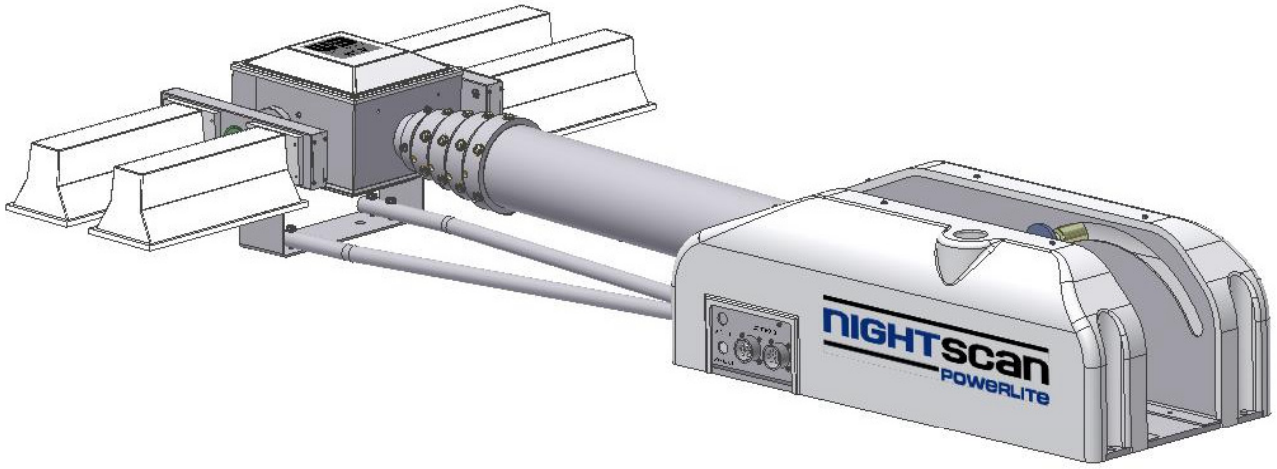
NIGHT SCAN POWERLITE
INSTALLATION, OPERATION & MAINTENANCE MANUAL



The Will-Burt Company
169 S. Main Street
Orrville, OH 44667
330-682-7015 – Fax: 330-684-1190
www.willburt.com
Revision 7, January 2006

WARRANTY

The Manufacturer warrants its products to be free from defects in material and workmanship for a period of one year from the date of shipment from the factory. The Manufacturer shall not be responsible for any damage resulting to or caused by its products by reason of improper installation, improper storage, unauthorized service, alteration of products, neglect or abuse, or use of the product in a manner inconsistent with its design, accident, acts of God, or failure to properly maintain this product. This warranty does not extend to any component parts not manufactured by Manufacturer, however, Manufacturer's warranty herein shall not limit any warranties made by manufacturers of component parts which may extend to Buyer.

THE FOREGOING WARRANTY IS IN LIEU OF ALL OTHER WARRANTIES, AND NO REPRESENTATIONS, GUARANTEES OR WARRANTIES, EXPRESS OR IMPLIED, (INCLUDING, BUT NOT LIMITED, TO A WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE) ARE MADE BY MANUFACTURER IN CONNECTION WITH THE MANUFACTURE OR SALE OF ITS PRODUCTS. NO EMPLOYEE, DISTRIBUTOR, OR REPRESENTATIVE IS AUTHORIZED TO CHANGE THIS WARRANTY IN ANY WAY OR GRANT ANY OTHER WARRANTY ON BEHALF OF MANUFACTURER.

Claims for defects in material and workmanship shall be made in writing to Manufacturer within thirty (30) days of the discovery of defect. Failure to provide notice as required hereby shall be conclusive evidence that the product was in conformity with the warranty, and the Manufacturer shall be released from any and all liability relating to the product. Manufacturer may either send a service representative or have the product returned to its factory at Buyer's expense for inspection. If judged by Manufacturer to be defective in material or workmanship, the product will be replaced or repaired at the option of Manufacturer, free from all charges except authorized transportation.

THE REMEDIES OF BUYER SET FORTH HEREIN ARE EXCLUSIVE AND ARE IN LIEU OF ALL OTHER REMEDIES. THE LIABILITY OF MANUFACTURER WHETHER IN CONTRACT, TORT, UNDER ANY WARRANTY, OR OTHERWISE, SHALL NOT EXTEND BEYOND ITS OBLIGATION TO REPAIR OR REPLACE, AT ITS OPTION, ANY PRODUCT OR PART FOUND BY MANUFACTURER TO BE DEFECTIVE IN MATERIAL OR WORKMANSHIP. MANUFACTURER SHALL NOT BE LIABLE FOR COST OF INSTALLATION AND/OR REMOVAL, OR BE RESPONSIBLE FOR DIRECT, INDIRECT, SPECIAL OR CONSEQUENTIAL DAMAGES OF ANY NATURE.

TABLE OF CONTENTS

LIST OF ILLUSTRATIONS

LIST OF TABLES

SAFETY SUMMARY

The following are general safety precautions that are not related to any specific procedures and therefore do not appear elsewhere in this publication. These are recommended precautions that personnel must understand and apply during many phases of operation and maintenance.

SHOCK HAZARD

Only trained and qualified personnel should install, use and service this equipment.

Observe general safety precautions for handling equipment using high voltage. Always disconnect power before performing repair or test operations.

Do not operate the Night Scan Powerlite until you have made certain that the area is clear of overhead power lines and other unwanted sources of electricity.

Do not operate the Night Scan Powerlite during an electrical storm.

HEALTH AND SAFETY HAZARD

Make sure all personnel are clear of the mast operational envelope as well as the direction of travel. In the event of an extreme pressure irregularity, it is possible that the mast could become separated and explosively launch.

Lamps are extremely hot when operating and should not come into contact with people or combustible and /or explosive materials. Do not operate if breakage occurs or unit is knocked over.

Do not look directly into the lights when they are illuminated. Temporary impairment or permanent damage of vision could occur.

Solvent used to clean parts is potentially dangerous. Avoid inhalation of fumes and also prolonged contact to skin.

EQUIPMENT HAZARD

Do not raise mast while vehicle is in motion. Do not move vehicle while mast is extended.

Do not allow objects to strike the unit.

RESUSCITATION

Personnel working with or near high voltages should be familiar with modern methods of resuscitation. Such information may be obtained from the Bureau of Medicine and Surgery.

WARNING

A WARNING is used to call your attention a potentially hazardous situation, which, if not avoided could result in death or serious injury.

CAUTION

A CAUTION is used to call your attention a potentially hazardous situation, which, if not avoided, may result in minor to moderate injury and/or property damage.

The following warnings appear in the text and are repeated here for emphasis.

WARNING

Before beginning installation, make certain that the area is free of overhead power lines and other unwanted sources of electricity. Follow OSHA safety regulations when working near energized power lines. Be sure to allow sufficient clearance on all sides of mast to allow for side sway.

WARNING

Only trained and qualified personnel should perform installation, adjustment and service. A properly trained and certified electrician should only perform electrical installations.

WARNING

Do not touch live wires.

WARNING

All operators must read the Operation section of this manual and be properly trained.

WARNING

Keep personnel clear of mast during operation.

WARNING

Make sure all power has been disconnected from the Night Scan prior to manually lowering mast.

WARNING

Make sure lights have cooled completely before manually panning or tilting the RCP.

WARNING

Support the mast before removing cap screw! Once removed, the mast and light assembly is free to fall.

WARNING

For outdoor use only. Do not use in areas that have been classified as hazardous as defined in Article 500 of the National Electric Code.

WARNING

Do not use in the presence of flammable gases or liquids such as paint, gasoline or solvents. Do not use in areas of limited ventilation or where high ambient temperatures are present. Contact with combustible materials can cause ignition resulting in fire or explosion.

WARNING

When relamping an installed fixture, make sure all power to fixture is off and that the fixture is cool

CHAPTER 1
INTRODUCTION

1.1 SAFETY PRECAUTIONS

Refer to the Safety Summary for precautions to be observed while operating or servicing this equipment.

1.2 INTRODUCTION

This manual covers the installation, operation, troubleshooting and maintenance instructions for the Night Scan Powerlite. The manual should be reviewed in its entirety. Contact the Will-Burt factory with any questions before performing any procedures outlined in this manual.

1.3 DESCRIPTION

The Night Scan Powerlite is a transportable lighting system consisting of a directionally adjustable group of lights attached to a self-erecting, extensible mast. It may also serve as a platform for communications antennae or a camera. Air pressure required to extend the mast is provided by an available vehicle air system, or an optional compressor unit mounted within the Night Scan. The unit is designed for installation on any vehicle for the purpose of providing on the scene temporary lighting, communications or surveillance. Refer to Figure 1-1 for identification of the major components of the Night Scan Powerlite unit.

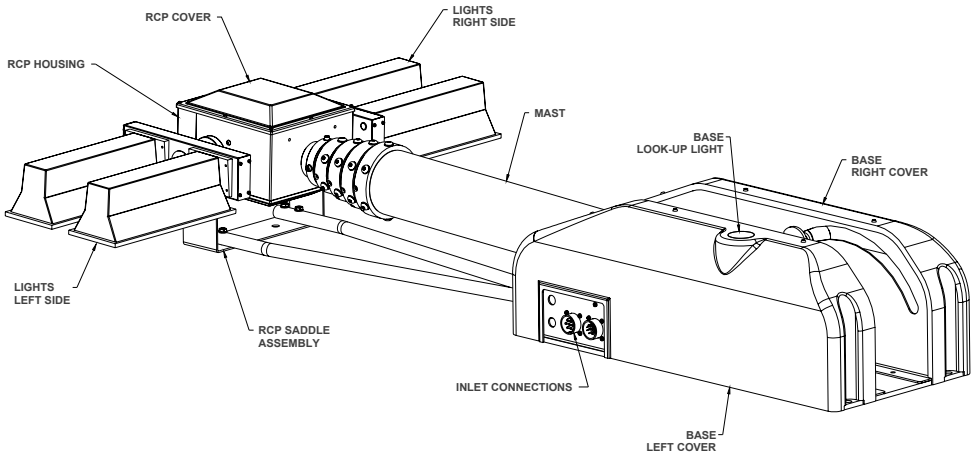


Figure 1-1 Night Scan Powerlite Base and Remote Control Positioner

1.4 REFERENCE DATA

The reference data for the Night Scan Powerlite given in Table 1-1.is not inclusive of all models. Please refer to product literature or http://www.willburt.com for additional information including length, width and height information.

Table 1-1. Reference Data

Model No.	3000	3600	5400	4500P	6000	9000	Camera Mt.
NS10 Stowed Height	1ft/	1ft/	1ft/	1ft/	1ft/	1ft/	1ft/
NS15 Stowed Height	1ft/	1ft/	1ft/	1ft/	1ft/	1ft/	1ft/
NS10 Ext. Height	10ft.	10ft.	10ft.	10ft.	10ft.	10ft.	10ft.
NS15 Ext. Height	15ft.	15ft.	15ft.	15ft.	15ft.	15ft.	15ft.
Total Unit Weight**	150 lb.	155 lb.	170 lb.	170 lb.	165 lb.	180 lb.	135 lb.
Tube Diameter Range	5 to 3 in.	5 to 3 in.	5 to 3 in.	5 to 3 in.	5 to 3 in.	5 to 3 in.	5 to 3 in.
No. of Mast Sections	5	5	5	5	5	5	5
Mast Air Volume (NS15)	1.2 cu. ft.	1.2 cu. ft.	1.2 cu. ft.	1.2 cu. ft.	1.2 cu. ft.	1.2 cu. ft.	1.2 cu. ft.
Max. Operating Air Pressure	20 psi	20 psi	20 psi	20 psi	20 psi	20 psi	20 psi
Required DC Electrical Power Supply	12V/20 amp 24V/10 amp	12V/20 amp 24V/10 amp	12V/20 amp 24V/10 amp	12V/20 amp 24V/10 amp	12V/20 amp 24V/10 amp	12V/20 amp 24V/10 amp	12V/20 amp 24V/10 amp

*Maximum dimension is the largest dimension on all specified models.

**Weight given is approximate for 15-foot models

1.5 TECHNICAL INFORMATION

1.5.1 AC Power Requirements

The AC power for the Night Scan Powerlite is supplied through a 7-pin MIL-type connector located on the side of the Night Scan. The mating connector is an MS3106E24-10SF80A206 or equivalent (Will-Burt Item Number 000013-107-007). Two pins are provided for each of two lighting loads (right and left) plus an additional two pins for earth/chassis ground. The remaining pin is unconnected. See Table 2-2 for pin out information and Figure 4-3 for wiring connection detail. This connector is sufficient to handle up to 8-gauge wire. Wire gauge size for external wiring should be chosen based on the actual lighting wattage/voltage load while taking into consideration overall length of wiring run for IR losses. Cable assemblies with the AC connector installed are available from Will-Burt in two lengths – 30 ft. (P/N 914378) and 50ft. (914379). All of the Night Scan lighting options require 20 amps nominal or less. No internal fusing or other circuit protection is provided, so the customer is responsible for adequate overload protection. Polarity is of no concern since both sides of the AC are switched by a common relay.

1.5.2 DC Power Requirements

The DC power for the Night Scan Powerlite is supplied through an 11-pin MIL-type connector. Cable assemblies with the connector installed are available from Will-Burt in two lengths – 30 ft. (P/N 913933) and 50ft. (913934). The DC power connects to two pins that accept up to 12-gauge wire. See Table 2-3 for pin out information and Figure 4-3 for wiring connection detail. The DC power is internally protected with a 20 amp auto-resetting circuit breaker. The Night Scan Powerlite will operate from either 12 or 24 volt DC power with no customer changes necessary. The electronic system has built in reverse polarity protection. For optimum performance, a minimum of 11 volts is required at the Powerlite base connector. Long runs of cable can introduce power loss. A good method of checking the voltage at the Powerlite is to connect a voltmeter to the wires in the junction box powering the HHRC (pins B and C of J1 see Figure 4-3). This will give a good indication of power loss across the DC cabling. For long runs, it may be necessary to add an intermediate junction box in the DC cable so that DC power can be applied closer to the Powerlite.

1.5.3 Mast Loads

It is important that the mast be securely mounted to a sturdy platform, which will not overturn during operational loading of the mast. Figure 1-2 provides loading information for the mast, which can be expected during operation. All values given are in lbs.

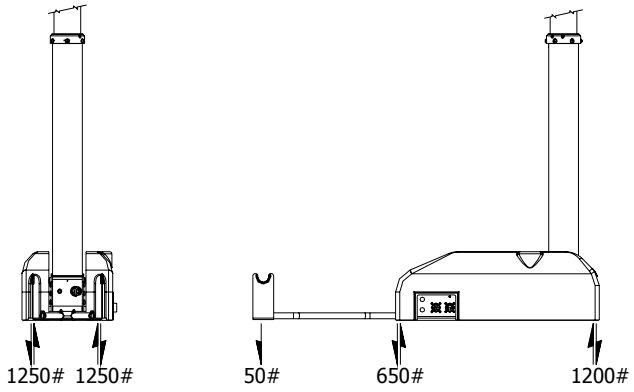


Figure 1-2 Mast Loads

CHAPTER 2
INSTALLATION

WARNING

Before beginning installation, make certain that the area is free of overhead power lines and other unwanted sources of electricity. Follow OSHA safety regulations when working near energized power lines. Be sure to allow sufficient clearance on all sides of mast to allow for side sway.

WARNING

Only trained and qualified personnel should perform installation, adjustment and service. A properly trained and certified electrician should only perform electrical installations.

2.1 INTRODUCTION

2.1.1 The Night Scan Powerlite has been designed to provide for ease of installation. This section of the manual provides the procedures that must be followed to insure a successful installation. Be sure to read and understand the entire installation procedure before you begin.

2.2 TOOLS AND MATERIALS REQUIRED FOR INSTALLATION

2.2.1 Table 2-1 provides a list of tools and materials required to install and test the Night Scan Powerlite.

Table 2-1. Tools and Materials Required for Installation

Wrenches	Crimping tool or Solder set
Screwdrivers	Wire cutter/stripper
½ inch or M12 Mounting Hardware (6 each)	Multimeter (to verify power is turned OFF)
Torque wrench	Clean Shop Rags
Drill	
Hoist (minimum 200 lb capacity)	

2.3 UNPACKING

Unpack the Night Scan Powerlite as follows:

1. Carefully open and remove all parts from shipping container. Lift the unit from the shipping container by the two struts and the lower portion of the base tube (see Figure 2-1). **Do not lift the Night Scan by the lights or RCP.**
2. Inspect for any shipping damage. If damage has occurred, notify carrier.
3. Be sure that all components are included and that the required tools are readily available.

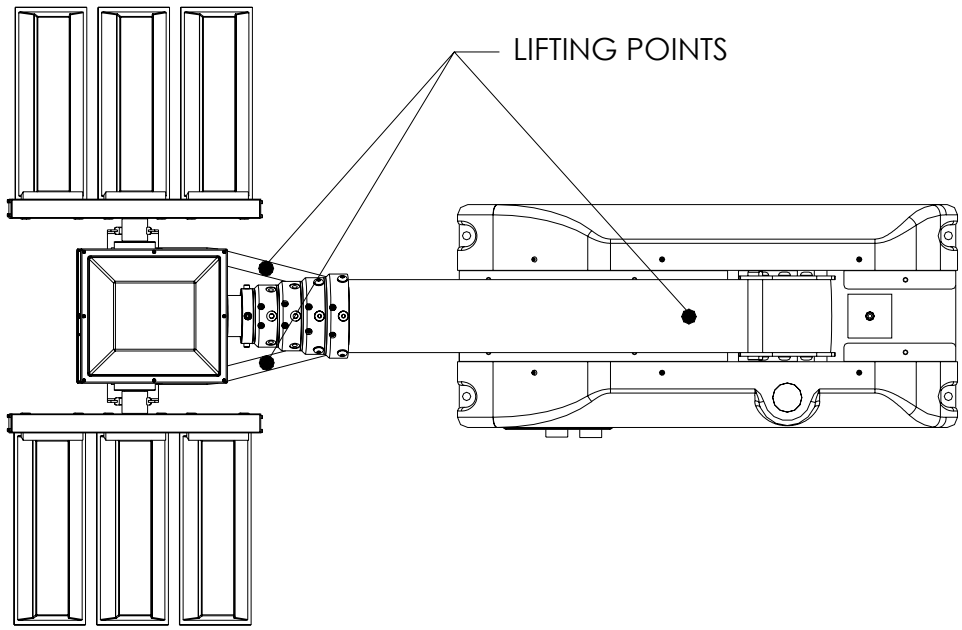


Figure 2-1 Lifting Points on the Night Scan Base

2.4 ATTACHING TO VEHICLE

If the Night Scan Powerlight is to be mounted in a well, be certain that adequate drainage is provided. A minimum of (4) drain holes (one per corner) at least one inch in diameter is recommended. While the unit has been designed to withstand adverse environmental conditions, it cannot be submerged.

The mounting holes provided in the Night Scan unit are 9/16 inches in diameter. There are four holes in the base plate and two holes in the RCP saddle. Studs or bolts (not provided) shall be located on the vehicle in accordance with Figure 2-2. It is important that the surface be flat such that the saddle and base plate are in the same plane. The areas to which the unit is mounted must be reinforced to withstand loading as shown in Figure 1-2. Attach and torque all hardware as appropriate for its material and size. It may be advantageous to attach the four (4) mounting bolts in the base plate, complete the wiring as outlined in the following sections and raise the unit before attaching the saddle bolts. Be certain that the saddle bolts are located in accordance with Figure 2-2 and that the saddle is centered with respect to the RCP. Adjust the location if necessary so that the saddle flanges do not hang up on the lights when the unit is raised.

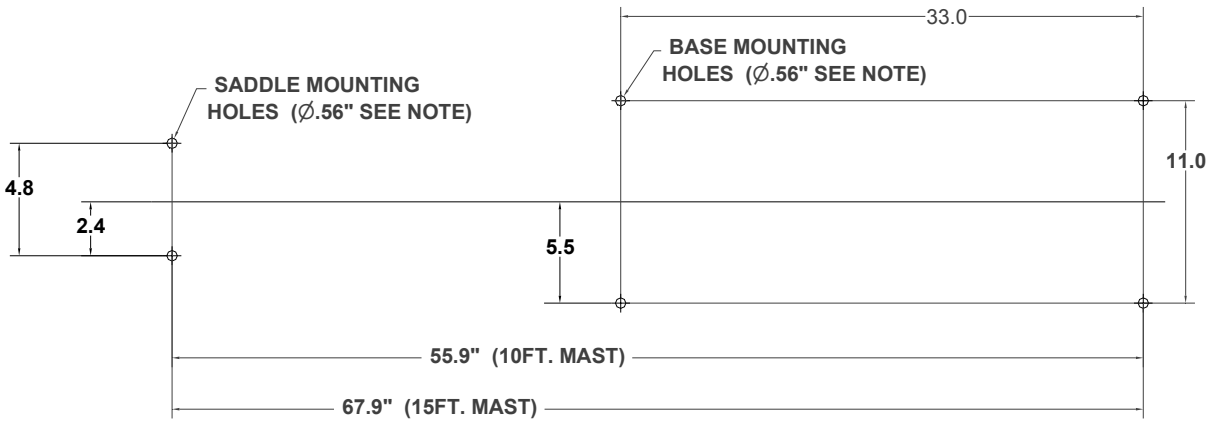


Figure 2-2 Night Scan Base Mounting Hole Locations

Profiler models require two additional holes as indicated below to provide support to the light assembly.

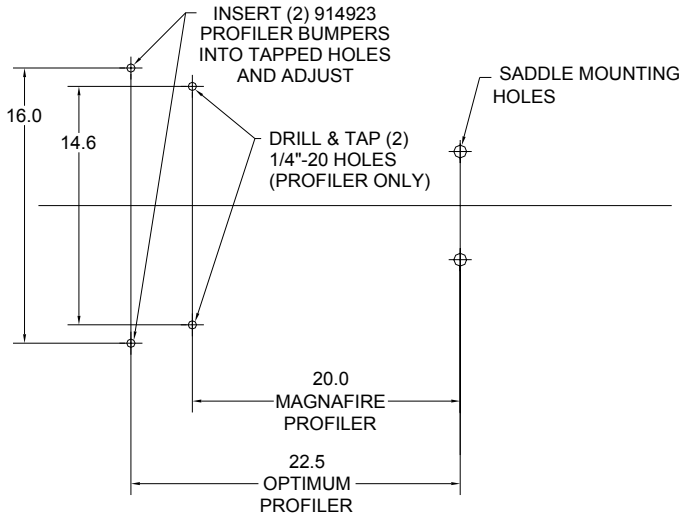


Figure 2-3 Additional Mounting Requirements – Profiler

2.5 JUNCTION BOX INSTALLATION

The junction box serves as an interface between the Hand Held Remote Control and the Night Scan Base. It also serves as a location to which DC power is routed by the installer for the unit. The junction box may be flush or surface mounted. Hardware for mounting is not supplied.

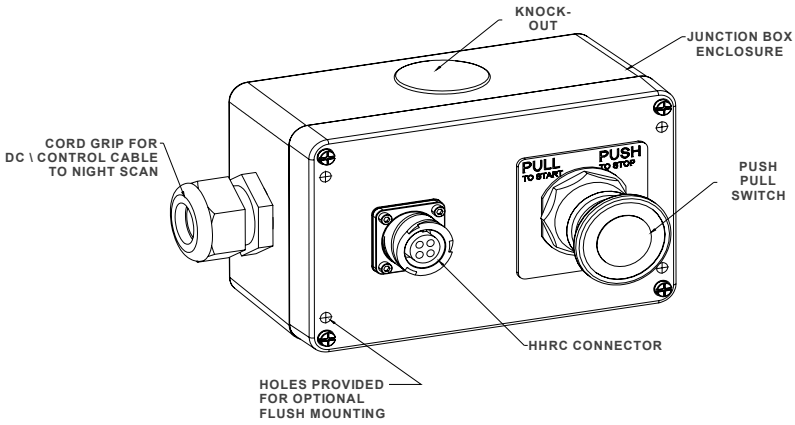


Figure 2-4 Junction Box

2.5.1 Flush Mounting

For a flush mount installation, four #8 screws, nuts and lock washers must be provided by the installer. The screw length should be 3 ½ inches plus the panel thickness. Remove the junction box cover and make the necessary cable connections (see Figure 4-3). Place the junction box behind the panel and guide the screws through the panel, junction box cover and junction box. Secure on back side using lock washers and nuts.

2.5.2 Surface mounting

For a surface mount installation, four #8 screws, nuts and lock washers must be provided by the installer. The screw length should be ¾ inch plus the panel thickness. Remove the junction box cover and mount unit through the counter bored holes in the junction box. Secure on the back side using lock washers and nuts. Make the necessary cable connections (see Figure 4-3) and replace cover.

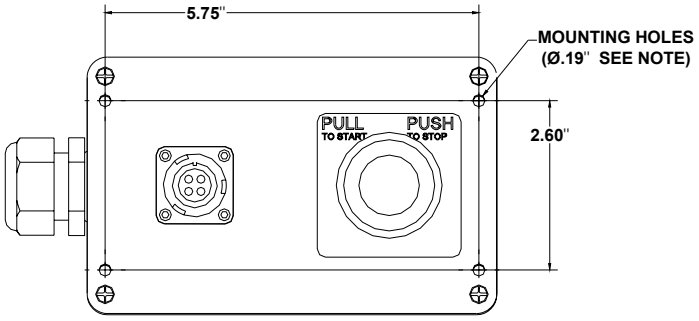


Figure 2-5 Junction Mounting Hole Locations

2.6 CABLE (S) INSTALLATION

2.6.1 AC Power Cable

AC power for the Night Scan Powerlite has its own connector (see Figure 2-6). If the connector mentioned in the AC Power Requirements (Section 1.5.1) is utilized, the wires are best crimped in the pins although soldering is possible. A power crimping tool is available from Pico Corporation. To maintain maximum creepage distance on the connector pins, it is recommended that pins A and F have the same electrical phasing, and that pins D and C have the same electrical phasing. Please refer to Table 2-2. See Figure 4-3 for wire color information.

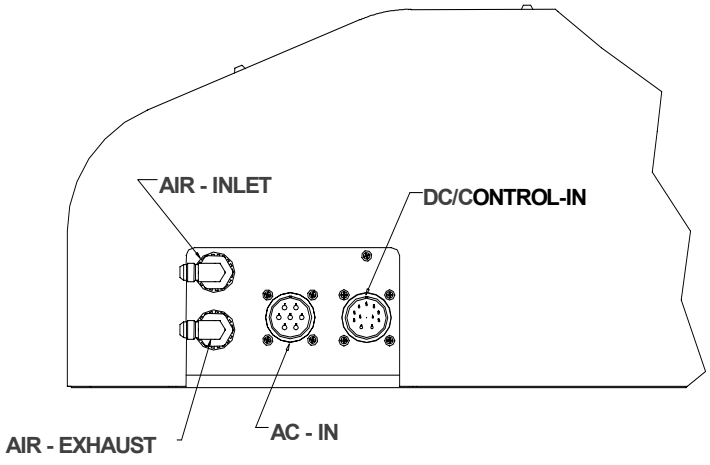


Figure 2-6 Inlet Connections

2.6.2 DC Power/Signal Cable

All of the DC lines have a common connector. If the connector mentioned in the DC Power Requirements (section 1.5.2) is utilized, the wires are best crimped in the pins although soldering is possible. A power crimping tool is available from Pico Corporation. Please refer to Table 2-3. See Figure 4-3 for wire color information.

2.6.3 Connector Pin-outs

Table 2-2. AC Power Connector Pin-out

Pin Letter	Pin Function	Recommended Wire Ga.
A	Right Light Power – L1	10
B	Earth/Chassis Ground	10
C	Right Light Power – L2	10
D	Left Light Power – L2	10
E	Earth/Chassis Ground	10
F	Left Light Power – L1	10
G	(Unused)	N/A

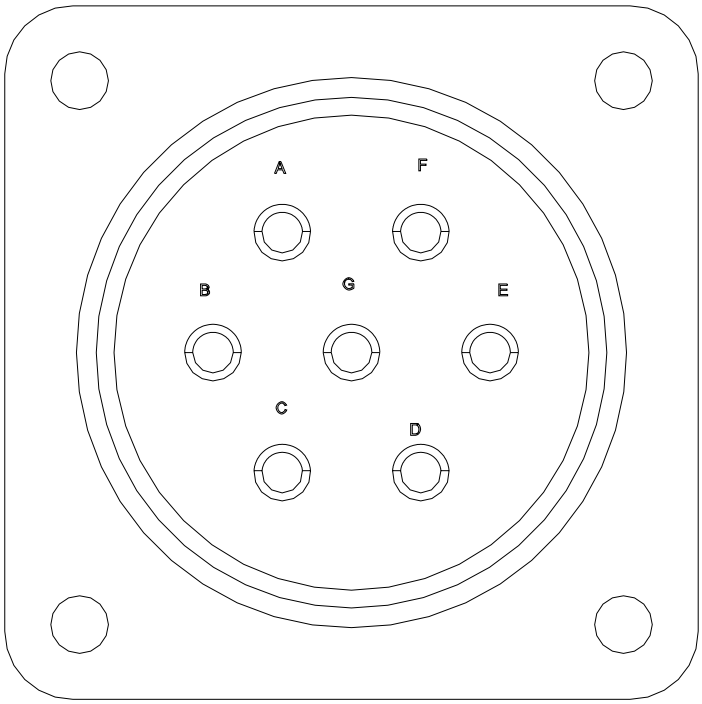
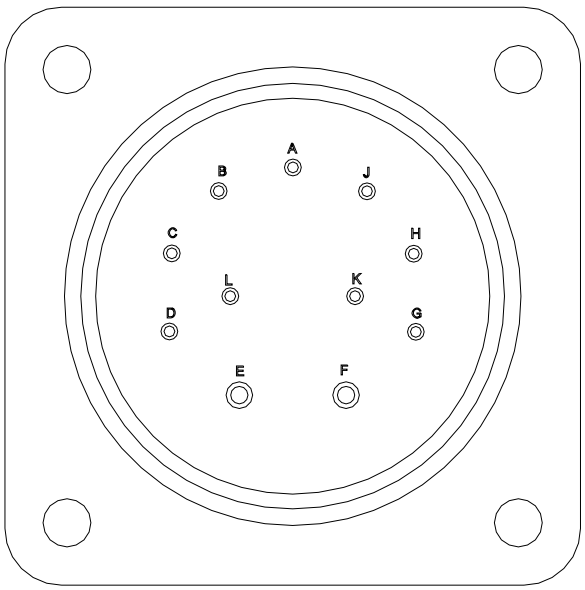


Figure 2-7 AC Connector Pins

Table 2-3. DC Power Connector Pin-out

Pin Letter	Pin Function	Recommended Wire Ga.	Destination	Comments
A	Int. Power. To HHRC - Pos.	20 minimum	HHRC Pin B	In twisted pair with Pin C of HHRC
B	Int. Power. To HHRC - Neg.	20 minimum	HHRC Pin C	In twisted pair with Pin B of HHRC
C	RS-485 Link – Data +	20 minimum	HHRC Pin A	In twisted pair with Pin D of HHRC
D	RS-485 Link – Data -	20 minimum	HHRC Pin D	In twisted pair with Pin A of HHRC
E	DC Power – Battery Pos.	12 minimum	Bat. + Term.	
F	DC Power – Battery Neg.	12 minimum	Bat. – Term.	
G	Initiate Switch Input	20 minimum	Push/Pull Switch	Momentary Normally Open switch
H	Switch Common	20 minimum	Push/Pull Switch	Same potential as Battery Negative
J	Mast Inactive Relay Output	20 minimum	Customer Circuit	2 ampere load maximum
K	Mast Inactive Relay Return	20 minimum	Customer Circuit	2 ampere load maximum
L	Emergency Stop Switch Input	20 minimum	Push/Pull Switch	Maintained Normally Closed switch

2.6.4



2.6.5

Figure 2-8 DC Power Connector Pins

2.7 AIR CONNECTIONS

Two barbed fittings are provided for connecting the air lines required to pressurize and exhaust the Night Scan mast unit. Air may be supplied externally by a compressor or other source of clean, dry air with a maximum pressure of 100 psi. The Night Scan has an internal regulator factory set to 20 psi. The fittings are for use with 3/8 inch I.D. air hose rated for the pressure supplied in combination with environmental factors, which may derate the hose (ie. high temperatures). Refer to Figure 2-9 for identification of the air fittings located adjacent to the power and control connectors. The exhaust hose must be routed to a location where it will not expel air or water onto personnel or equipment sensitive to moisture.

If the unit was provided with the optional on-board air compressor, only the exhaust hose need be connected. The exhaust hose must be routed to a location where it will not expel air or water onto personnel or equipment sensitive to moisture.

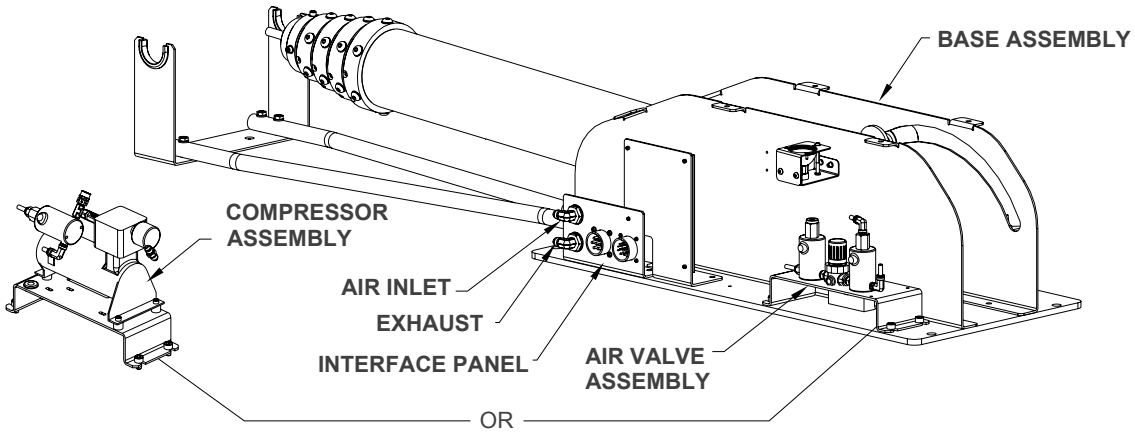


Figure 2-9 Base with Valve Assembly (optional Compressor also shown)

2.8 CONNECTING THE PUSH/PULL SWITCH (JUNCTION BOX)

While a two switch implementation of this circuit can be realized, the use of a Push/Pull switch is highly preferred. One switch available is a Square-D 9001SKR8RH25. Other manufacturers of Industrial Control Pilot Devices should have equivalent switches. This switch is available as part of a pre-wired kit (part # 913316) from Will-Burt or in a Connector/Switch kit (part #913935). For the initiate part of the circuit, a normally open switch must be connected between Pins G and H of the DC Power/input connector. For the emergency stop part of the circuit, a normally closed switch must be connected between Pins H and L of the DC Power/input connector. Please refer to Table 2-3 and Figure 4-3.

If the installation requires multiple junction boxes be installed, the normally open (KA-3) contact block of the push-pull switches are wired in parallel. The normally closed (KA-5) contact block of the switches are wired in series. The connectors for the hand held remote controls are wired in parallel. One twisted pair connects pins B and C of one connector to B and C of the other connector respectively. The same is true for pins A and D. Refer to Figure 2-10 for a schematic of a dual junction box installation.

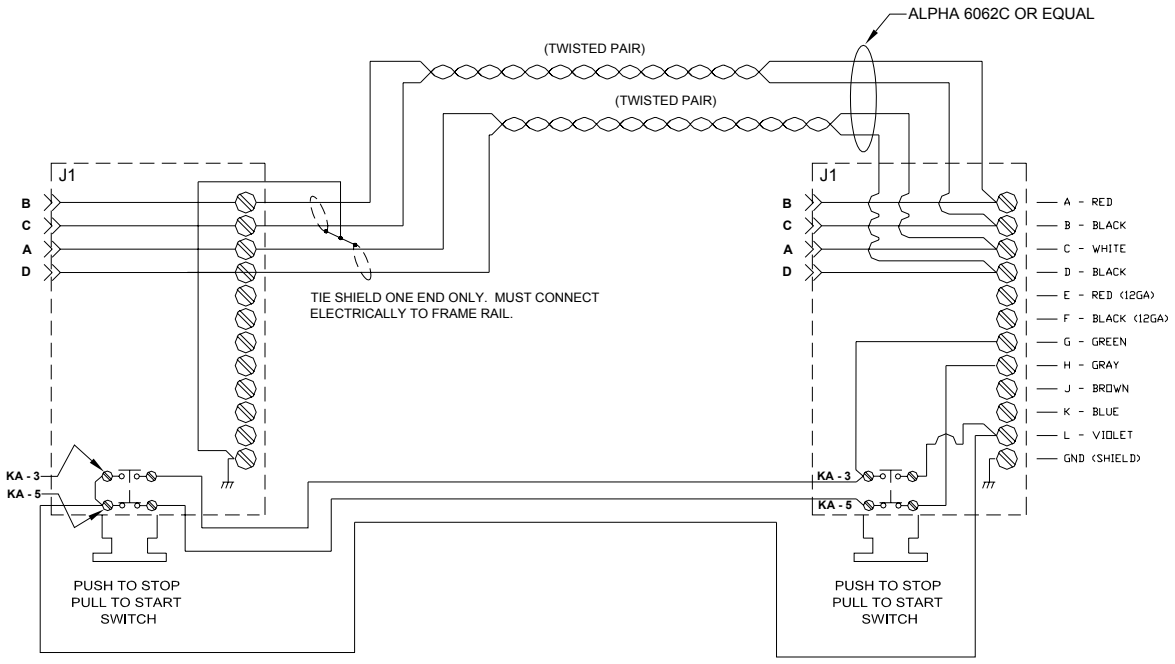


Figure 2-10 Two Junction Box Installation Wiring

2.9 CONNECTING THE HAND HELD REMOTE CONTROL

In the event that the accessory kit (part # 913316) is not used, a suitable connector must be supplied by the customer to mate with the connector of the handheld remote control (HHRC). The connector on the HHRC is an ITT Cannon CA3106E14S-2P-B-F80-A232. Please refer to Table 2-4 and Figure 4-3.

Pin B of the HHRC should connect to pin A of the DC Power/input connector. Pin C of the HHRC should connect to pin B of the DC Power/input connector. Pin A of the HHRC should connect to pin C of the DC Power/input connector. Pin D of the HHRC should connect to pin D of the DC Power/input connector.

Table 2-4. Handheld Remote Control Connector Pin-out

HHRC Pin	Pin Function	To Pin of DC Power Connector	Recommended Wire Ga.
A	+ Signal	C	20
B	+ Power	A	20
C	- Power	B	20
D	- Signal	D	20

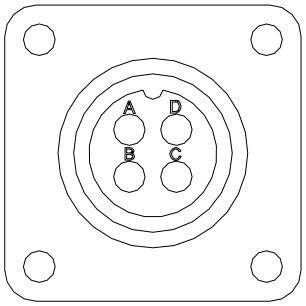


Figure 2-11 Hand Held Receptacle Pins

2.10 CONNECTING THE INTERLOCK CONTACT (OPTIONAL)

The Night Scan Powerlite provides an interlock relay contact output to enhance integration into vehicle safety circuitry. This relay output is from a bi-stable (latching) relay whose contacts close when the Night Scan has completely stowed. This type of scenario gives the best failsafe condition in the event of a broken wire. Its state is not affected by whether or not there is power to the mast. This isolated contact is capable of carrying up to 2 amperes and is available on pins J and K. Please refer to Table 2-3 and Figure 4-3. Its usage is at the discretion of the integrator. It can be used in conjunction with a customer-supplied relay to drive a flashing warning light.

2.11 INSTALLING THE WARNING LIGHT

As required by NFPA regulations, a red flashing or rotating light, located in the driving compartment, must be automatically illuminated whenever the vehicle parking brake is not fully engaged and the light tower is extended. The warning light is wired into the system via the interlock contact described above. A customer provided, normally closed pilot relay should be installed on pins J and K of the DC/Control cable. See Table 2-3 and Figure 4-3. A customer supplied flashing relay and lamp may then be installed in the driving compartment such that the lamp can be seen by the driver. One example using a Bosch relay is shown below.

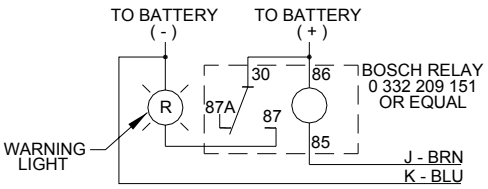


Figure 2-12 Example of Warning Light Installation

2.12 PRE-OPERATIONAL CHECK

WARNING

Before beginning installation, make certain that the area is free of overhead power lines and other unwanted sources of electricity. Follow OSHA safety regulations when working near energized power lines. Be sure to allow sufficient clearance on all sides of mast to allow for side sway.

WARNING

For outdoor use only. Do not use in areas that have been classified as hazardous as defined in Article 500 of the National Electric Code.

WARNING

Do not use in the presence of flammable gases or liquids such as paint, gasoline or solvents. Do not use in areas of limited ventilation or where high ambient temperatures are present. Contact with combustible materials can cause ignition resulting in fire or explosion.

Before operating the Powerlite, be sure that there are no overhead obstructions and that there are no power lines within 20 feet of the mast. Visually inspect the unit for any damage. If damage is apparent, do not use the mast. Have it serviced prior to use. Check for any objects which might obstruct motion of the mast or cause binding. Remove any material that may hinder mast function.

CHAPTER 3
OPERATING INSTRUCTIONS

WARNING

All operators must read the Operation section of this manual and be properly trained.

WARNING

Keep personnel clear of mast while during operation.

WARNING

For outdoor use only. Do not use in areas that have been classified as hazardous as defined in Article 500 of the National Electric Code.

WARNING

Do not use in the presence of flammable gases or liquids such as paint, gasoline or solvents. Do not use in areas of limited ventilation or where high ambient temperatures are present. Contact with combustible materials can cause ignition resulting in fire or explosion.

WARNING

Before operating, make certain that the area is free of overhead power lines and other unwanted sources of electricity. Be sure to allow sufficient clearance on all sides of mast to allow for side sway.

WARNING

Do not move vehicle until mast has been securely stowed.

3.1 THEORY OF OPERATION – MECHANICAL

The Night Scan Powerlite operates using a DC powered actuator to drive the mast from nest to 90 degrees. When at 90 degrees, a proximity sensor detects the actuator position and prevents further driving of the actuator. The sensor also notifies the operator through the HHRC that certain RCP functions are available. The standard valve assembly included in the Night Scan Base will receive power and allow air to enter the mast when the up button is depressed. If, at any time, power to the unit is lost, the inlet valve closes and the exhaust valve opens. This will exhaust all air from the mast.

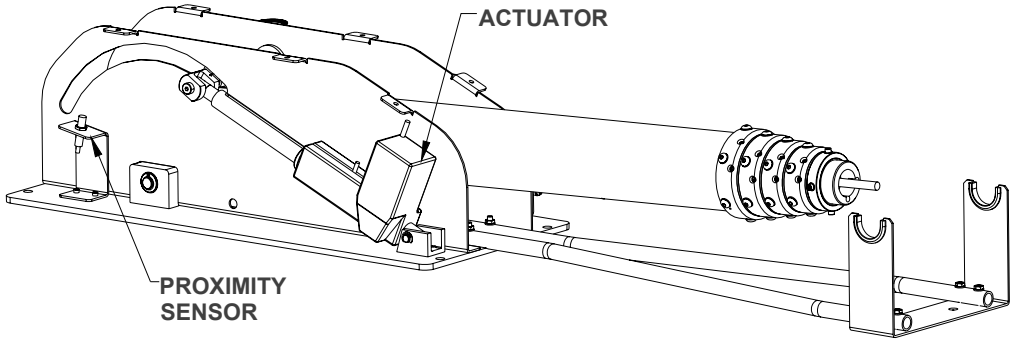


Figure 3-1 Actuator and Proximity Sensor

The RCP provides pan and tilt functions upon command from the HHRC. DC powered gear motors turn the shafts until an opaque flag in the assembly reaches a photo interrupter. At this time, the LED on the HHRC for that direction of travel will go out, indicating that a limit has been reached in that direction.

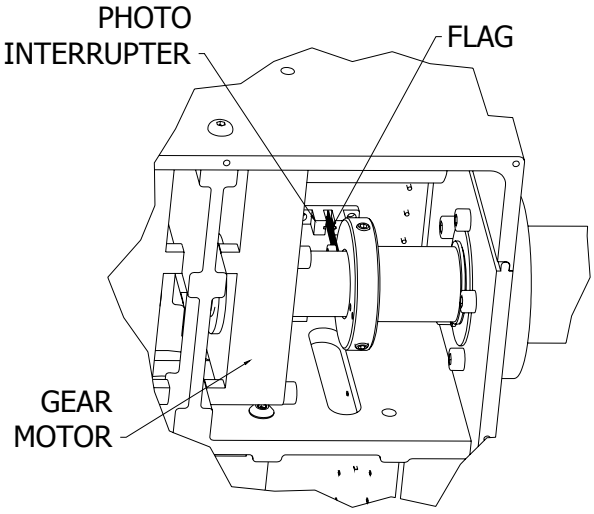


Figure 3-2 Photo Interrupter and Flag

As the mast is nested, the base control looks for indication from a magnetic switch that the mast has fully retracted and may be safely restored to its fully nested (horizontal) position. If the “double click” unattended stow sequence was not used, the RCP will begin the autostow sequence to insure that the RCP is properly positioned for engagement with the saddle. If the autostow “double click” sequence was used, the RCP will have properly positioned itself as the mast descended prior to horizontal nesting into the saddle.

3.2 THEORY OF OPERATION - ELECTRICAL

The Night Scan Powerlite control is based on a distributed intelligence control structure. Each main section of the Night Scan Powerlite has a circuit board with an embedded micro controller. These sections are: the Base, the RCP, and the HHRC. These boards "talk" to each other over a multi-drop RS-485 serial communications link.

Another key component of the control is an initialization circuit. A completely stowed Night Scan Powerlite draws zero current and cannot be extended or operated in any shape or form until the initiate circuit is engaged. Included in this initialization circuit is an input for a safety interlock. This can be used for an emergency stop, or other interlock function such as a "Park/Neutral" switch from the vehicle transmission.

Additionally, a bi-stable contact closure is provided that indicates that the mast is properly stowed. It will close when the mast is properly stowed. If the mast is not stowed, the contact will be open. Even if the emergency stop feature is used prior to the mast completely stowing, the contact will still remain open. If the Night Scan has been stopped using the emergency stop button or by some other interruption of power, the initiate circuit will need to be activated again in order to continue operation.

When stowing the mast, the control monitors the current of the actuator. When the mast lowers and comes up against the mechanical resistance of the saddle, it senses it, considers itself stowed, and shuts itself down. This ensures a certain amount of pre-load on the RCP saddle.

If at any time during the operation of the mast an unexpected control situation occurs, the mast will stop any movement and a fault message will be displayed on the HHRC display. Clearing the fault is accomplished by first manually shutting the control down by pushing the Push/Pull switch or momentarily interrupting power some other way. Then the control may be re-initiated and operated again.

3.3 PUSH/PULL SWITCH

All operation of a completely stowed mast must be preceded by proper initialization. The initiate switch must be momentarily closed to power-up the Night Scan. When the Will-Burt Accessory Kit is used, the Push/Pull switch is located on the junction box. It is used to perform two functions. First, it can be used to "initiate" the control by pulling the switch operator. This is a momentary function, and the switch will return itself to a neutral position on its own. Secondly, it functions as an emergency stop when the switch operator is pushed all the way in. This is a maintained function, and the switch will stay in that position until it is pulled back out. When using Will-Burt's accessory kit push/pull switch, accidental initiating is extremely unlikely since it would require pulling the switch button. Even with this, the HHRC would have to be simultaneously pushed to get any action. In the unlikely event that the initiate switch were engaged, the Night Scan will power itself down if no HHRC action occurs within thirty seconds. The "Push" portion of the Push/Pull switch functions as an Emergency Stop. If it is pushed, the mast will immediately be disconnected from power and stop. Other interlock contacts could be inserted into this circuit to provide additional safety. The control also monitors the initiate input, and if it sees that this input is present for a prolonged period of time; the control will stop the mast and begin flashing the "Mast Stowed" contact. This is a preventative measure to ensure the initiate input is not hot-wired. Once the mast has been initiated, the handheld remote control (HHRC) must then be used to begin raising the mast within thirty seconds or the control will shut itself down. If the mast has been initiated and raised any amount, the control will remain powered until the mast is fully stowed, the emergency stop function is used, or the power is somehow otherwise interrupted.

3.4 HANDHELD REMOTE CONTROL (HHRC)

The handheld remote control (HHRC) accepts switch activations from the operator and translates them into serial commands for transmission to the base control board via the RS-485 link. If the operator engages a switch, the HHRC will appropriately send commands repeatedly as long as the operator continues to engage that switch. The Base control will pass along appropriate serial commands to the RCP in response to the HHRC. Additionally, various states of the system will be passed to the HHRC so that button status LEDs can give proper indication of the state of the Night Scan. An example of this is that the LED next to the "Mast Down" button will not be lit unless it is appropriate to lower the mast. Upon first beginning to raise the mast, it will be noted that the "Mast Down" button does not become active until a certain amount of movement has been accomplished. This is to ensure that there is

enough downward travel available for proper stowing of the mast. If the button status LED for a particular button is not lit, that button will not function. Another reason for a button status LED not being lit could be an actuator reaching the extent of its travel (or limit switch). Switches available to the operator are shown in Figure 3-3, and are as follows:

- Mast Up
- Mast Down
- Pan Right
- Pan Left
- Left Tilt Up
- Left Tilt Down
- Right Tilt Up
- Right Tilt Down
- Left Lights (toggles Off and On)
- Right Lights (toggles Off and On)
- Aux. Light (toggles Off and On)

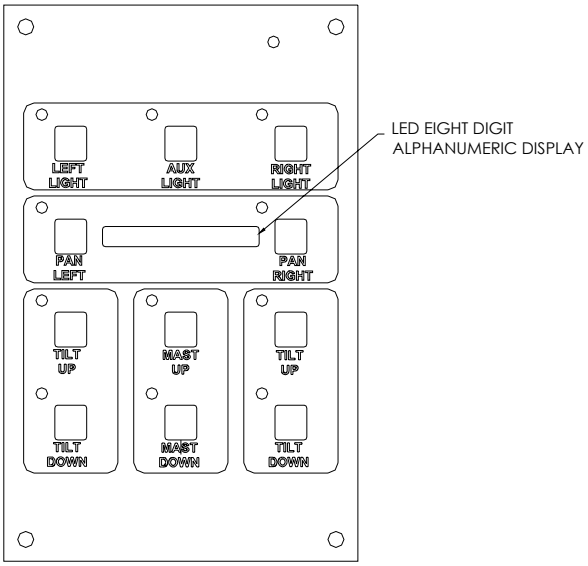


Figure 3-3 Hand Held Remote Keypad Layout

A special function is implemented in software whereby the operator can initiate an unattended lowering and stowing of the mast. This is accomplished by two rapid sequential activations of the “Mast Down” button within a half second period of time. This automatic unattended sequence can be aborted at any time by a single activation of the “Mast Up” button or any other button on the HHRC.

3.5 HAND HELD REMOTE CONTROL FUNCTION FOR PROFILER

The hand held remote control supplied with Powerlite Profiler models is the same as that supplied with the standard dual tilt models. However, on the Profiler model, the lights may be toggled on and off using either the left or right light buttons. Similarly, the tilt function is available from either the left or right tilt buttons.

3.6 RAISING THE MAST

Operation of the mast using the HHRC is fairly intuitive. A typical operational sequence could be as follows:

- Momentarily pull the Push/Pull Initiate button.
- Press and hold the "Mast Up" button on the HHRC until the mast has fully extended.
- Press the desired Pan and Tilt buttons until the lights are facing appropriately.
- Press the Right, Left, and Aux light buttons momentarily to turn the desired lights on and off.
- Press the "Mast Down" button until the mast has completely stowed and the HHRC goes dead.

During the process of raising the mast, the mast will first be inclined to a position perpendicular to its mounting surface by an actuator. Once the control senses it is in this position, air pressure will be applied to the tube sections to raise the mast further into the air. Lowering the mast is in reverse order. Air is vented from the tube sections reducing its height. Then the actuator declines the mast until it is finally stowed.

3.7 AIMING THE REMOTE CONTROL POSITIONER

The positioner can be "aimed" by utilizing the pan and tilt buttons located on the HHRC. The Pan Left and Pan Right buttons allow horizontal movement, while there are independent Tilt Up and Tilt Down functions for vertical adjustment of each side of the RCP.

3.8 STOWING THE MAST

There are two methods of stowing the mast. The normal method involves pressing and holding the "Mast Down" button until the mast is fully stowed and the control shuts itself off. A second method involves giving two quick successive depressions of the "Mast Down" button (within ½ second). This will initiate an unattended complete stowing of the mast. This auto-stow mode can be interrupted and canceled at any time by pressing any of the buttons on the HHRC. To ensure proper seating of the RCP in the saddle, the control watches for an increase of current from the actuator. Once this has been satisfied, the control will shut itself off. If by chance there is no increase in current and the actuator shuts off because of its internal limit switch, a fault message will be displayed.

Once the control has shut itself off, the Night Scan is totally disconnected from power, and the "Mast Stowed" safety interlock contact closes signaling it is safe to move the vehicle. **Be sure that no buttons are illuminated on the remote after stowing. Illuminated buttons indicate that the unit is not stowed.** After making certain that the unit is properly stowed in the saddle, unplug the remote control and stow it where it will not be damaged in transport. Unplugging the remote will remove any possibility that the Powerlite could become active and extend unexpectedly.

3.9 EMERGENCY STOW (LOSS OF POWER)

WARNING

Make sure all power has been disconnected from the Night Scan prior to manually lowering mast.

WARNING

Make sure lights have cooled completely before manually panning or tilting the RCP.

In the event of power loss, the Night Scan Powerlite will automatically exhaust all air and nest. However, the mast will NOT return to its fully stowed, horizontal position. This must be accomplished manually. It is required that two people perform this operation as the mast is very heavy and can cause severe injury or death if not done with extreme caution. It may be necessary to manually pan the RCP so that when it is manually nested, the lights do not make contact with the mounting surface or the saddle. To manually pan the unit, firmly grasp the RCP by the horizontal shafts and **slowly** rotate to a point perpendicular to the length of the base. Additionally, it may be necessary to manually tilt the lights to prevent damage when stowing the mast. Tilt the lights by grasping the top and bottom of the light bar and **slowly** rotating the lights such that they face down when fully stowed.

WARNING

Support the mast before removing shoulder screw! Once removed, the mast and light assembly is free to fall.

Remove the right side base cover (opposite look up light). Secure the mast in an upright position to prevent it from falling freely. **Remove the M3 set screw from the top of the actuator yoke**. Remove the M10 shoulder screw from the side of the yoke. CAREFULLY lower the mast down into the saddle. Secure the mast in this nested position before moving the vehicle.

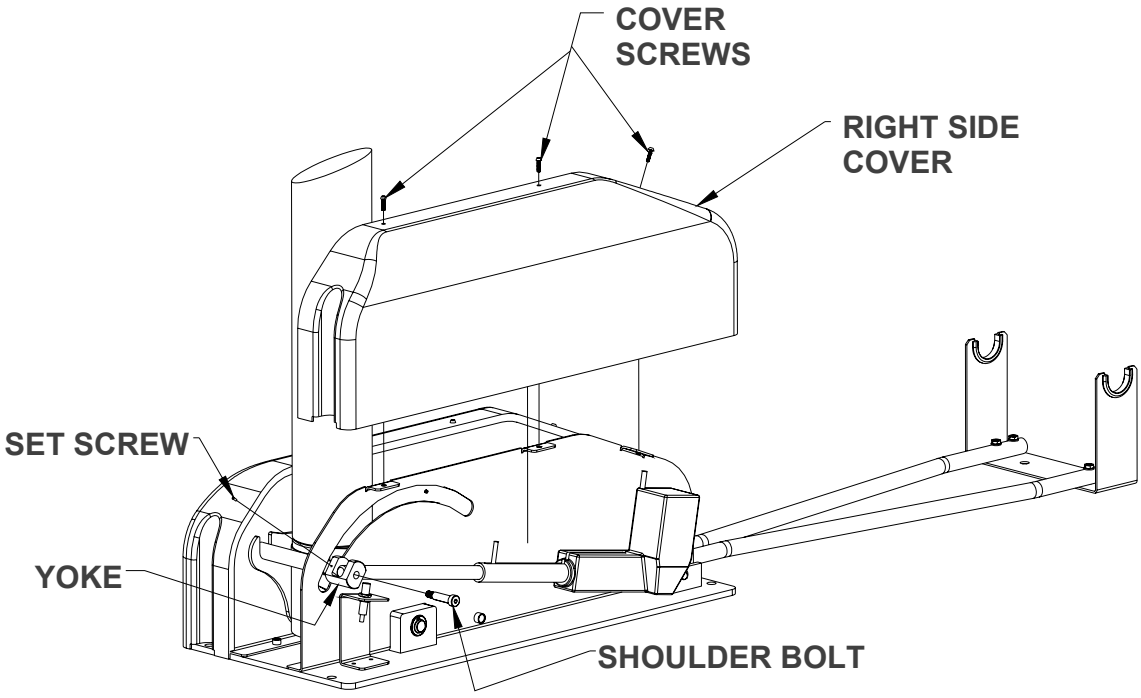


Figure 3-4 Cover and Screw Removal for Manual Stow

CHAPTER 4
MAINTENANCE AND SERVICE INSTRUCTIONS

4.1 INTRODUCTION

This section of the manual describes routine maintenance procedures and covers general service information. Refer to Chapter 5 for exploded views of the Night Scan Powerlite and the accompanying Tables with item descriptions and part numbers, which may be used for ordering replacement parts.

4.2 SCHEDULED MAINTENANCE

4.2.1 Cleaning and Lubrication - Mast

Will-Burt pneumatic telescoping masts should be cleaned and lubricated on a regular basis to insure smooth operation and to prolong useful life. This maintenance should be performed typically about once a month depending upon local environmental conditions and frequency of use. Signs that cleaning and lubrication are needed can be:

- A noticeable gritty film on the exterior surfaces of the mast sections
- Erratic extension or retraction of the mast
- Noisy operation of the mast
- Sticking of one or more mast sections when mast is extending or retracting

WARNING

A pneumatic telescoping mast is a pressure vessel. Caution must be exercised to stay clear when the mast is being extended. Do not lean directly over the mast. Proper eye protection should be worn when working on the mast.

PROCEDURE:

1. Reduce the regulator setting such that it pressurizes the mast to between 5 and 10 PSIG. Pull up on the regulator cap and rotate counterclockwise. Push cap down to lock into place.
2. One person operating hand held remote control should slowly pressurize the mast just enough to extend the top mast section. Another person may need to hold down the larger mast section collars to assure the proper sequence of extension. Release “Mast Up” button as soon as the mast section is up.
3. Wipe down the extended mast section using a non-abrasive cleanser or solvent such as lacquer thinner. Do not allow the cleaning fluid or solvent to run down inside the collar.
4. Repeat steps 2 and 3 for the next larger mast section.
5. Inject approximately 1/2 oz. of TMD Mast Lubricant* or a lightweight machine oil into the weep hole (drain) of the exposed mast section. The weep holes are located approximately 10 inches below the collar on each tube except the top one.

6. Repeat steps 2, 3 and 5 for each of the remaining mast sections.

7. Exhaust the mast completely. Allow several minutes for the lubricant to settle and spread around the wear ring and seal at the bottom of each mast section.

WARNING

Keep hands clear of the descending collars while the mast is being lowered to avoid pinching.

8. Extend the mast again one section at a time in the same sequence (smallest to largest). Wipe off any excess lubricant which flows out of the weep holes.

   NOTE: Do not lubricate the exterior of the mast, as this will cause it to attract dust and contaminants from the air.

* TMD Mast Lubricant is specifically formulated for cold weather use, but is suitable for year around use. Regular winter maintenance and the frequent use of TMD Mast Lubricant should significantly reduce the potential for mast freeze ups. TMD Mast Lubricant is also intended for use in air in-line lubricators.

4.2.2 Cleaning Night Scan Base and Remote Control Positioner (RCP)

WARNING

Make sure lights are completely cool before attempting to clean.

The exterior of the RCP and Night Scan base should be wiped down periodically to remove dirt and road grime using a soft cloth or sponge and a mild solution of soapy water. The lenses of the lights should be cleaned using standard glass cleaner and a soft towel.

4.3 ADJUSTMENTS

4.3.1 Adjusting the Proximity Switch

The proximity switch (sensor) is intended to stop the actuator when the mast is at 90 degrees when being raised. It senses the steel in the actuator shaft and signals the base circuit board to cut power when the actuator is in the correct position. In the event that this switch needs adjusted (ie. after replacing the actuator) to stop the mast at 90 degrees, the following procedure must be followed. Use Figure 4-1 as an aid to identify the components.

1. Make certain that the Powerlite is level.
2. Remove the right hand base cover (opposite the look up light)
3. Loosen the upper jam nut to lower the switch approximately 1/8".
4. Initiate the mast by pulling the Push-Pull switch on the junction box and raise the mast to 90 degrees. Verify that the mast is plumb using a level or check to see that it is square to the sheet metal side plate on the base.
5. Raise the switch until it senses the actuator. This will be indicated by 1) an audible "click" of the exhaust valve closing, 2) lights on the hand held will change state, indicating that RCP functions are available and 3) the LED on the proximity switch will light.

6. Secure the switch in position using the upper and lower jam nuts.
7. Cycle the mast several times, checking that the mast is plumb each time. Adjust the switch if necessary.
8. Replace cover.

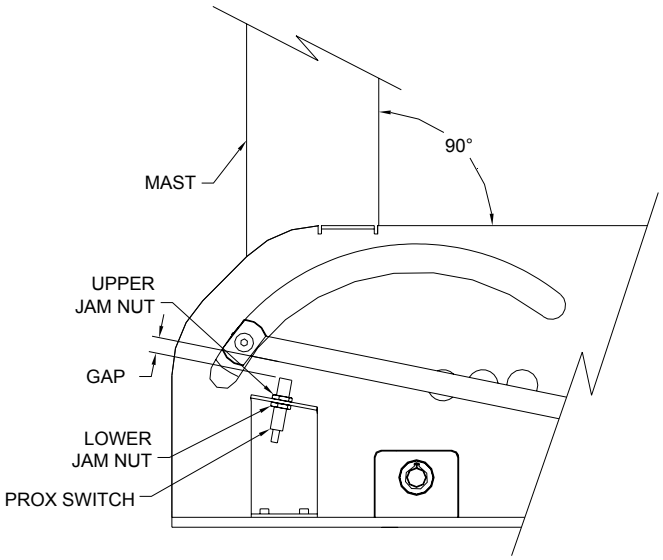


Figure 4-1 Proximity Switch Adjustment

4.3.2 Adjusting the Magnetic Switch

The Magnetic Switch Is located on the mast base tube. When stowed, the switch is on the underside of the mast. This switch senses a magnet located in the top tube and serves to indicate that the mast has exhausted all air and that it is safe to nest into the saddle. If the switch is out of adjustment, it will prevent the mast from nesting to the saddle from the 90 degree position. **It is important that the mast has properly nested by verifying that the collars are stacked with no gaps between them.** If the collars are not properly stacked see Table 4-5 for further instructions. If the switch is found to require adjustment, it will most commonly need to be moved upward (toward the RCP) on the mast. The magnet is located at the lower end and side of the top tube. It is not visible outside the mast.

The following procedure must be followed to adjust the magnetic switch.

1. Loosen the band clamp securing the switch to the base tube. Move the switch up approximately 1/8” and tighten band clamp.
2. Initiate the mast, if necessary, and press the down button the hand held remote. If the mast does not nest, repeat the adjustment until it does. A small piece of steel or iron filings may be used to help locate the magnet.
3. If repeated attempts do not succeed, hold a magnet up to the switch and press the down button. If the mast begins to nest, continue repeating the adjustment until the switch has sensed the magnet.
4. If the mast will not nest when a magnet is held to the switch, check the wiring to at the circuit board for loose or disconnected wires. See Figure 4-3. If the wiring is intact, replace the magnetic switch.

4.3.3 Resetting the RCP Home Position

The Powerlite unit is shipped with the lights in home position. Home position is established by setting small flags in the RCP that engage photo interrupters on the RCP board. It orients the lights such that the light bars are parallel to the axis of the mast and are facing downward when nested. In Profiler models, the lights should be face down when

nested and parallel to the base plate of the Powerlite. On all models, the RCP shafts should contact the saddle simultaneously during nesting when correctly set. It should be noted that having the RCP covers off can cause improper RCP operation when outdoors. This procedure should be performed indoors. To set the home position, the following procedure must be observed.

1. **DISCONNECT ALL AC POWER TO THE POWERLITE!**
2. Initiate the mast and raise it to the 90-degree position. The hand held remote should show both left and right tilt up functions are available and the pan left function is available.
3. Remove the front (face down when nested) RCP cover to access the flags.
4. Refer to Figure 5-3 and Table 5-2 for reference. The flags are attached to the timing rings on the horizontal and vertical shafts. Each timing ring has two set screws that must be loosened. It may be necessary to loosen one in each, then pan and tilt the unit to access the others. **The flags have sharp edges that may cause cuts.**
5. Once the set screws are loose, pan and tilt the unit to the correct home position. Be careful that the flags do not come into contact when panning and tilting, they may become bent.
6. It is important that the flags engage the correct photo interrupter when setting the home position, see Figure 4-2. Turn the timing ring on the right horizontal shaft such that it rotates down toward the upper photo interrupter. As you approach the interrupter, watch the hand held remote. As soon as the right tilt down LED goes out, stop rotating the ring and tighten the set screw. Repeat on the left horizontal shaft. To set the pan home position, turn the timing ring counterclockwise (looking from above the RCP) until the pan right LED goes out. Tighten the set screw to secure the ring.
7. Pan and tilt the unit until the second set screw in each ring is accessible and tighten.
8. Stow the mast, watching for the lights to be oriented as described in the beginning of this section.
9. Initiate and raise the mast to 90 degrees. Replace the RCP cover.

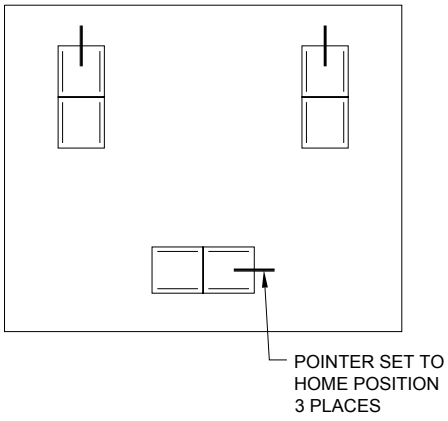


Figure 4-2 Flag Settings (Viewed from RCP front)

4.4 SYSTEM SCHEMATIC

A system schematic is given in order to aid in electrical troubleshooting as outlined in the following section.

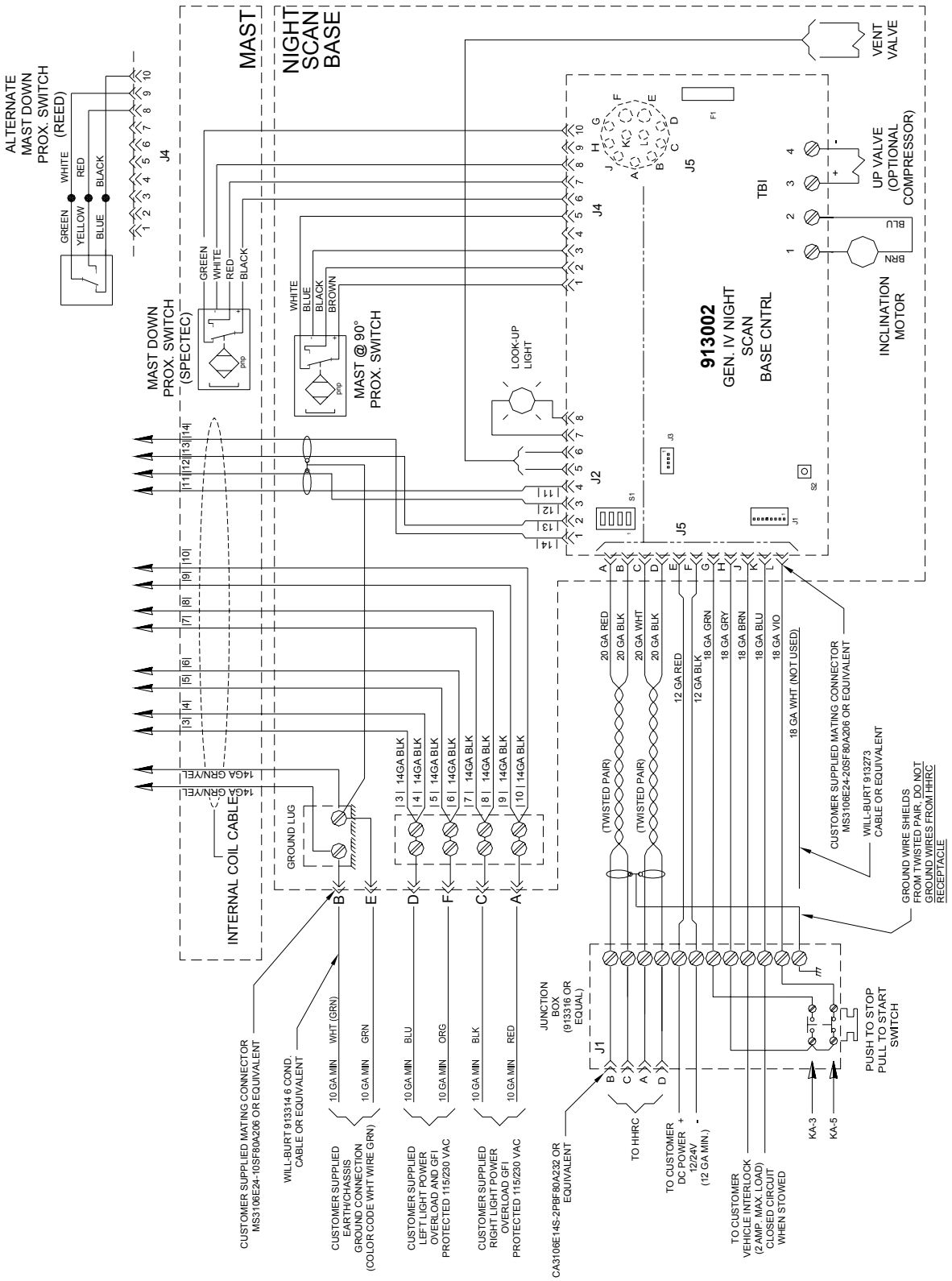


Figure 4-3 Night Scan Base System Schematic

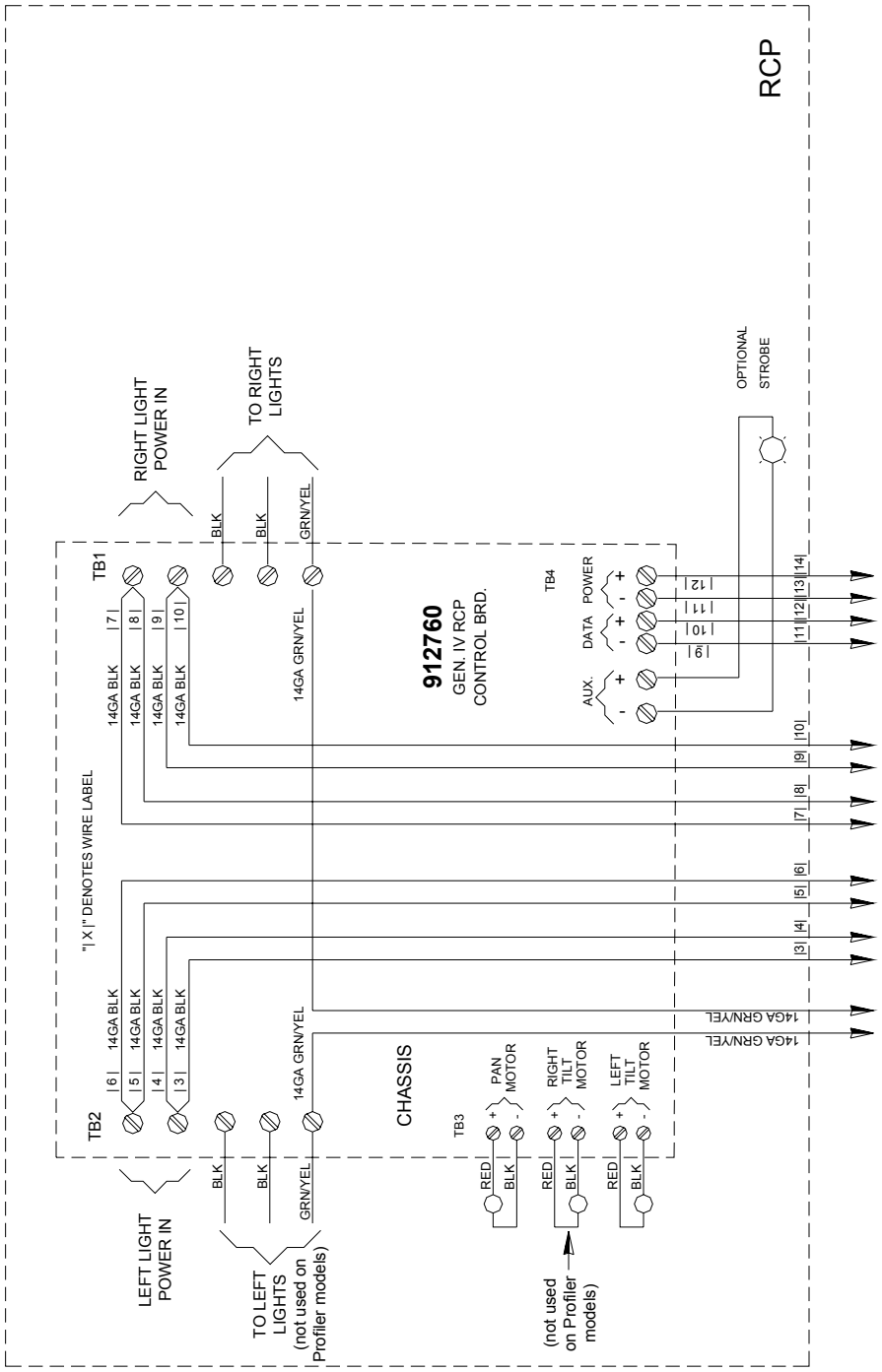


Figure 4-4 Night Scan Remote Control Positioner Schematic

4.5 TROUBLESHOOTING ELECTRICAL

4.5.1 Operating Environment

One of the most common causes of improper operation is trying to operate outside of the stated system requirements. (see Table 1-1), with low battery voltage at the top of the list. A good method of checking the voltage at the Powerlite is to connect a voltmeter to the wires in the junction box powering the HHRC (pins B and C of J1 see Figure 4-3). This will give a good indication of power loss across the DC cabling. For long runs, it may be necessary to add an intermediate junction box in the DC cable so that DC power can be applied closer to the Powerlite.

4.5.2 Fault Codes

Fault codes are presented on the LED eight digit alphanumeric display (see Figure 3-3). The codes are a combination of numbers that identify both the general location of the fault, and the type of fault. The first of two numbers is a single digit number indicating which board. The second number is a two-digit number indicating the fault. When faults occur, all operation ceases. Faults may only be cleared by killing power to the Powerlite. This may be accomplished by momentarily pushing in the Push/Pull switch. The codes are as follows:

4.5.2.1 Base Board

The Base board is located in the base of the mast and is assigned unit number one (1). The Base board may generate the messages of Table 4-1:

Table 4-1. List of Base Board Faults

Message	Meaning	Root Issue	Potential Causes
Err 1,01	Mast Down Magnetic Switch Wiring Error	The Mast Down Magnetic Switch appears to have its complimentary outputs wired backwards This switch is located on the side of the mast. For the Vertical Powerlite, it is the lower of the two switches.	This check is only made at power-up when the mast thinks it is nested. The wires on pins 8 and 10 of J4 may need to be swapped. The magnetic switch not being energized could also cause it. Place a magnet close to the switch to check before changing wiring.
Err 1,08	Communication Fault	The base board has sent an invalid message	Indicates a software problem. Notify Will-Burt
Err 1,09	Initiate Pushbutton	The Initiate input has been closed for too long.	Wiring Short in the DC cable or Defective Switch/wiring in the junction box. Disconnect the DC cable from the Powerlite. Check the continuity between pins G and H of the DC cable connector. It should be open. If not, trace to problem. If it is, replace the base board.
Err 1,10	EEPROM Life	More than 20,000 writes have been made to a particular EEPROM location	Will only occur when the mast has had in excess of 20,000 cycles which is unlikely to happen. Replace the base board.
Err 1,11	Saddle Location	The internal linear actuator limit switch has opened before preload occurred	The saddle is too low with respect to the Powerlite base. Shim the saddle up as needed. Refer to section 2.4 for flatness requirement.

Err 1,12	Actuator 90° Proximity Switch Disagreement (Should never occur on Vertical Powerlites)	The proximity switch sensing the mast actuator at 90° has conflicting complementary outputs.	There may be a wiring problem, or a defective proximity switch. Check the voltages at J4 pins 2 and 5 with respect to pin 3. These two voltages should be opposite of each other as the proximity switch is activated and inactivated. The voltages should be close to battery voltage or close to ground. If they are not, replace the actuator 90° proximity switch. Refer to Figure 4-3
Err 1,13	RCP Stow Magnetic Switch Disagreement (Only should occur on Vertical Powerlites)	The magnetic switch sensing the mast is close to lowered (referring to tube set) has conflicting complementary outputs.	There may be a wiring problem, or a defective magnetic switch. Check the voltages at J4 pins 2 and 5 with respect to pin 3. These two voltages should be opposite of each other as the magnetic switch is activated and inactivated. The voltages should be close to battery voltage or close to ground. If they are not, replace the RCP Stow switch. Refer to Figure 4-3
Err 1,14	Mast Down Magnetic Switch Disagreement	The magnetic switch sensing the mast is lowered (referring to tube set) has conflicting complementary outputs.	There may be a wiring problem, or a defective proximity switch. Check the voltages at J4 pins 8 and 10 with respect to pin 6. These two voltages should be opposite of each other as the magnetic switch is activated and inactivated. The voltages should be close to battery voltage or close to ground. If they are not, replace the Mast Down switch. Refer to Figure 4-3
Err 1,15	Actuator 90° Proximity Switch Wiring Error (Should never occur on Vertical Powerlites)	The proximity switch sensing the mast actuator at 90° appears to have its complimentary outputs wired backwards	This check is only made at power-up when the mast thinks it is nested. The wires on pins 2 and 5 of J4 may need to be swapped. The proximity switch not being energized could also cause it. Place a large piece of ferrous metal close to the switch to check before changing wiring. Refer to Figure 4-3
Err 1,16	RCP Stow Magnetic Switch Wiring Error (Should only occur on Vertical Powerlites)	The RCP Stow Magnetic Switch (the upper of two located on the side of the mast) appears to have its complimentary outputs wired backwards	This check is only made at power-up when the mast thinks it is nested. The wires on pins 2 and 5 of J4 may need to be swapped. The magnetic switch not being energized could also cause it. Place a magnet close to the switch to check before changing wiring. Refer to Figure 4-3

4.5.2.2 RCP Board

The remote control positioner (RCP) board is located in the positioner at the top of the mast and is assigned unit number two (2). It should be noted that having the RCP covers off can cause improper RCP operation, especially outdoors. The RCP board may generate the messages of Table 4-2:

Table 4-2. List of Remote Control Positioner Board Faults

Message	Meaning	Root Issue	Potential Causes
Err 2,01	Pan Limit Overlap	Both pan photosensors are blocked simultaneously	Foreign material in one of the photosensors or faulty photosensor. Check to make sure there is no foreign material in the photosensors. Clean with a soft cloth. If this does not get rid of the fault, replace RCP board
Err 2,02	Left Tilt Stuck	The state of the left tilt photosensors have not changed even though the motor has been told to move for some period of time	Something is preventing movement of left tilt mechanism or the motor is defective. Check to see if voltage is being applied to the left tilt motor. If it is, replace the gearmotor. Otherwise, the problem is in the photosensor on the RCP board. Replace RCP board
Err 2,03	Right Tilt Stuck	The state of the right tilt photosensors have not changed even though the motor has been told to move for some period of time	Something is preventing movement of right tilt mechanism or the motor is defective. Check to see if voltage is being applied to the right tilt motor. If it is, replace the gearmotor. Otherwise, the problem is in the photosensor on the RCP board. Replace RCP board
Err 2,04	Pan Stuck	The state of the pan photosensors have not changed even though the motor has been told to move for some period of time	Something is preventing movement of pan mechanism or the motor is defective. Check to see if voltage is being applied to the pan motor. If it is, replace the gearmotor. Otherwise, the problem is in the photosensor on the RCP board. Replace RCP board
Err 2,07	Communicatio n Timeout	The RCP board has not sent out communications recently	Bad connection in communications link, or RCP is not powered or is inadequately powered. Make sure the power at the RCP board is at least 10.5 volts (on TB4). Check continuity of the internal coiled cable between the base board and the RCP board (see Figure 4-3 and Figure 4-4)
Err 2,08	Communicatio n Fault	The RCP board has sent an invalid message	Indicates a software problem. Notify Will-Burt
Err 2,09	Left Tilt Up Limit	The left tilt down photosensor was made before the up photosensor indicating wrap around or the up photosensor is linear or defective	Check to make sure the left tilt flag is not located in between the two photosensors. If it is, slowly move the left light bank by hand (with power off) until it is in the proper position. Readjustment of the flag may be necessary to set the proper home position. See 4.3.3. If the flag is not in between, replace the RCP board
Err 2,10	Left Tilt Down Limit	The left tilt up photosensor was made before the down photosensor indicating wrap around or the down photosensor is linear or defective	Check to make sure the left tilt flag is not located in between the two photosensors. If it is, slowly move the left light bank by hand (with power off) until it is in the proper position. 0 Readjustment of the flag may be necessary to set the proper home position. See

		defective	4.3.3. If the flag is not in between, replace the RCP board
Err 2,11	Right Tilt Up Limit	The right tilt down photosensor was made before the up photosensor indicating wrap around or the up photosensor is linear or defective	Check to make sure the right tilt flag is not located in between the two photosensors. If it is, slowly move the right light bank by hand (with power off) until it is in the proper position. Readjustment of the flag may be necessary to set the proper home position. See 4.3.3. If the flag is not in between, replace the RCP board
Err 2,12	Right Tilt Down Limit	The right tilt up photosensor was made before the down photosensor indicating wrap around or the down photosensor is linear or defective	Check to make sure the right tilt flag is not located in between the two photosensors. If it is, slowly move the right light bank by hand (with power off) until it is in the proper position. Readjustment of the flag may be necessary to set the proper home position. See 4.3.3. If the flag is not in between, replace the RCP board
Err 2,13	Pan Right Limit	The left pan photosensor was made before the right photosensor indicating wrap around or the right photosensor is linear or defective	Check to make sure the pan flag is not located in between the two photosensors. If it is, slowly move the RCP head by hand (with power off) until it is in the proper position. Readjustment of the flag may be necessary to set the proper home position. See 4.3.3. If the flag is not in between, replace the RCP board
Err 2,14	Pan Left Limit	The right pan photosensor was made before the left photosensor indicating wrap around or the left photosensor is linear or defective	Check to make sure the pan flag is not located in between the two photosensors. If it is, slowly move the RCP head by hand (with power off) until it is in the proper position. Readjustment of the flag may be necessary to set the proper home position. See 4.3.3. If the flag is not in between, replace the RCP board
Err 2,15	Left Tilt Limit Overlap	Both left tilt photosensors appear to be blocked simultaneously	Foreign material in one of the photosensors or faulty photosensor. Check to make sure there is no foreign material in the photosensors. Clean with a soft cloth. If this does not get rid of the fault, replace RCP board
Err 2,16	Right Tilt Limit Overlap	Both right tilt photosensors appear to be blocked simultaneously	Foreign material in one of the photosensors or faulty photosensor. Check to make sure there is no foreign material in the photosensors. Clean with a soft cloth. If this does not get rid of the fault, replace RCP board

4.5.2.3 HHRC Board

The handheld remote control (HHRC) board is located in the handheld unit and is assigned unit number three (3). The HHRC board may generate the messages of Table 4-3:

Table 4-3. List of Hand Held Remote Control Board Faults

Message	Meaning	Root Issue	Potential Causes
Err 3,07	Communication Timeout	The HHRC board has not received communications from the base board recently	Bad or improper connection in communications link, or HHRC is not properly powered. Check continuity of the data lines from the DC power cable connector to the HHRC connector. Refer to Figure 4-3 Check to make sure that the base board software is 2.6 or newer. Refer to section 7.1 on how to check software revision level. Also check that the shield in the junction box has a good electrical connection all the way to the frame rail.
Err 3,08	Communication Fault	The HHRC board has received an invalid message	Indicates a software problem. Notify Will-Burt
Err 3,09	Internal Communication Fault	The HHRC has problems communicating with internal HHRC circuitry	Return HHRC to factory for repair

4.5.3 Warning Codes

Warning codes are presented on the LED eight digit alphanumeric display (see Figure 3-3). The codes are a combination of numbers that identify both the general location of the warning, and the type of warning. The first of two numbers is a single digit number indicating which board. The second number is a two-digit number indicating the warning. Warning codes differ from Fault codes in that they do not require clearing. If the condition causing the warning goes away, so does the warning. At that point, normal operation continues. The codes are as follows:

Table 4-4. List of Warning Codes

Message	Meaning	Root Issue	Potential Causes
WRN 1,01	Low Voltage Warning	The Base board is experiencing a low voltage condition	The vehicle battery may not be fully charged. There also could be excessive voltage drop across cabling because of long cabling runs/small gage wires
WRN 2,01	Low Voltage Warning	The RCP board is experiencing a low voltage condition	The vehicle battery may not be fully charged. There also could be excessive voltage drop across cabling because of long cabling runs/small gage wires
WRN 3,01	Low Voltage Warning	The HHRC board is experiencing a low voltage condition	The vehicle battery may not be fully charged. There also could be excessive voltage drop across cabling because of long cabling runs/small gage wires

4.6 TROUBLESHOOTING MECHANICAL

Table 4-5. Mechanical Troubleshooting

Symptom	Root Issue	Troubleshooting Sequence
Mast sticking during extension or retraction	Mast is dirty and/or requires lubrication.	1) Clean and lubricate mast. 2) If condition continues, mast requires overhaul.
Mast leaks down when extended	Air leak in mast or valve/compressor assembly.	Use a soapy water solution to pinpoint the leak. If the mast is leaking, it will require new seals. If the valve or compressor assembly is leaking at a fitting, remove the fitting, clean and reinstall using thread tape or sealant. Replace a faulty valve or compressor.
Erratic or noisy when raising to 90 degrees	Bent or worn actuator or pivot shaft	Replace damaged component
RCP continually pans or tilts	Bent flag in RCP	1) Remove RCP cover straighten or replace flag. 2) Make sure wiring is not wound tight. Reset home position
Pan or tilt motor will not respond with no errors displayed on HHRC	Broken or loose motor wire lead or faulty motor	1) Reconnect wire lead 2) Replace motor.
Mast fails to fully nest in saddle and disconnects power	Binding of actuator, software fault or control erroneously sensed an increase in current	1) Check that base board has software version 2.6 or later. See section 7.1 for verifying revision. Contact Will-Burt if update is required. 2) See Table 4-1, Table 4-2 and Table 4-3 for software fault codes. 3) Check actuator for binding. Replace actuator if binding.
Mast will not begin to lower from 90° position	Mast tube sections do not fully collapse	1) Extend and retract mast. 2) Check tube sections for damage. 3) Internal coil cord may be binding, contact Will-Burt.
Mast will not begin to lower from 90° position	Magnetic switch band clamped to mast is not made	1) Magnetic switch is may be out of adjustment. Loosen clamp and slide switch up and down the mast until contact is established. 2) Check wiring 3) Replace defective magnetic switch.

CHAPTER 5
PARTS LIST

5.1 PARTS LIST

Table 5-1. Base Assembly Parts List

Mark No.	Description	Part Number
1	Base Circuit Board	913002
2	Air Inlet Hose Barb	-
3	Air Exhaust Hose Barb	-
4	AC Power Connector	914019
5	Circuit Board Bracket	913157
6	DC / Control Connector	-
7	Valve Assembly	913502
8	Upper Light Bracket	914099
9	Look Up Light Bulb, MR16, 20 Watt, 40 Degree Flood	913397
10	Bulb Socket	913420
11	Valve/Compressor Mounting Bracket	913185
12	Base Left Side Wall	913175
13	Actuator Set Screw, M3	3383
14	Actuator Shoulder Bolt, M10	3382
15	Proximity Sensor	913429
16	Proximity Sensor Mounting Bracket	913170
17	Lower Pivot Block	913179
18	Actuator	914787
19	Actuator Pivot Shaft	913196
20	Actuator Pivot Block	913177
21	Base Right Side Wall	913176
22	Yoke Weldment	913411
23	Lower Light Bracket	914100
24	Compressor Assembly	913503

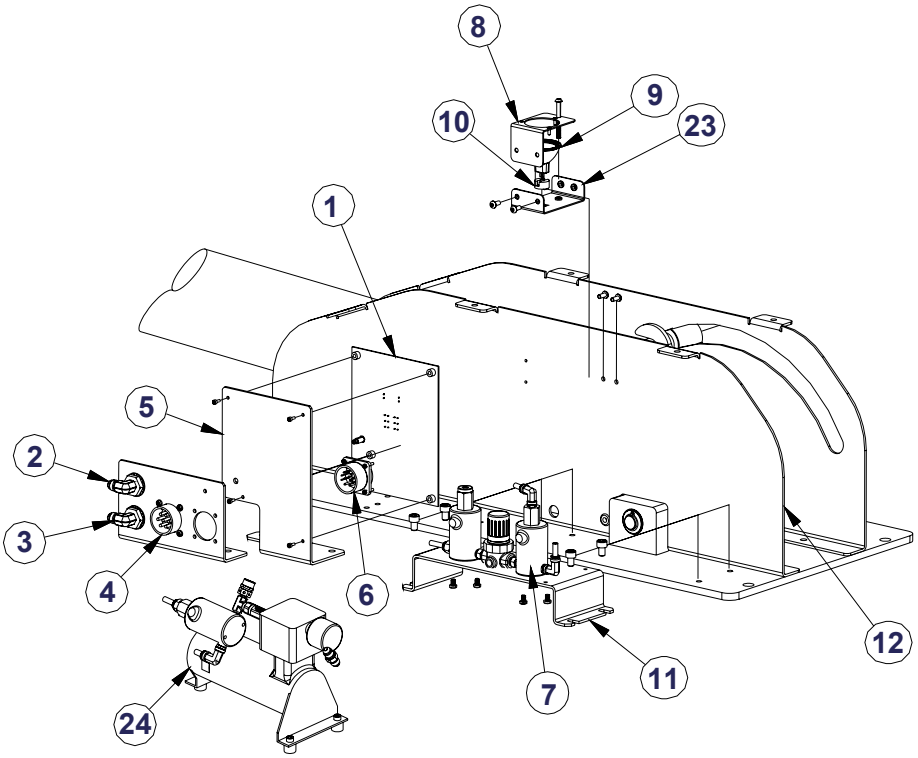


Figure 5-1 Exploded View - Base Left Side

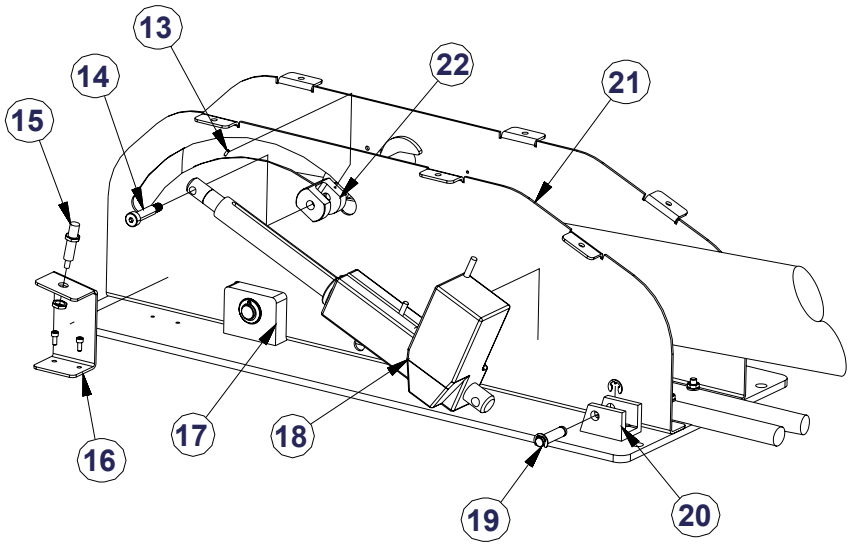


Figure 5-2 Exploded View - Base Right Side

Table 5-2. Remote Control Positioner Assembly Parts List

Mark No.	Description	Part Number
1	Remote Control Positioner Frame	913165
2	Circuit Board, Standard RCP Circuit Board, Profiler RCP	912760 914942
3	Horizontal Shaft	913156
4	Timing Ring	913161
5	Bearing Retainer	913168
6	O-ring, Teflon	3398
7	Bearing	913435
8	Thrust Washer	913449
9	Retaining Ring	3401
10	Key	913268
11	Vertical Shaft	913166
12	Bushing	913272
13	Thrust Needle Roller & Cage Assembly	913448
14	RCP Motor	910673

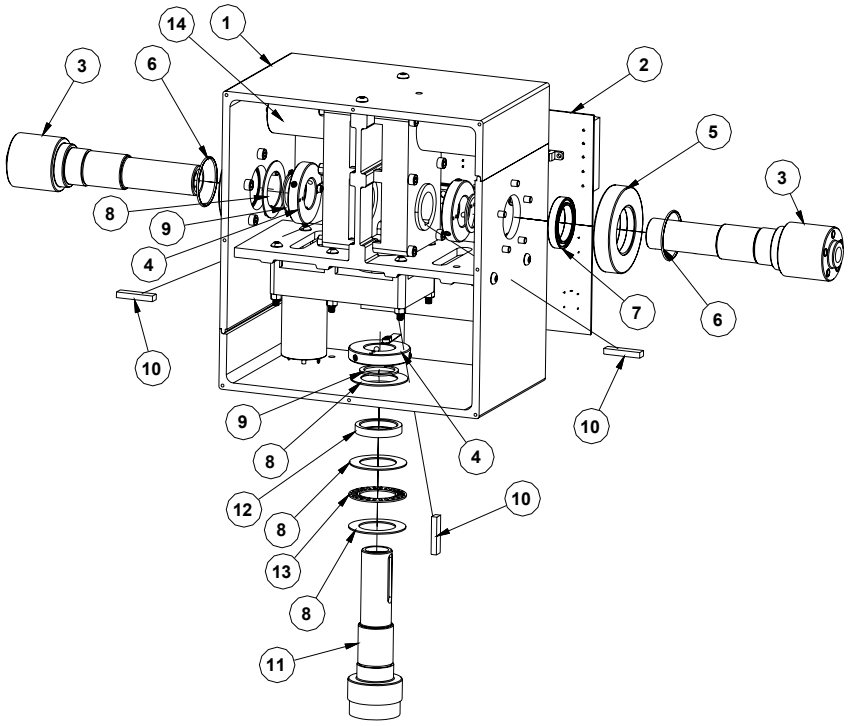


Figure 5-3 Exploded View - Remote Control Positioner

CHAPTER 6
REVISIONS

Revision 1, January 2005: Updated schematic on page 4-3 to reflect current cable used in DC/Control cable assy.

Revision 2, January 2005: Updated schematic on page 4-3 to reflect current cable used in AC Power cable assy. Updated exploded parts view (Figure 5-1) and BOM (Table 5-1) to reflect redesigned look up light assembly. Added reference to completing wiring and raising unit prior to saddle attachment to vehicle.

Revision 3, March 2005: Updated schematic on page 4-3 to reflect use of Reed magnetic switch, Turck shown as optional switch. Changed AC Connector part number in Table 5-1 to include installed wire harness.

Revision 4, April 2005: Added view of compressor assembly to Figure 2-9 and Figure 5-1. Added compressor item number to Table 5-1. Added Section 3.5 for Hand Held Remote Control Function for Profiler. Added Err 1,12 to Table 4-1. Updated Figure 4-4 to include Profiler wiring information to lights and tilt motor. Corrected cable availability information in sections 1.5.1 and 1.5.2. Included statement on hand held illumination after stow in section 3-5.

Revision 5, June 2005: Change P/N for actuator in Table 5-1 from 913413 to 914787. Added additional mounting requirements for Profiler models in Section 2.4.

Revision 6, July 2005: Added additional information in section 4.5. Added “Adjustments” section 4.3.

Revision 7, Jan. 2006: Added additional Error Codes in section 4.5.2. Added Warning codes section. Changed system schematic Figure 4-3. Added well drain recommendations in Section 2.4. Added Figure 2-12 showing sample warning light installation. Corrected errors in pin functions of Table 2-4. Added wiring for improved mag switch in base schematic Figure 4-3.

CHAPTER 7
SOFTWARE REVISIONS

7.1 INTRODUCTION

There are several circuit boards in the Powerlite system. Each has its own microcontroller with associated software. A person may "query" the software revisions by simultaneously holding down all four HHRC tilt buttons (up, down, left, right). The revision levels can then be viewed as they scroll across the alphanumeric display. A typical display might be "1:2.6 2:2.2 3:2.1". This would indicate that board 1 (the base board) has revision 2.6, board 2 (the RCP board) has revision 2.2, and board 3 (the HHRC board) has revision 2.1. To date, all software revisions are backward compatible, and require no hardware changes.

Table 7-1. Software Revision Log

Board	Board No.	Revision	Comments	Compatibility Issues
HHRC	3	2.0	Initial Release to production	None
HHRC	3	2.1	Added factory test routines	None
HHRC	3	3.0	Major Release to add several functions. See Base Revision 3.0. Added Low Voltage warning.	None (Although two HHRCs require version 3.0 Base software or newer)
RCP	2	2.0	Initial Release to production	None
RCP	2	2.1	Added factory test routine	None
RCP	2	2.2	Added Profiler capability via settable data bit	None
RCP	2	3.0	Major Release to add several functions. See Base Revision 3.0. Corrected some Error Code functions. Added Low Voltage warning.	None
Base	1	2.0	Initial Release to production	None
Base	1	2.1	Added factory test routine	None
Base	1	2.2	Added code to prevent premature actuator retraction if unit came off of 90° limit switch (wind gust, etc.)	None
Base	1	2.3	Added code to prevent RCP stowing if momentary loss of 90° limit switch (wind gust, etc.)	None
Base	1	2.4	Added code to latch the vertical state to further strengthen false retractions or stowing	None
Base	1	2.5	Relax communication startup and error recovery timing	None
Base	1	2.6	Reworked current sense algorithm to correct occasional incomplete nesting. Added time at nesting to confirm proper state of the Nested output contacts	None
Base	1	2.7	Improved recovery from dissimilar board power-up times. Reduces communication faults at power-up.	None
Base	1	3.0	Added support for D-Tec II, dual HHRCs, non-RCP unit, Vertical (non-tilt) unit; added low voltage warning, added dual inputs for vertical limit switch, added faults for	None

			miswiring detection of complementary input limit switches	
Base	1	3.1	Improved recovery from dissimilar board power-up times. Reduces communication faults at power-up.	None