mode.

The Model A704-5 is now in Ship Mode.

In the following sections, shorthand terminology is used to refer to particular push hold / button press sequences in the format: [x, y] specifying hold for x amber flashes, press y times followed by y green flashes. For example, [0, 5] is Flash Toggle; [4, 1] is Battery Check. [0] = no hold; proceed directly to the press.

Button Sequence [0, 1]: Standby Mode

Button sequence [0, 1] puts the Model A704-5 in Standby Mode. This will immediately extinguish the light, and the light will resume autonomous operation at its last set Autonomous Output Mode after detecting a day-to-night transition.

If a light is in a Temp Mode and is put into Standby Mode, it reverts to the last programmed Autonomous setting (and will turn on in the next day-night transition).

Button Sequence [0, 2-4]: Autonomous Output Modes

The Model A704-5 has three Autonomous Output Modes: low, medium, and high intensity. These are the standard operating modes for dusk to dawn operation when the light is deployed differing by light intensity. The Autonomous Modes operate independently of an external power source as long as local sunlight conditions can adequately sustain the battery state of charge.

If the light is put into an Autonomous Mode during the day or in a bright environment, the main LEDs will remain off until the light senses nightfall. If the Model A704-5 is programmed to the Autonomous Mode at night or in low-light conditions, the main LEDs will be on until daylight is detected.

Button [0, 5]: Flash Toggle

The flash toggle setting alternates the light between steady-on or flashing. In Flash Mode, the light flashes at once per second (0.3 seconds on, 0.7 seconds off). The three Autonomous Output Modes (low, medium and high) can be either steady-on or flashing.

When in Autonomous Mode, the Model A704-5 may automatically decrease its intensity if it detects that it does not have sufficient battery charge to continue autonomous operation at that brightness. When the Model A704-5 detects that it is receiving sufficient battery charge to resume autonomous operation at the original user setting, it revert to its original intensity. For more information, see section *4.3.3 Automatic Light Control (ALC)*.

Button Sequence [1, 1-3]: Temporary High-Intensity Modes

The Model A704-5 has three temporary, high-intensity output modes: low, medium, and high. These modes are typically used when the Model A704-5's maximum or near maximum output is required for a brief period of time – such as poor visibility due to bad weather conditions. To activate a high-intensity output mode, use [1, 1] for low, [1, 2] for medium, and [1, 3] for high. Day or night, the Model A704-5 will immediately turn on at the selected temporary high-intensity setting, and will remain on for **one hour**. At the end of this hour, the Model A704-5 will resume operation in its last set Autonomous Mode. The high-intensity output can be cancelled by selecting an Autonomous Output Mode or by setting the Model A704-5 into either Standby Mode [0, 1] or Ship Mode [2, 1].

Prolonged and repeated use of high-intensity settings of the Model A704-5 will cause rapid battery depletion and use more energy than the solar panels can collect in a day. It is important to budget energy use to match solar conditions.

If the Temporary Timeout [5, 3] toggle is off and there is external power applied to the Model A704-5, then the light will remain in a programmed temporary high-intensity setting until commanded otherwise (or until the light detects that external power is no longer available). For more on this, see Button Sequence [5, 3] Temporary High-Intensity Mode Timeout.

If the wireless handheld controller is used to invoke a temporary High-Intensity Mode, the lights will remain on for only 15 minutes before resuming their last Autonomous Mode. See section 5.6.4 Temporary Operation Mode.

Output peak intensities for each setting are as follows:

Table 4-2: Output Intensities (based on Warm White LEDs)

	Visible LEDs				Infrared (870nm) LEDs (optional)	
Intensity	**Autonomous Steady-on**	**Autonomous Flashing**	**Temp-Steady-on**	**Temp-Flashing**	**Steady-on**	**Flashing**
Low	6 cd	10 cd	52 cd	34 cd	15 mW/sr	9 mW/sr
Med	10 cd	20 cd	63 cd	43 cd	30 mW/sr	18 mW/sr
High	16 cd	32 cd	95 cd	57cd	60 mW/sr	36 mW/sr

The flashing intensities in *Table 4-2: Output Intensities (based on Warm White LEDs)* are effective intensities derived using the Schmidt-Clausen method

Autonomous steady-on and flashing modes at a given intensity setting (Low, Medium or High) provide the same autonomy. Temporary flashing modes offer greater autonomy than Temporary steady-on modes, for a given intensity setting (Low, Medium or High). This is why the Autonomous flashing intensities in *Table 4-2: Output Intensities (based on Warm White LEDs)* are higher than the Autonomous steady-on ones, and the Temp flashing intensities are lower than the Temp steady-on ones.

Button Sequence [2, 1]: Set Ship Mode

Ship Mode is used for shipping or long-term storage to preserve battery life. To set the Model A704-5 into Ship Mode, hold the button until the amber LED flashes twice, then release. Immediately press the button once to put the Model A704-5 into Ship Mode. When in Ship Mode, the Model A704-5 will remain off until the push button is pressed. A day-to-night transition will not activate the Model A704-5 when in this mode. Only an Autonomous or Temporary command-level push button input will activate it (see *Table 4-1: Overview of Command Levels and Modes*).

A704-5 lights equipped with the wireless control system will not respond to wireless commands when in Ship Mode.

Button Sequence [3, 1]: Infrared Toggle

Observe precautions when the Model A704-5 is in IR Mode. Refer to section *2.1 Viewing Precautions* for details.

If the infrared LED option is installed on your Model A704-5, it can be toggled between Visible Light Mode and IR Mode. To toggle into IR Mode, use button sequence [3, 1]. Repeat this sequence to toggle the Model A704-5 back into visible light operation.

If your Model A704-5 lights aren't equipped with the optional infrared LEDs, the infrared toggle will have no effect. The Model A704-5 will continue to operate in the visible light mode last set.

When infrared mode is toggled on, the Model A704-5 will continue operating in whatever mode it was previously programmed for (i.e. intensity and flash/steady on), except that it will be emitting infrared instead of visible light. The indicator LEDs will not display anything when the light is in IR Mode, to prevent the Model A704-5 from emitting any visible light.

Button Sequence [4, 1]: Battery Status Check

To determine the battery status of the Model A704-5, use button sequence [4, 1] to request a battery status check. The indicator LEDs will show the battery status for 10 seconds as follows:

Table 4-3: Battery Indicator LEDs

Indicator LED Response While in Battery Status Check Mode	Corresponding Battery Charge
Green	75% – 100%
Amber	50% – 75%
Red	5% – 50%
Flashing Red	Less than 5%

Low battery state: If the detected battery charge at any time falls below 5%, the light will enter the low battery state. In this mode the light will emit a short flash once every minute (either in visible or IR light depending on its setting). The light will not exit low battery state until the detected battery level exceeds 40% for 10 minutes. On exit from low battery state, the light will enter its previously set autonomous state.

Lights may report artificially high battery levels during and immediately following charging (both solar and via the optional AC/DC charger).

Button Sequence [4, 2]: UCS Status

To determine if the UCS is enabled or disabled on the A704-5, use button sequence [4, 2] to request the UCS status. The indicator LEDs will blink **3 times** to show the UCS status as follows:

Table 4-4: Indicator LEDs

Indicator LED Response While in UCS Status Check Mode	UCS Status
Amber	Enabled
Red	Disabled (default)

Button Sequence [5, 2]: Push Button Lock Toggle

The Model A704-5 switch can be locked so that inadvertent button presses will not accidentally modify the light's operation. This is a useful feature for transporting the light, or for when it is important that it not be accidentally reprogrammed in the field. To lock or unlock the light, use button sequence [5, 2]. Red flashes indicate when the light enters locked mode, and two green flashes when the light exits locked mode. When locked, the red indicator LED will flash three times each time any other command is given, other than the unlock command, to indicate that the light is in this mode.

Button Sequence [5, 3]: Temporary High-Intensity Mode Timeout

This function toggles on/off the Temporary High-Intensity Timeout (Temp Timeout). With the Temp Timeout toggle is on, the light always stays on for one hour when placed into a temporary high-intensity setting using the pushbutton switch. When the Temp Timeout toggle is off, and the light senses that it's connected to an active 12V DC source, the light will stay on indefinitely when placed into a temporary setting. Regardless of the Temp Timeout toggle setting, if the light senses that it's not connected to a 12V DC source, it will stay on for one hour to avoid overly depleting the batteries.

Table 4-5: Indicator LEDs

	Light behavior when put in a Temporary High-Intensity Mode using the pushbutton switch	
Temp Timeout Toggle Status	**12V DC detected**	**12V DC not detected**
On (default)	Turns off after 1 hour	Turns off after 1 hour
Off	Stays on until 12V DC not detected	Turns off after 1 hour

Button Sequence [5, 5]: Factory Reset

This will reset the A704-5 light back to the factory defaults, meaning that you will not be able to use the light with the wireless controller if it has been configured with a UCS.

The A704-5 light uses the following factory defaults:

- Autonomous Low
- Flashing Off
- Infrared Off
- Temporary Timeout On

A704-5 lights equipped with the wireless control system are configured with these additional settings:

- Assigned to Group 1
- UCS Disabled

4.3.3 Automatic Light Control (ALC)

Automatic Light Control (ALC) is a patented algorithm that allows the light to adjust its energy consumption to the amount of sunlight available to charge the batteries. This ensures the light will continue to operate through periods of limited sunlight.

ALC is always enabled in the Model A704-5 for Autonomous Modes and it is not user configurable. ALC is disabled for Temporary High-Intensity Modes.

These thresholds are not to be confused with battery state-of-charge thresholds.

Table 4-6: ALC Dimming Levels

State of Charge	ALC Dimming Level
60% - 100%	100% intensity
50% - 60%	75% intensity
40% - 50%	50% intensity
0% - 40%	25% intensity

4.3.4 24-Hour Shutoff

If the Model A704-5 senses ambient light levels of 30 lux or less for 24 consecutive hours, it will assume it is being stored and automatically enter Ship Mode to preserve the battery. The ambient light thresholds are set so that a very dark winter season will not cause the Model A704-5 to enter Ship Mode unintentionally.

The A704-5 will still charge while in Ship Mode as long as sunlight is available or if external power is connected.

5.0 Wireless Controller Operation

Keep the controller at a distance of at least 3 feet (1 meter) from the light.

5.1 Proper Antenna Orientation

The effective range of the transmitter is 2.5 miles (4 km) for the 1 watt controller and ~1.2 miles (~2 km) for the ½ watt controller, depending on the location. The antenna's range is most effective when pointed parallel to the light's antenna. See the diagrams below for more detail.

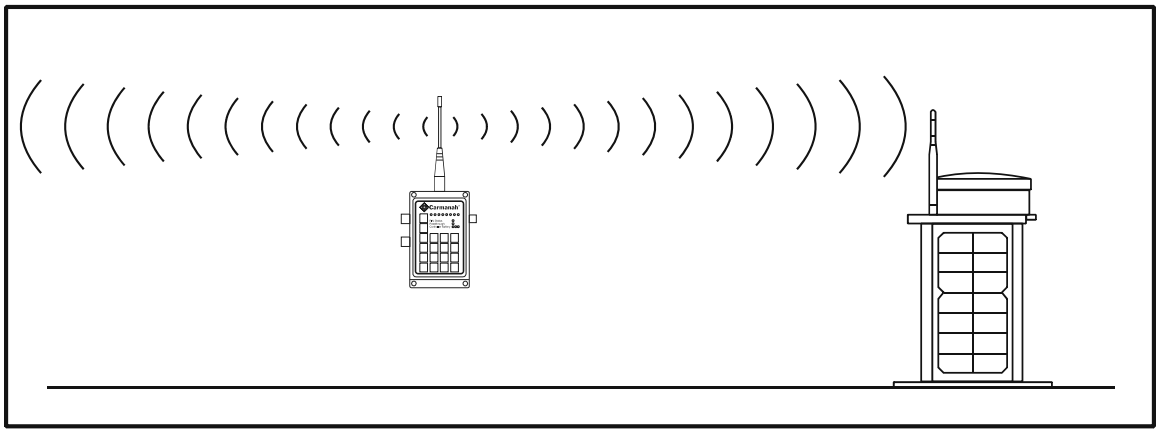

Figure 5-1: Correct Orientation of Controller Antenna to Light

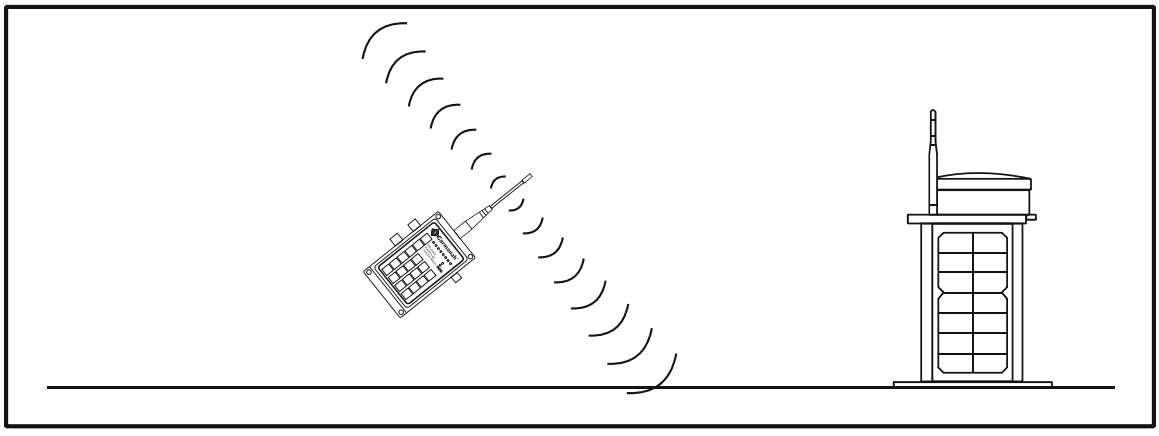

Figure 5-2: Incorrect (less effective range) Orientation of Controller Antenna to Light

5.2 Understanding the Controller

The A704-5 wireless controller is made of rugged aluminum with a sealed backlit keypad and a 900 MHz transceiver. The wireless controller enables secure configuration and operation of the A704-5 light and is designed to withstand water immersion.

The controller uses a tactile keypad interface and features the following capabilities:

Model A704-5 Light Control

The controller allows for wireless operation of all the functions available through the push button as well as additional features. Light Control allows for the changing of light intensities, powering the light on/off and flash pattern.

Grouping

The A704-5 controller allows A704-5 lights to be grouped for convenience, enabling configuration or operation instructions to be sent to any of eight predefined subsets of A704-5 lights, or all A704-5 lights. For example, a set of helipad lights can be configured as a group and therefore controlled independently from lights on a main landing strip.

Unique Code Sequence (UCS)

The UCS feature allows one or more controllers to be uniquely associated to one or more A704-5 lights. When UCS is enabled, the controller sends a UCS with each radio transmission; only lights configured to accept that particular UCS will respond to the transmission. The UCS feature has several benefits:

1. Added security: in the event that a controller is stolen or lost, a new UCS can be configured between the new controller and the lights. This prevents the stolen or lost controller from being used by unauthorized persons to control the lights.

Independent operation: nearby installations of lights can be operated independently by different controllers without interference. The A704-5 wireless system can operate at ranges up to 2.5 miles (4 km). For example, two islands, 1 mile (2 km) apart, could each have an airfield equipped with A704-5 lights. With UCS enabled, each island's controller will only control the lights on its airfield.

To use UCS on an airfield, all lights must be configured for UCS. The system cannot control UCS configured and non-UCS configured lights at the same time.

For more information on UCS, see section *5.8.3 Unique Code Sequence (UCS) Management*.

Battery Charge State and Charging

The controller is powered by an internal rechargeable battery. The battery charge is indicated by one of three multicolored LEDs:

- Green indicates 75% or greater charge
- Amber indicates the charge level is between 50% and 74%
- Red (solid) indicates that the battery level is below 50% and that the light soon requires recharging
- Red (flashing) indicates the battery level is very low, and requires recharging immediately

A universal wall charger is included with each controller. It is strongly recommended that the controller be allowed to fully charge before each use by plugging it into the wall charger. This will maximize the life of the battery.

5.3 Wireless Controller Quick Start Guide

1. Be sure to maintain a distance of at least three feet (one meter) between the radio and the lights when sending commands.
2. Unpack the controller and verify that it is operational by pressing the CONTROLLER POWER button. All LEDs on the controller will flash briefly. Next, the CONTROLLER POWER button LED will then light to indicate power is on and the PIN STATUS red LED will light to indicate a Personal Identification Number (PIN) must be entered. The controller battery status LED will also be lit.
3. Ensure that the antenna is screwed into the controller.
4. Ensure the lights are not in Ship Mode by briefly pressing the lights' push button.
5. The controller is PIN protected to prevent unauthorized access and control of the A704-5 lights. Before the controller will operate a PIN must be entered. (The default PIN is 123; to change this PIN, see section *5.8.1 Changing PINs* for details.)
   a. Press 1, 2, 3. As the PIN is entered the ACTIVE GROUP green LEDs will light to indicate the number of digits pressed.
   b. Press ENTER.
   c. The PIN STATUS red LED will turn off to indicate the controller has accepted the PIN and is ready to be used to control A704-5 lights.

If the PIN is accepted, the ENTER key LED will briefly light green and PIN STATUS will turn off or begin to flash depending on whether the User or Administer Mode was selected. If the PIN is not accepted, the ENTER key LED will briefly light red and the PIN Status red LED will remain lit.

6. To verify that the radio control is functioning, press the following buttons on the controller: TEMP – HIGH – ENTER. All of the lights should turn on in the Temporary High Output Mode.
7. Once the radio control is verified, turn off all the lights: LIGHTS OFF – ENTER.

For instructions on unpacking the lights, preparing the antennas, and setting up the lights, see section *4.2 Model A704-5 Light Quick Start Guide*. For further operational instructions on your wireless controller proceed to the next section.

5.4 Wireless Controller Modes

The wireless controller function is divided into two modes:

- User Mode
- Administrator Mode

5.4.1 User Mode

User Mode allows an operator to control one or more A704-5 lights with the operations listed in sections *5.6 Basic User Operations* and *5.7 Advanced User Operations*. In User Mode, the wireless controller turns off after 60 minutes of inactivity to avoid unauthorized access and to maximize battery life.

When the controller is in User Mode, the PIN Status red LED is off.

5.4.2 Administrator Mode

Administrator Mode allows an operator access to the following management operations of the wireless controller.

- Personal Identification Number (PIN) Management
- Unique Code Sequence (UCS) Management
- ARCAL Entry

In Administrator Mode, the wireless controller turns off after 10 minutes of inactivity to avoid unauthorized access to management operations.

When the controller is in Administrator Mode, the PIN Status red LED flashes and the CONFIG green LED is lit.

5.4.3 Mode Selection

User and Administrator modes each have a unique PIN associated with them. When the controller is turned on, this unique PIN is used to select the Operational Mode of the controller. To change modes, the controller must be powered off and then on again, and the appropriate PIN entered.

To power off the controller, press the POWER button.

5.5 PIN Entry

Turn on the wireless controller by pressing the POWER button. To use the wireless controller after turning it on, a PIN must be entered; the red PIN Status LED turns on steady to indicate this. As the PIN is entered, the ACTIVE GROUP green LEDs will light to indicate the number of keys pressed. Press the ENTER key to submit the PIN.

The wireless controller factory default PINs are shown in Table 8: Default PINs.

Table 5-1: Default PINs

Mode	Default PIN
User	123
Administrator	789

If the PIN is accepted, the ENTER key LED will briefly light green and PIN STATUS will turn off or begin to flash depending on whether the User or Administer mode was selected. If the PIN is not accepted, the ENTER key LED will briefly light red and the PIN Status red LED will remain lit.

5.6 Basic User Operations

This section outlines the basic user operations of the wireless controller.

5.6.1 Turning the Controller On

To start using the system, press the CONTROLLER POWER button. All LEDs on the controller will flash briefly to indicate they are functioning. After the LEDs flash briefly:

- The CONTROLLER POWER button green LED will light steady to indicate power is on.
- The PIN STATUS red LED will light steady to indicate a PIN must be entered.

5.6.2 Entering the PIN

The controller is PIN protected to prevent unauthorized access and control of the A704-5 lights. Before the controller will operate, a PIN must be entered.

- Press 1, 2, 3. As the PIN is entered, the ACTIVE GROUP green LEDs will light to indicate the number of digits entered.
- Press ENTER.
- The PIN STATUS red LED will turn off to indicate the controller has accepted the PIN and is ready to be used to control A704-5 light(s).
- The green ENTER LED will flash once.

123 is the default user PIN. To change this PIN, see section *5.8.1 Changing PINs*.

5.6.3 Autonomous Operation Mode

AUTO is an autonomous setting – when set in this mode, the light(s) will turn on from dusk to dawn automatically at the selected intensity level. They can be programmed day or night; however, they will not turn on in the daytime when programmed in the daytime.

To turn on the light(s) in Autonomous Operation Mode:

- Press the AUTO button
- Press intensity level LOW, MED, or HIGH
- Press ENTER

A704-5 lights in AUTO Mode located near other lights (within 1 foot) may turn off due to the light emitted from them.

5.6.4 Temporary Operation Mode

Lights set to temporary high-intensity operation using the controller will remain at this intensity for 15 minutes before returning to their previously set Autonomous Mode. If a light is connected to a 12V DC power source and the Temporary Timeout has been turned off by the push button, the light will stay in the Temporary High-Intensity Operation.

To turn on the lights in TEMP Mode:

- Press the TEMP button
- Press intensity level LOW, MED, or HIGH
- Press ENTER

5.6.5 Steady on vs. Flash Mode

The FLASH button allows control of Flash Mode in any of the above modes.

To turn on lights in AUTO Mode with flash:

- Press the AUTO button
- Press intensity level LOW, MED, or HIGH
- Press FLASH
- Press ENTER

To turn off flash:

- Press FLASH (the FLASH button LED off)
- Press ENTER

5.6.6 Visible vs. Infrared (IR) Mode

The IR button will turn on/off Infrared Mode in any of the above modes.

To turn on lights in IR TEMP Mode:

- Press TEMP button
- Press intensity level LOW, MED, or HIGH
- Press the IR button (turning the IR button LED on)
- Press ENTER

Only those A704-5 lights with Infrared option will go into Infrared Mode. Model A704-5 lights without infrared option will ignore this command and stay in Visible Mode.

To turn off Infrared Mode:

- Press the IR button (turning the IR button LED off)
- Press ENTER

5.6.7 Standby Mode

Standby Mode turns off all lights until the next nightfall.

To go into standby mode:

- Press STANDBY
- Press ENTER

5.6.8 Lights Off Mode

If the lights are placed in Lights Off mode they **will not** automatically turn on at the next day-night transition.

Lights Off Mode turns off all lights until they are turned on again by the wireless controller or the push button on the light.

To turn off lights:

- Press LIGHTS OFF
- Press ENTER

Lights in Standby Mode do not accept the Lights Off command; the A704-5 light must be on to accept the Lights Off command.

5.6.9 Emergency Mode

Emergency Mode sets all lights in all groups to emergency flash. After 15 minutes the lights will revert back to their previous autonomous state.

To activate Emergency Mode:

- Press EMERG/ALL
- Press ENTER (all groups become active)

To cancel Emergency Mode:

- Press EMERG/ALL (Clears the EMERG LED)
- Press ENTER (The previously selected groups become active)

5.6.10 Clear

Pressing **CLEAR** deselects all buttons pressed since ENTER was last pressed.

Turn controller off.

5.7 Advanced User Operations

This section outlines the advanced user operations of the wireless controller.

5.7.1 Battery Diagnose Function

The Diagnose function sends a command to the lights to display the charge level of the batteries.

Lights within the following battery charge ranges will identify themselves by responding with five (5) flashes. The light must be steady-on state for the flashes to be visible:

- DIAGNOSE, HIGH: 75% to 100%
- DIAGNOSE, MED: 50% to 75%
- DIAGNOSE, LOW: 5% to 50% (not including Low Battery State)
- DIAGNOSE, Lights Off: Low Battery State (5% or less)

To enter Diagnose Mode on the controller:

- Press DIAGNOSE (The DIAGNOSE LED starts flashing)
- Press ENTER (The DIAGNOSE LED turns on)

To send the Diagnose command to the lights:

- Press (one of) HIGH, MED, LOW or Lights Off.
- Press ENTER

To exit diagnose mode on the controller:

- Press DIAGNOSE (The DIAGNOSE LED starts flashing)
- Press ENTER (The DIAGNOSE LED turns off)

5.7.2 Radio Health Diagnose Function

The Radio Health Diagnose function sends a command to the lights to display a radio health indication. The A704-5 light continually monitors the health of its radio module and automatically restarts the radio if needed. A count is kept of these restart events; intermittent radio problems are thus automatically recovered from and are very likely to go unnoticed in normal operation. For chronic radio health issues, the A704-5 light will automatically flash five times every minute.

To enter Diagnose Mode on the controller:

- Press DIAGNOSE (The DIAGNOSE LED starts flashing)
- Press ENTER (The DIAGNOSE LED is on)

To send the Radio Health Diagnose command to the lights:

- Press EMERG/ALL
- Press ENTER

Lights with radios that have needed one or more automatic restarts will identify themselves to the remote operator by responding with five flashes:

To send the Radio Health Diagnose (Clear) command to the lights:

- Press FLASH
- Press ENTER

All lights will flash five times indicating the radio health count has been cleared. A subsequent Radio Health Diagnose command will not produce a five-flash response until the radio module is restarted.

To exit Diagnose Mode on the controller:

- Press DIAGNOSE (The DIAGNOSE LED starts flashing)
- Press ENTER (The DIAGNOSE LED turns off)

5.7.3 Group Control

Up to eight individual groups of lights can be created, with any number of lights included in each group, and controlled independently. This feature provides added flexibility in controlling a complete airfield lighting system. The controller sends commands to one or more groups indicated by the LEDs on the controller labeled Active Groups. The factory default setting has all lights initially assigned to group one. Each light can be assigned to only one group at a time, but can be easily reassigned to another group as required. To select one or more groups of lights to control:

- Press SELECT GROUP.
- Press the group number(s) using the buttons 1 through 8.
- Press ENTER.

Commands entered now apply only to the groups indicated by the Active Group LEDs.

5.7.4 Configure Groups

To configure a subset of lights as a group:

Enter Configure Mode on the controller:

- Press CONFIG (The CONFIG LED starts flashing)
- Press ENTER (The CONFIG LED is on)

Then send the Configure Group command to the lights:

- Choose a number from 1 through 8 for the new group. Press the corresponding number on the keypad.
- For each individual light you wish to add to the selected group, press the switch on each light. The light is now prepared to receive its group assignment. The light will listen for its group assignment for 5 minutes
- Press ENTER on the controller to assign the group

The controller will transmit the group assignments and the light will flash to indicate acceptance. Do not use the switch on lights that you do not want in the new group while the group assignment process is underway. They will be added to the group.

When you provide group assignments, lights that are already members of that group will remain members after the assignment process is complete. This means that you can add lights to a group as you go, without having to re-assign all lights in the group

Any one light cannot be a member of more than one group.

When you finish configuring groups, exit Configure Mode on the controller:

- Press CONFIG (The CONFIG LED starts flashing)
- Press ENTER (The CONFIG LED turns off)

5.7.5 Keypad Backlighting

The keypad backlighting and LED brightness can be adjusted for optimal visibility in different amounts of ambient light. This backlighting and brightness can be set to the following three illumination levels by pressing and holding the CONFIG button:

1. Low level illumination LEDs with backlight.
2. Low level illumination LEDs with no backlight.
3. High level illumination of indicator LEDs with no backlight.

To conserve battery power the keypad backlighting dims after 30 seconds of inactivity. To restore the backlight without executing any command press the CONTROLLER POWER button briefly.

5.8 Administrator Operations

This section outlines the advanced Administrator Mode operations of the wireless controller. The controller must be in Administrator Mode to access any of the features described in this section.

To place the controller into Administrator Mode:

- Turn on the controller by pressing the CONTROLLER POWER button. All buttons flash briefly
  - The green LED on the CONTROLLER POWER button will turn on and the red PIN Status LED will be on steady
- Enter the default Administrator PIN 789
- Press the ENTER button
  - If successful, the PIN Status LED will begin to flash red continuously and the green LED on the CONFIG button will turn on

5.8.1 Changing PINs

To change the user or administrator PIN follow the steps outlined below.

The user and administrator PINs must be different.

To change the user PIN:

- Place the controller into Administrator Mode (reference 5.8, above)
- Press 1 (The 1 LED starts flashing)
- Press ENTER (The 1 LED becomes steady-on)
- Enter new PIN using numeric buttons (3-8 digits)
  - The Active Group LEDs will light up indicating how many digits have been entered.
- Press ENTER
  - The ENTER key LED will light green indicating an acceptable PIN, or red indicating the PIN does not have enough digits

- Re-enter the new PIN a second time to confirm
  - The Active Group LEDs will turn off as the PIN is entered
- Press ENTER
  - If both PINs match then the Enter key LED will briefly flash green
  - If the PINs do not match, or the PIN is the same as the Administrator PIN, the Enter key LED will briefly flash red

To change the Administrator PIN:

- Place the controller into Administrator Mode (reference 5.8, above)
- Press 2 (The 2 LED starts flashing)
- Press ENTER (The 2 LED becomes steady-on)
- Enter new PIN using digit buttons (3-8 digits)
  - The corresponding Active Group LEDs will light up indicating how many digits have been entered
- Press ENTER
  - The ENTER key LED will light green indicating a correct PIN or red indicating the PIN does not have enough digits
- Re-enter the new PIN a second time to confirm
  - The Active Group LEDs will turn off as the PIN is entered
- Press ENTER
  - If both PINs match then the Enter key LED will briefly light green
  - If the PINs do not match, or the PIN is the same as the User PIN, the Enter key LED will briefly light red and you will need to start again

Using the CLEAR key

- If the CLEAR key is pressed and no PIN digits have been entered the controller will return to Administrator Mode with no Administrator operations selected
- If the CLEAR key is pressed and at least one PIN digit has been entered, the controller will return to the start of the Change PIN operation

5.8.2 PIN Reset

Use this operation to reset both the user and administrator PINs to factory default:

- Place the controller into Administrator Mode
- Press 3 (The 3 LED starts flashing)
- Press ENTER (The 3 LED will turn off)
  - The ENTER key LED will light green indicating a correct operation or red indicating an incorrect operation.

5.8.3 Unique Code Sequence (UCS) Management

The UCS allows a unique code to be shared between the wireless controller and light(s). This code ensures the light(s) will only respond to commands from a wireless controller with the same UCS. The UCS can also be assigned to additional controllers for backup purposes or shared control.

UCS management is made up of 4 operations:

- Generation
- Transmission

- Removal
- Reception

This section details how to perform each operation. For detailed instructions on configuring an airfield for UCS see section *5.9 UCS Configuration*.

Generate UCS Operation:

- Place the controller into Administrator Mode
- Press 7 (The 7 LED starts flashing)
- Press ENTER (The 7 LED turns off)
    - The ENTER key LED will light green indicating a correct operation or red indicating an incorrect operation.

A new UCS has now been generated.

The newly generated UCS is not saved until a UCS transmission occurs; therefore, if UCS is generated unintentionally then it will not affect the current UCS.

Transmit UCS Operation:

Set the wireless controller to Transmit UCS operation:

- If the controller is not already in Admin Mode, place the controller into Administrator Mode.
- Press 9 (The 9 LED starts flashing)
- Press ENTER (The 9 LED will turn on)
    - The ENTER key LED will light green briefly to indicate a successful operation.

The controller is now in the Transmit UCS operation and will transmit the UCS every time the ENTER key is pressed. Pressing CLEAR will exit the Transmit UCS operation and return the wireless controller to Administrator Mode.

Remove UCS Operation:

- Place the controller into Administrator Mode
- Press 0 (The 0 LED starts flashing)
- Press ENTER (The 0 LED will turn off)
    - The ENTER key LED will light green briefly to indicate a successful operation.

The removed UCS is not saved until a UCS transmission occurs; therefore, if UCS is removed unintentionally it will not affect the current UCS

Receive UCS Operation:

- Place the controller into Administrator Mode
- Press 8 (The 8 LED start flashing)
- Press ENTER (The 8 LED will turn on)

The controller is now in the Receive UCS Mode is waiting for a UCS to be transmitted to it from another controller. Pressing CLEAR will exit the Receive UCS operation and return the wireless controller to Administrator Mode.

The ENTER LED on the controller will light briefly to indicate the UCS was received; the controller then exits Receive UCS Mode and return to Administrator Mode.

5.9 UCS Configuration

As a security precaution, the A704-5 lights have a five-minute window from the push button press to listen for the UCS. If the UCS is transmitted after the five-minute window, the A704-5 light UCS will ignore the controller's UCS command and will not flash. Follow directions to initialize that light.

Configuring an airfield system for UCS will normally involve the following operations:

- Initialization: generate the UCS in the wireless controller and lights
- Adding: add one or more lights to an existing UCS configuration
- Re-keying: transmit a new UCS to the airfield lights
- Removal: remove the UCS in the wireless controller and lights
- Reception: transmit the UCS to another wireless controller

The wireless controller can only store one UCS at a time. A UCS will be overwritten with a new one in the following circumstances:

- A Generate UCS operation is performed and it is followed immediately by a Transmit UCS operation
- A Remove UCS operation is performed and it is followed immediately by a Transmit UCS operation
- A Receive UCS operation is performed and a UCS is transmitted from another controller

There is no way to retrieve a UCS once it has been removed or overwritten, so it is recommended the UCS be transmitted to a backup controller.

Initialization

Both the wireless controller and A704-5 light arrive from the factory with UCS removed. Complete the following steps to initialize an airfield with a UCS:

1. If not already in Administrator Mode, put the controller into Administrator Mode; see section *5.4.2 Administrator Mode*.
2. Generate a new UCS using the controller (7, ENTER, see section *5.8.3 Unique Code Sequence (UCS) Management*).
3. Put the controller into Transmit UCS Mode (9, ENTER, see section *5.8.3 Unique Code Sequence (UCS) Management*).
4. Press the push button on the A704-5 light(s).
5. Transmit the UCS by pressing the ENTER button on the wireless controller, see section *5.8.3 Unique Code Sequence (UCS) Management* Unique Code Sequence (UCS) Management.
   - The A704-5 light(s) will flash for five seconds to indicate acceptance of the UCS.
6. When all lights have been initialized, press the CLEAR button on the wireless controller to exit Transmit UCS Mode.

If the lights are already deployed on the airfield, it may be easier to initialize a small set of lights at a time. To do this follow steps 1-5 for the first set and then follow steps 4-5 for each additional set.

Adding a Light to a UCS System

Adding allows additional lights to be included in an existing UCS configuration.

Complete the following steps to add a light to an airfield with an existing UCS configuration:

1. If not already in Administrator Mode, place the controller into Administrator Mode see section *5.4.2 Administrator Mode*.
2. Enter Transmit UCS Mode (9, ENTER, see section *5.8.3 Unique Code Sequence (UCS) Management*)
3. Press the push button on the A704-5 light(s)
4. Transmit the UCS by pressing the ENTER button on the wireless controller.
   - The A704-5 light(s) will flash for five seconds to indicate acceptance of the UCS.
5. When the additional lights have been added, press the CLEAR button on the wireless controller to exit Transmit UCS Mode.

This operation works for all lights (both non-UCS and UCS).

A704-5 lights previously initialized with the same UCS will also flash in response to the UCS transmission in Step 4

Creating a new UCS Re-keying

Re-keying allows a new UCS to be transmitted to all lights that have been initialized with the wireless controller. Carry out the following steps to re-key a light or group of lights:

1. If not already in Administrator Mode, place the controller into Administrator Mode (section *5.4.2 Administrator Mode*).
2. Generate a new UCS (7, ENTER, see section *5.8.3 Unique Code Sequence (UCS) Management*)
3. Enter Transmit UCS Mode (9, ENTER, see section *5.8.3 Unique Code Sequence (UCS) Management*)
4. Transmit the UCS by pressing the ENTER button on the wireless controller, see section *5.8.3 Unique Code Sequence (UCS) Management*.
   - The A704-5 light(s) will flash for five seconds to indicate that it received and accepted the new UCS.
5. When all lights have been re-keyed press the CLEAR button on the wireless controller to exit Transmit UCS Mode.

Re-keying only works for lights in which UCS has been initialized.

Removal

Removal disables the UCS in the wireless controller and A704-5 lights. Perform the following steps to remove the UCS from an airfield:

1. If not already in Administrator Mode, place the controller into Administrator Mode (see section *5.4.2 Administrator Mode*).
2. Remove the UCS (0, Enter, see section *5.8.3 Unique Code Sequence (UCS) Management*)
3. Enter Transmit UCS Mode (9, Enter, see section *5.8.3 Unique Code Sequence (UCS) Management*)
4. Press the pushbutton on the A704-5 light(s)
5. Transmit the UCS removal command by pressing the ENTER button on the wireless controller, see section *5.8.3 Unique Code Sequence (UCS) Management*
   - The A704-5 light(s) will flash for five seconds to indicate that it received and accepted the remove UCS command.

6. When the UCS has been removed from all lights, press the CLEAR button on the wireless controller to exit Transmit UCS Mode.

If some lights do not receive broadcasted UCS, they can be programmed individually by following the instructions within the section Adding a Light to a UCS System, above.

Copying the UCS to another Controller Reception

Reception allows a controller to receive a UCS from another controller. This allows two or more controllers to be configured for identical UCS, allowing them to be used for backup, emergency or loss of the primary controller. To transmit the UCS to another controller the following steps are performed:

In the steps below, controller A refers to the controller transmitting the UCS, and controller B refers to the controller receiving the UCS.

1. If not already in Administrator Mode, place both controllers into Administrator Mode (see section *5.4.2 Administrator Mode*).
2. Enter Receive UCS Mode on controller B (8, ENTER, see section *5.8.3 Unique Code Sequence (UCS) Management* Unique Code Sequence (UCS) Management).
3. Enter Transmit UCS Mode on controller A (9, ENTER, see section *5.8.3 Unique Code Sequence (UCS) Management* Unique Code Sequence (UCS) Management).
   - The ENTER LED on controller B will light briefly to indicate the UCS was received; controller B will then exit Receive UCS Mode and return to Administrator Mode.
4. Press the CLEAR button on controller 1 to exit the Transmit UCS Mode.

The controllers are now programmed with the same UCS, and either can be used to control lights configured with that UCS.

5.10 ARCAL Mode

The Aircraft Radio Control of Aerodrome Lighting (ARCAL) feature works in conjunction with an ARCAL VHF receiver to allow aircraft pilots to control the airfield lights. For more information about this feature, contact your Carmanah representative.

Enabling ARCAL:

1. Place the controller into Administrator Mode
2. Press ARCAL (The ARCAL LED starts flashing)
3. Press ENTER (The ARCAL LED is on)

The controller is now in ARCAL Mode.

Disabling ARCAL:

1. Place the controller into Administrator Mode
2. Press ARCAL (The ARCAL LED starts flashing)
3. Press ENTER (The ARCAL LED is off)
4. ARCAL is disabled and the controller is ready for the User or Administrator PIN to be entered.

5.11 Factory reset code

Factory reset returns the controller to the factory default settings. All passwords are reset and the UCS information (if enabled) is removed. The UCS light returns to its default state, which is UCS disabled.

To perform the Factory Reset:

1. Turn the controller off, and then turn it on.

   The PIN STATUS red LED will turn on to indicate the controller is ready to receive the password.

1. Enter the factory reset code: 1223334444
2. Press ENTER

All controller LEDs will turn on briefly, indicating a successful factory reset and then wait for a PIN to be entered.

6.0 Troubleshooting

Table 6-1: Troubleshooting

Symptom	Hypothesis	Verification	Solution	
The light is unresponsive to pushbutton and radio commands	The light is in Infrared Mode	The status LEDs will all be off (after 10 seconds of button inactivity), even if the light is taken out of Ship Mode.	Toggle Infrared Mode off	
	The light is in Low Battery state	The light will flash once every 60 seconds	Charge the light	
	The light battery has been discharged beyond Critical Low Battery	Measure the voltage on each of 4 cells, they should read no less than 2.0V	If the cells are lower than this, Critical Low Battery Recovery may be attempted alternately change the battery	
The light is unresponsive to radio commands (but works via pushbutton)	The light is configured in a different group than is active on the controller	Try using the controller in All Groups	Reassign light to a known group, or find out which group the light is assigned to.	
	The light has a different (unknown) UCS or the UCS has not been configured yet	None	Reconfigure light UCS	
	The light is in Ship Mode	All three indicator LEDs will all be off	Take out of Ship Mode	
	The controller and/or light antenna(s) are not installed.	Check to see if the antenna(s) are firmly installed	Install antenna(s) by tightening firmly by hand	
	No groups have been selected on controller.	Look at group LEDs on controller to see if lit.	Select all groups and confirm lights are operating through trial and error.	
	The light is encountering radio reset problem.	Perform the Radio Health Diagnostic (section *5.7.2 Radio Health Diagnose Function*)	Install antenna(s) by tightening firmly by hand	
The light is off in Autonomous Mode	The ambient brightness level is above 500 lux	Darken the environment and wait 10 seconds, does light turn on?	If yes: no problem	
			If no: is it in standby?	
	Lights in close proximity are shining on the light in question	Inspect distance between lights to see if one light within the cluster is on.	Turn off the surrounding lights	
The light flashes briefly every 10 seconds	The light is in Critical Low Battery (resetting)	The red indicator LED will be on for the majority of this time	Perform Critical Low Battery Recovery operation or replace the battery.	
The light flashes once every minute.	The light is in Low Battery state	Low battery state can be confirmed per steps in section *4.3.2 Push Button Operation* (press sequence [4,1])	Recharge the batteries per section *9.2 Charging Model A704-5 Light's Batteries*	
The controller is unresponsive/No LEDS	The battery needs charging.	Plug in the charger; do the Controller Battery LEDs cycle?	If yes: let the controller charge for approx. 12 hours.	
			If no: Is the power outlet on? (Do other devices function when plugged into the outlet?)	If yes: Is the charger functioning correctly? (In a dark place, connect the charger to an A704-5 light briefly: does the amber LED flash?) If so, the charger is working correctly. If the controller still does not work,

Symptom	Hypothesis	Verification	Solution	
				power cycle the controller, see Appendix B: Power Cycling the Controller.
The controller Passthrough LED flashes SOS (3 short, 3 long, 3 short)	The radio module may be faulty		Call Carmanah for service.	
The controller flashes 3 red flashes	Push button lockout		Follow the instructions to toggle out of push button lockout.	

6.1 Critical Low Battery Recovery Method

A critical low battery condition occurs when the A704-5 batteries have been discharged to a point where the A704-5 cannot resume normal operation and battery damage is likely. In this state, the light will briefly flash about every 10 seconds, and the red and green indicator LEDs will light up during the cycle. Battery replacement is recommended, although some batteries will respond to the following advanced recharge method.

This is an advanced method and should be carried out by personnel familiar with the equipment outlined below. Perform in a room temperature (~68°F (20°C)) environment.

Required equipment:

- Power supply capable of 10V, 5A
- Custom cable harness to connect all cells in series
- Temperature sensor

Advanced recharge method

1. With the battery pack disconnected, turn the power supply on
3. Adjust the open circuit power supply voltage to 10V
4. Adjust the power supply current limit to 5A
5. With the power supply still on, connect the power supply to the battery
6. Monitor the battery voltage and terminal temperature periodically for five hours (see below for recharge monitoring guidelines)
7. Once the recharge attempt is complete, disconnect the power supply from the battery (while the power supply is still on)

Recharge monitoring guidelines

One of three things will occur during charging:

- If the battery terminal temperature exceeds 18°F (10°C) rise from ambient, this indicates the battery has no useful life left. Stop charging and replace the battery.
- If the battery voltage does not reach 10V (power supply switching to CV from CC Mode) within five hours, then the battery is not taking a charge. Stop charging and replace the battery.
- If the battery voltage has reached 10V within five hours, stop charging and reconnect the battery to the A704-5. You can then top up the battery using the A704-5 external charging adapter. (When using the external charger, a full charge should be attained after only a few hours.) For best results you should only begin using the A704-5 after it has been fully charged.

7.0 Installing the Model A704-5 Aviation Light

7.1 Installation

Installation typically takes very little time. For stability and safety, a minimum of three fasteners is recommended, placed 120° apart. To protect the top surface of the mounting base from damage, use a washer under the head of the fastener.

It is a good idea to test the light before heading out into the field; the light does not need to be mounted before programming and testing can occur. Try the different functions to ensure the light is working properly and to become familiar with the behavior of the light.

7.2 Optional Airport Mounting Stake

The Model A704-5 Aviation light can also be installed using an optional airport mounting stake. Made of galvanized steel, the airport mounting stake is suitable for permanent installation in earth and gravel. The 30" (76.2 cm) airport mounting stake is available in 2" (5.08 cm) and 1.5" (3.81 cm) frangible coupling sizes.

Coupling size must be determined before ordering.

Stake (Angle Iron) Mounting Instructions:

Using an auger, drill a 3" (7.62 cm) to 4" (10.16 cm) diameter hole to a depth of 30" (76 cm). Install the top of the stake even with, or not more than 1/2" (1.3 cm), above the finished grade and maintain within 1 degree of the vertical. Backfill around the stake with thoroughly compacted earth (or suitable backfill material such as sand or concrete). For hard bedrock or sediment areas, 15" (38.1 cm) stakes can be used. In areas where frost may cause heaving, anchor the stake with concrete and use a permeable backfill material such as sand and then cover the top surface with an impervious material to reduce moisture penetration.

7.3 Location

Observe the following precautions to ensure optimal performance:

- Mount the light in direct sunlight. Any shadow or shading of the solar panels will prevent the light's ability to charge.
- Avoid mounting the light directly in contact with tarmac or asphalt. Temperatures of these surfaces during the summer can rise above the maximum recommended operating temperatures of the light. If the light must be mounted on tarmac, asphalt or other similar dark surface, place a square of plywood or other thermally insulating material between the base and the mounting surface.
- Lights mounted close to each other may sense each other's emitted light and turn off (if programmed in Autonomous Mode). Recommended minimum separation is 6 feet (2 m) between lights to prevent this from occurring.

8.0 Model A704-5 Operational Maintenance/Diagnostics

This section describes the procedure for performing routine maintenance checks on the Model A704-5 runway lighting system. Routine maintenance checks will ensure the system is operational and ready in the event of an emergency.

Once the runway system has been deployed and the operation of the lights has been verified, it is recommended that airport staff perform the following routine maintenance checks. Carmanah recommends initially performing these checks daily (or nightly) for the first 10 days, and then two or three times per week thereafter.

These diagnostics are best performed after dusk when the lights can be seen more easily, but this can also be done during the day.

Maintenance check procedure:

1. Enter User Mode.
2. Select All Groups.
3. Verify all lights are operational and responsive to radio control commands by sending the TEMP – LOW – ENTER command from the radio controller. All lights should come on in the Temporary Low Mode. If it is not obvious, then drive or walk the length of the runway to verify operation.
4. If any lights fail to respond, then repeat Steps 1-3 above. If lights still do not respond, then refer to section *6.0: Troubleshooting*.
5. Extinguish the lights by pressing STANDBY – ENTER. Verify that all lights turn off. If not, repeat the command.
6. Perform the battery diagnostic check using the DIAGNOSE feature (see section *5.7.1 Battery Diagnose Function*). All lights should be in MEDIUM or HIGH state of charge. If any lights show a LOW or LOW BATTERY state of charge then monitor them daily for several days, limiting the use of temporary brightness modes during that time. If any light stays in a LOW or LOW BATTERY state of charge for more than a few days, remove the light and place it outside in Ship Mode to charge for a few days. An alternative would be to place the light in Ship Mode and connect it to a power source with the optional AC/DC power adaptor.
7. Perform the radio diagnostic check using the DIAGNOSE feature (see section *5.7.2 Radio Health Diagnose Function*).
8. Return the lights to the desired operational state.

9.0 Maintenance and Product Care

Although the A-704-5 light is designed to be maintenance-free, significant performance gains can be made with clean solar panels and lenses. Clean the solar panels monthly. Use water and a soft sponge or cloth. A mild non-abrasive cleanser can be used for more stubborn residue. Rinse well.

The following other maintenance precautions should also be taken:

- Clean solar panels and lenses more frequently during drier months, as they may become covered in dust more quickly. A pressure washer is not recommended.
- Visual inspection – check the exterior for cracks, missing or broken hardware or other potential problems.

9.1 Light Battery Self-Discharge During Storage

Table 9-1: Recharge Intervals provides the recommended maximum storage intervals between recharging, depending on the temperature of the storage location.

Table 9-1: Recharge Intervals

Storage Temperature		Recharge Interval [Months]
^{o}F	^{o}C	
68 or lower	20 or lower	3
68 to 104	20 to 40	1
104 or higher	40 or higher	Twice monthly

9.2 Charging Model A704-5 Light's Batteries

Follow one of the charging recommendations outlined in *Table 11: Charging Alternatives*. Follow the instructions in section *5.7.1 Battery Diagnose Function* to test the lights charge level. Once the light is fully charged, you can continue to store it or deploy it.

Do not place your Model A704-5 closer to the light source than recommended in *Table 9-2: Charging Alternatives*, as it may overheat, or damage to one or more of the solar panels could occur.

Table 9-2: Charging Alternatives

Charging Source	Distance From Solar Panels	Hours to Charge from 10% to 100%
500 W halogen	24" (60 cm)	600
60W tungsten in reflector housing (desk lamp)	2" (5 cm)	600
Direct sunlight (light should be in Ship Mode)	–	150
External Charger for wall outlet charging (Part # 48898)	–	18

9.3 Model A704-5 AC/DC Charger (Part# 48898)

The A704-5 AC/DC charger consists of an AC adapter with a cable that plugs into the A704-5, and a power cord that connects the AC adapter to a North-American wall outlet.

Using the Charger:

1. Plug one end of the power cord (the AC Adapter) into the wall outlet.
8. Plug the 3-pin plug into the receptacle on the base of the Model A704-5. Mate the connectors by rotating the collar on the charger plug clockwise.

The amber LED on the Model A704-5 will flash to indicate that the light's batteries are charging.

The charger may be left connected to the Model A704-5. Once a full charge is reached the light automatically goes into Trickle Charge Mode to prevent the batteries from overcharging.

Safety Information

- Only use the Model A704-5 charger indoors
- Do not use the charger in a location that could become wet
- Keep the charger away from sources of heat
- Ensure the charger is uncovered and has adequate ventilation for cooling
- Do not operate the charger near flammable liquids or gasses

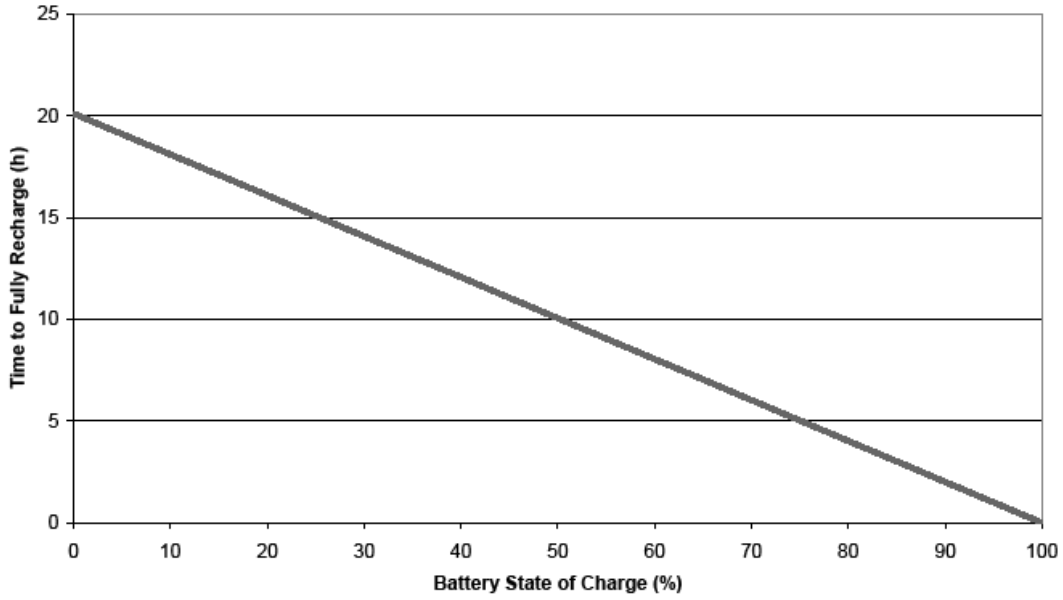

Figure 9-1: Recharging Time vs. Battery State of Charge

10.0 Service and 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.

Before contacting Carmanah's customer service department, please have the serial number of your A704-5 available, a brief description of the problem, as well as all details of the installation and recharging efforts.

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

11.0 FCC Compliance

11.1 Introduction

This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

Changes or modifications not expressly approved by Carmanah Technologies Corporation could void your authority to operate the equipment.

11.2 FCC Statement for Model A704-5 Light and Wireless Controller

This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications; however, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off or on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna
- Increase the separation between the equipment and receiver
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected
- Consult the dealer or an experienced radio/TV technician for help

11.3 FCC Statement for Non-wireless Model A704-5 Light

This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case you will be required to correct the interference at your own expense.

Appendix A: Glossary

Aircraft Radio Control of Aerodrome Lighting (ARCAL): The Aircraft Radio Control of Aerodrome Lighting (ARCAL) feature works in conjunction with an ARCAL VHF receiver to allow aircraft pilots to control the airfield lights. Contact your Carmanah representative for more information about this feature.

Automatic Light Control (ALC): Automatic Light Control (ALC) is a patented algorithm that allows the light to adjust its energy consumption to the amount of sunlight available to charge the batteries. This ensures the light will continue to operate through periods of limited sunlight.

Autonomy: The amount of time in hours or days that the A704-5 can continue normal operation in the absence of sunlight.

Electrostatic Discharge (ESD): Electrostatic discharge (in layman's terms, a shock) is a build-up of charge difference between a person and an object, often caused by friction between synthetic materials, or electronic equipment. ESD can easily destroy semiconductor products, even when the discharge is too small to be felt.

Infrared (IR): The name means below red (from the Latin infra, below), red being the color of visible light of longest wavelength. The invisible part of light with longer wavelengths that is felt as heat radiation. The invisible heat radiations are beyond the red end on the visible spectrum and cannot be seen by the human eye.

Light Emitting Diode (LED): A Light Emitting Diode (LED) is a solid-state semiconductor device that converts electrical energy directly into light.

Self-discharge: During storage, the charge in the A704-5 batteries will experience a normal, gradual decrease. The chemistry of the batteries creates a small electrical current within them, and the electronics of the A704-5 will draw an even smaller amount of electricity to keep itself ready for use. The self-discharge is extremely low compared to the electrical currents when the A704-5 is in operation, but over time it becomes significant enough to require the regular check and recharge intervals outlined in *Table 9-1: Recharge Intervals*.

Unique Code Sequence (UCS): The UCS feature allows one or more controllers to be uniquely associated to one or more A704-5 lights. When UCS is enabled, the controller sends a UCS with each radio transmission; only lights configured to accept that particular UCS will respond to the transmission.

Appendix B: Model A704-5 Battery Replacement

The following instructions describe the proper method for replacing the Model A704-5 batteries. For the safety of personnel performing the replacement, ensure all the steps are properly followed.

When the battery pack's useful life is over and must be replaced, please do not throw the old battery pack into the garbage. Lead is toxic and harmful to the environment. Please recycle.

Tools Required:

- Ratchet
- 1/2" socket with extension
- 5/32" Hex key
- #2 Phillips screwdriver

Contact Carmanah sales to order toolkits and replacement batteries.

Battery Replacement Procedure:

Remove all jewelry including rings and bracelets. Bridging battery terminals with any metal could cause high electrical currents and severe burns.

1. Use an ESD wrist strap connected to a suitable electrical ground. If one is not available, avoid touching any electronics within the enclosure unless required by this process.

1. Place the light into Ship Mode – refer to the Section 4.3.2 Push Button Operation.

2. Remove the top plate screws and their nylon washers using the hex key supplied; see Figure 11-1.

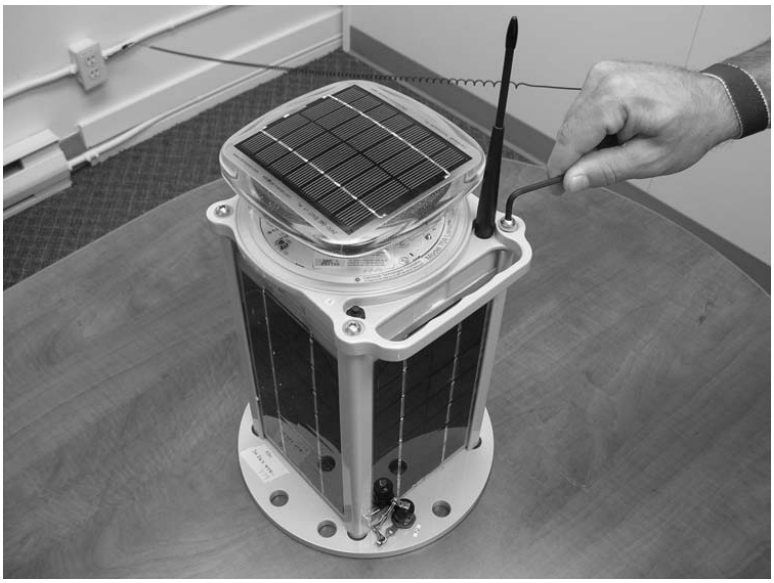

Figure 11-1: Removing the Top Plate

3. Lift the head off – the head gasket seal may be sticky; see Figure 11-2.

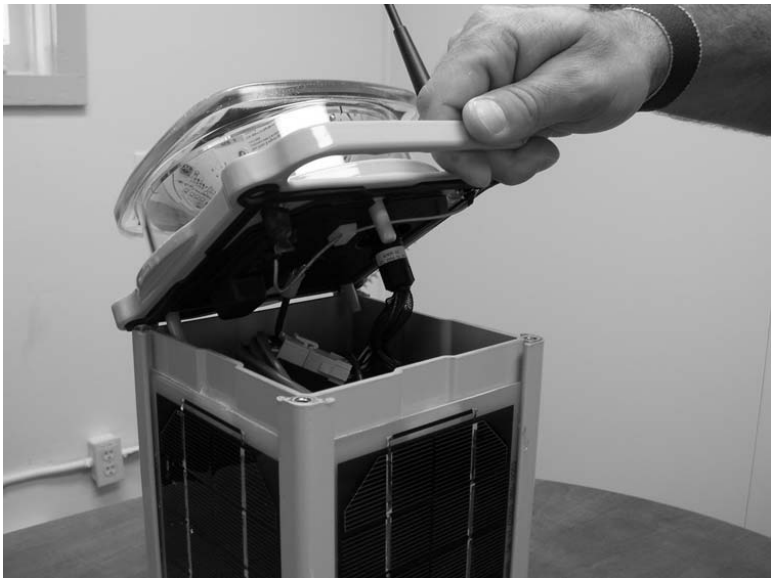

Figure 11-2: Lifting off the Head

4. Disconnect the main wiring harness from the underside of the head; see Figure 11-3.
5. Use the pinch points to squeeze the connector then pull it free. Do not force the connector as it will pull free easily when the pinch points are properly squeezed.

Figure 11-3: Wire Harness Disconnection

6. Remove the ground strap from the head using the Phillips screwdriver; see Figure 11-4.

Do not drop the ground strap retaining screw into the housing.

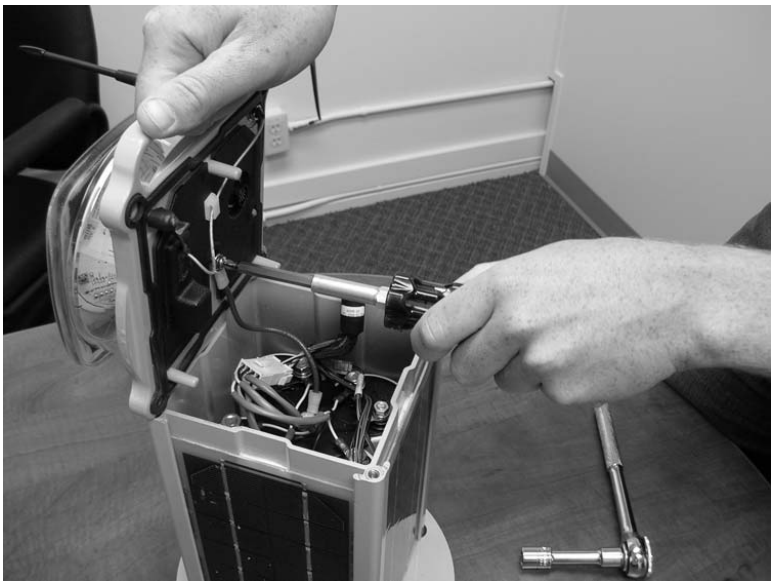

Figure 11-4: Removing the Ground Strap

7. Remove the head and set aside.
8. Disconnect the battery harness; see Figure 11-5.

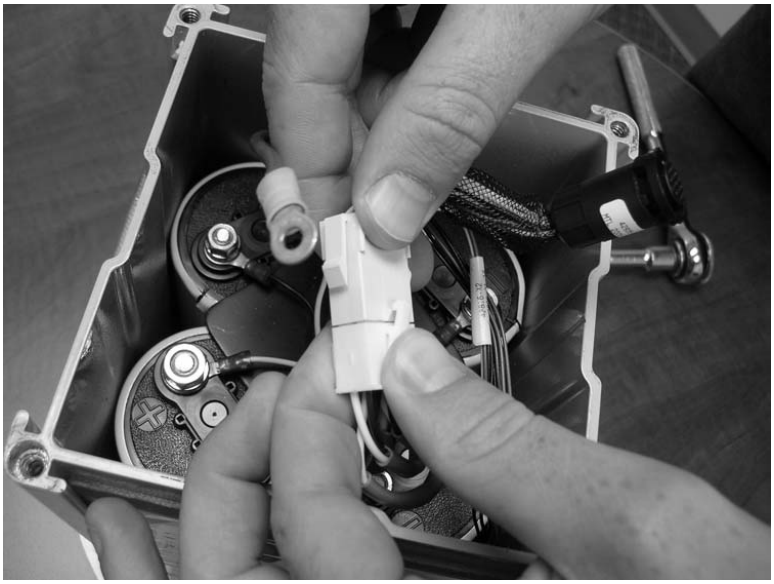

Figure 11-5: Disconnecting the Battery Harness

9. Remove the battery retention bolt using the ratchet and socket with extension; see Figure 11-6.

Do not contact the battery terminals with the ratchet tool. Bridging the battery terminals will create large electrical currents and could cause severe burns. Once the bolt is loosened completely, carefully remove the bolt and ground strap.

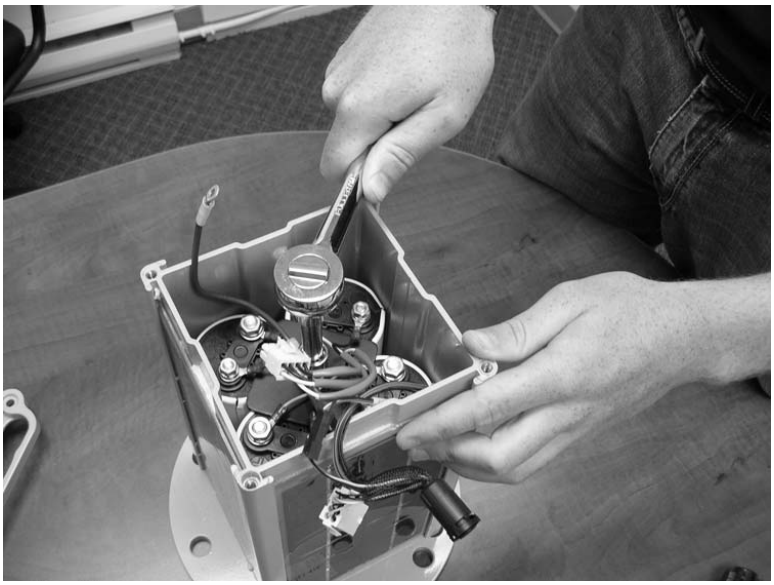

Figure 11-6: Removing the Battery Retention Bolt

10. Grasp the battery harness by the wires and pull the battery pack straight up out of the main housing; see Figure 11-7. Ensure that you grasp the wires rather than just the connector when removing the battery pack. Place the battery pack to one side.

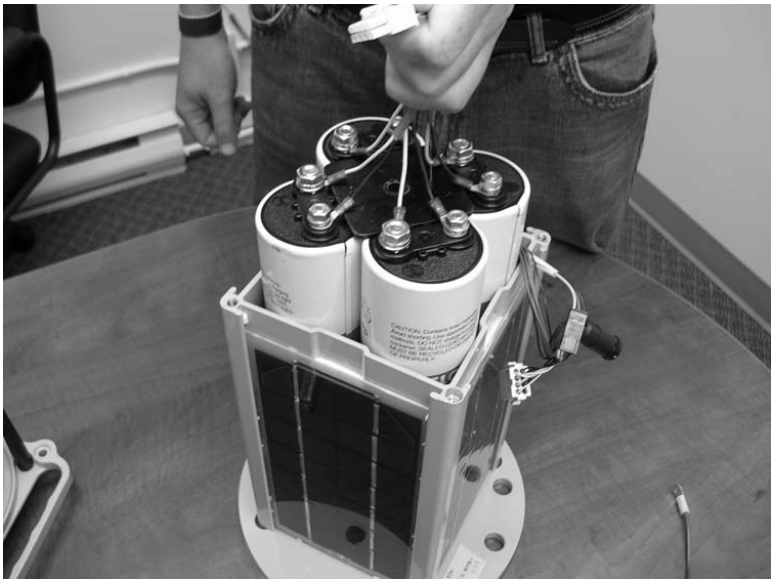

Figure 11-7: Removing the Batteries

11. Pull the batteries apart and carefully remove the battery top plate; see Figure 11-8.

Figure 11-8: Removing the Battery Top Plate

12. Obtain replacement battery pack and carefully insert the battery top plate
13. Grasp the new battery harness by the wires and lift the new batteries into the main housing.
14. Insert the battery retention bolt through the circular terminal of the ground strap, and hand tighten the bolt using the socket and extension; see Figure 11-9.

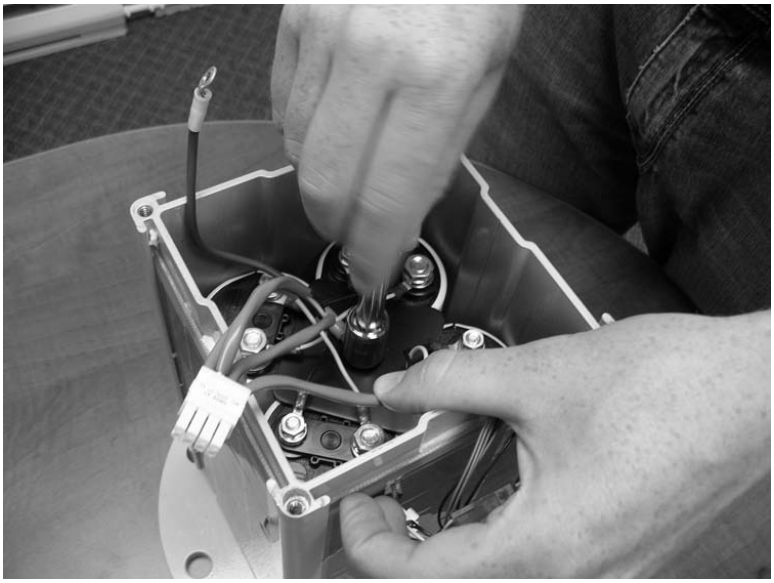

Figure 11-9: Tightening the Bolt

15. Using the ratchet, tighten the battery retention bolt ¼ turn at a time. After each ¼ turn check that the batteries are firmly held. Do not continue to turn the bolt once the batteries are snug. Over tightening the bolt can cause battery damage.
16. Re-connect the battery harness.

17. Replace the head gasket by removing and discarding the old gasket, then inserting the new gasket. Ensure the new gasket is fully seated in the gasket groove; see Figure 11-10.

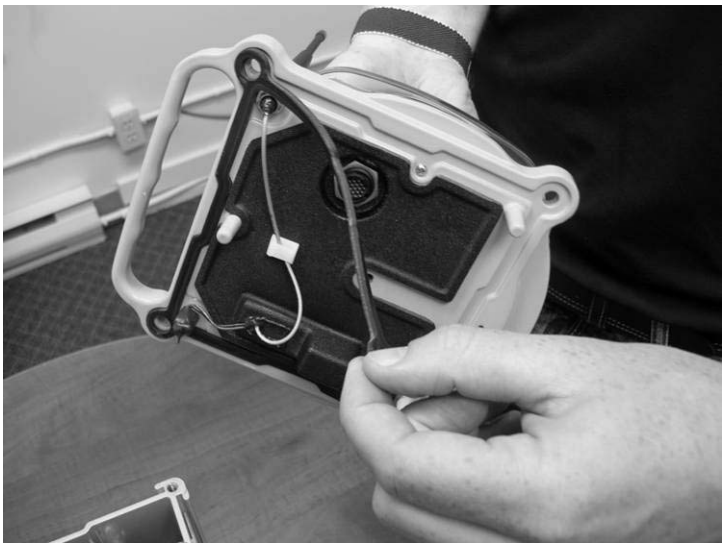

Figure 11-10: Replacing the New Gasket

18. Grasp the head and align the handle with the charge plug on the base of the light. While holding the head, re-attach the ground strap using the screwdriver; see Figure 11-11.

Do not drop the ground strap retaining screw into the housing

19. Place the head on top of the housing, aligning the handle and the charging connector on the base of the light so they are on the same side of the light.

Figure 11-11: Re-attaching the Ground Strap

20. While holding the head, reconnect the main harness.

The proper alignment is critical. Align the white markings on the connector and the connector receptacle that indicate proper orientation. Gently push the connector on until it clicks into place. Do not force the connector as it can be damaged.

21. Check light operation (optional).
22. Carefully lower the head onto the main housing. Ensure that all wiring on the underside is tucked in the housing and there are no pinched wires. Ensure the gasket is seated properly; see Figure 11-12.

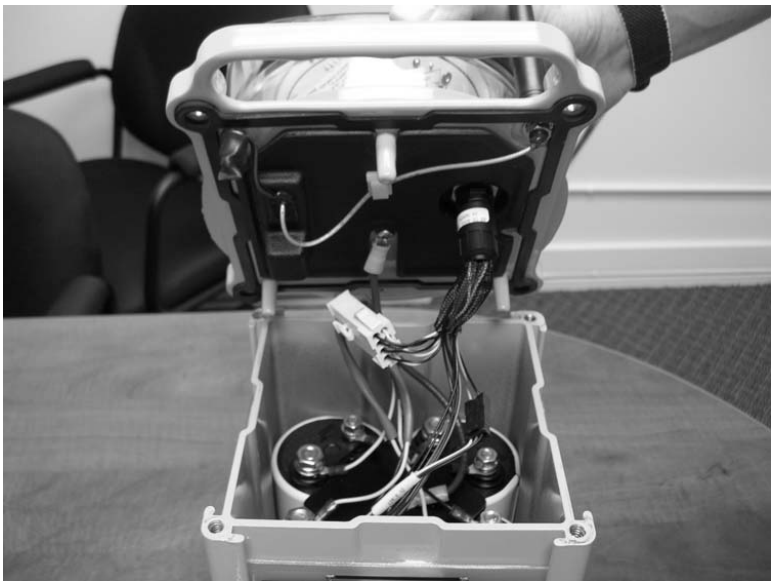

Figure 11-12: Replacing the Head

23. Replace top plate screws and washers, and tighten to finger tight.
24. Using the hex key, tighten the four screws down lightly to ensure the top plate is flat against the housing. Next, tighten the screws snug using a cross-bolt pattern whereby the second screw tightened is diagonally across from the first screw. If a torque wrench is available, use a torque setting of 70 inch-pounds.
25. Verify operation of the Model A704-5.
26. Recycle the old batteries.

Appendix C: Power Cycling the Controller

If your controller is unresponsive, and the LEDs unlit, and the steps outlined in the troubleshooting guide didn't resolve the problem, perform the following steps:

1. Use an ESD wrist strap connected to a suitable electrical ground. If one is not available, avoid touching any electronics within the enclosure unless required by this process.
2. Open the controller lid by removing the four screws in the enclosure corners. (See Figure 20: Controller Lid).

Figure 11-13: Controller Lid

3. Unplug the battery and WAIT 3 or 4 MINUTES to allow the capacitors in the circuit to drain their residual charge.

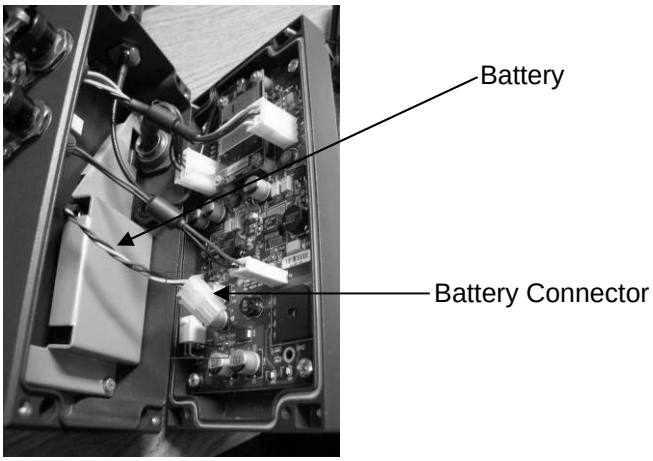

Figure 11-14: Battery Connector

4. Plug the battery back in.

Figure 11-15: Battery Connector, Final Position

5. Replace the controller lid, tightening the four screws firmly.
6. Connect the AC/DC charger: the controller battery LEDs should cycle.
7. Leave the controller connected to the AC/DC charger to allow it to charge overnight.

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