

# OPERATION AND INSTALLATION MANUAL



HV Model



## SCP SERIES Brushless DC SOLAR ELECTRIC POOL PUMPS 1 HP to 3 HP



Intertek  
4009458  
Conforms to UL Std's 1081 & 1563



**Manufactured & Serviced By:**

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**Made in America**

# Table of Contents

Introduction .....	1.0
Precautions	
Safety Instructions	
Product Overview .....	2.0
Table 1: Differences in Controller Models	
Controller Features .....	2.1
Controller Applications .....	2.2
Installation and Operations .....	3.0
Warnings	
System Location .....	3.1
System Design Basics .....	3.2
Solar Pump System Terms and Layout	
Pump Installation .....	3.3
Pump Basket Strainer .....	3.4
Figure 1:	
Wiring .....	3.5
Figure 2: PCA Control Panel Wiring Diagram	
Figure 3: PCC Control Panel Wiring Diagram	
Figure 4: 48 Volt Control Panel Wiring Diagram	
Figure 5: PCA Dip Switch Settings	
Figure 6: PCC Dip Switch Settings	
Controller Settings .....	3.6
Auxiliary Control Circuits .....	3.7
Remote Switch	
Output Power Limit Circuit	
Low Power Shut-Down Circuit	
Low Water Shut-Down Circuit	
Over-Current Shut-Down Circuit	
Figure 7: PCC Series Display Screens	
Troubleshooting .....	4.0
Controller does not turn on	
Controller turns on but pump does not run	
Pump is running but the output is low	
Pump draws excessive current	
Before Calling Sun Pumps	
Warranty Statement .....	6.0

## **1.0 Introduction**

Thank you for selecting a SunPumps SCP series solar pool pump system. The SCP series pump and PCA or PCC series Sensorless Brushless DC - pump controller are the key components to high quality solar powered pumping systems. Their stand-alone, pollution free and low noise operation makes them an ideal solution for swimming pool filtration, spas, hot tubs water falls, pond water circulation and flood irrigation.

SunPumps SCP series pumps are single-stage centrifugal type with sensorless brushless DC motors designed specifically for pool water filtration but can be used for water falls or low head irrigation systems as long as it is part of a permanent installation. Do not use with storable pools.

The PC series brushless DC controllers are microprocessor based solid state DC power converters designed as the interface between a solar module array and a sensorless brushless DC pump motor. The purpose of the controller is to operate the high efficiency, high reliability DC motor and maximize the total daily water output while providing protection for the pump as well as providing an interface with other related pumping system equipment.

**Although these PC series pump controllers are easy to install, please read this manual to become familiar with the controller features, functions, connection points and various configurations. Save this manual and other relevant product information in a safe place for future reference.**

### **PRECAUTIONS**

- **Safety First – Always understand what you are doing when working with any form of electricity. Guessing at something is not worth the potential of product damage and/or severe personal injury. Improper installation may create an electrical hazard which could result in damage to property, injury or death. Read and follow all instructions.**
- **Shut down all power when working on the system. Do not attempt to feed live wires into the PC-series controller or product damage and/or personal injury may result.**
- **Do not exceed the voltage rating of the motor and controller.**
- **Do not splash water on the controller especially when the cover is open.**
- **Mount the controller in a shaded, well vented area and in a vertical position out of reach of any pool or spa users.**
- **Installation of this system should be done by a licensed Electrical or Pool Contractor in accordance with the National Electrical Code and all applicable local codes and ordinances. Improper installation will create an electrical hazard which could result in death or serious injury to servicemen, pool users or others due to electrical shock.**
- **For a replacement manual contact SunPumps directly. For replacement stickers we recommend contacting a local spa dealer, but can be ordered from SunPumps. Contact SunPumps for further details.**

## **IMPORTANT SAFETY INSTRUCTIONS**

When installing and using this electrical equipment, basic safety precautions should always be followed, including the following:

1) **READ AND FOLLOW ALL INSTRUCTIONS**

2) **WARNING** – To reduce the risk of injury, do not permit children to use this product unless they are closely supervised at all times.

3) A wire connector is provided on this unit to connect a minimum 8 AWG (8.4 mm<sup>2</sup>) solid copper ground conductor between this unit and any metal equipment, metal enclosures of electrical equipment, metal water pipe, or conduit within 5 feet (1.5 m) of the unit.

4) **WARNING** – Risk of Accidental Drowning. Extreme caution must be exercised to prevent unauthorized access by children. To avoid accidents, ensure that children cannot use a spa or hot tub unless they are closely supervised at all times.

5) **DANGER** – To reduce the risk of drowning from hair and body entrapment, install a suction fitting(s) with a marked flow rate that equals or exceeds the flow rate marked on the equipment assembly.

6) **DANGER** – To reduce the risk of injury, do not remove the suction fittings. Never operate a spa or hot tub if the suction fittings are broken or missing. Never replace a suction fitting with one rated less than the flow rate marked on the equipment assembly.

7) **DANGER** – Risk of Electric Shock. Do not permit any electric appliance, such as a light, telephone, radio, or television, within 5 feet (1.5 m) of a spa or hot tub.

8) **WARNING** – Risk of Electric Shock. Install at least 5 feet (1.5 m) from inside wall of hot tub or spa using nonmetallic plumbing. This equipment must be attached to a ground fault circuit interrupter.

9) **WARNING** – To reduce the risk of injury:

a) The water in a spa should never exceed 40°C (104°F). Water temperatures between 38°C (100°F) and 40°C are considered safe for a healthy adult. Lower water temperatures are recommended for young children and when spa use exceeds 10 minutes.

b) Since excessive water temperatures have a high potential for causing fetal damage during the early months of pregnancy, pregnant or possibly pregnant women should limit spa water temperatures to 38°C (100°F).

c) Before entering a spa or hot tub, the user should measure the water temperature since the tolerance of water temperature-regulating devices varies.

d) The use of alcohol, drugs, or medication before or during spa or hot tub use may lead to unconsciousness with the possibility of drowning.

e) Obese persons and persons with a history of heart disease, low or high blood pressure, circulatory system problems, or diabetes should consult a physician before using a spa.

f) Persons using medication should consult a physician before using a spa or hot tub since some medication may induce drowsiness while other medication may affect heart rate, blood pressure, and circulation.

10) **CAUTION** – This pump is for use with permanently-installed pools and may also be used with hot tubs and spas if so marked. Do not use with storable pools. A permanently-installed pool is constructed in or on the ground or in a building such that it cannot be readily disassembled for storage. A storable pool is constructed so that it is capable of being readily disassembled for storage and reassembled to its original integrity.

11) Do not install within an outer enclosure or beneath the skirt of a hot tub or spa.

12) You can purchase more spa warning signs from your local spa supplier or directly from SunPumps, Inc..

13) **SAVE THESE INSTRUCTIONS FOR FUTURE REFERENCE.**

## 2.0 Product Overview

The SunPumps PCA-BLS-M2 and PCC-BLS-M2 series controllers were designed specifically for SunPumps Sensorless Brushless DC motors. When properly installed and configured, the features incorporated into this stand-alone system will control and protect your pump system permitting many years of dependable, trouble free service. SunPumps has produced multiple versions of this controller. The PCA controller is for lower power applications and lacks an LCD screen. Functionally the notable differences are certain set points and electrical characteristics which are detailed in the table below.

**Table 1**

Controller Model	Min Voltage <sup>1</sup>	Max Voltage	Min Power	Max Power	Low Water Cutoff Min	Low Water Cutoff Max	Nominal Voltage
PCA-60BLS-M2 <sup>2</sup>	30 V	100 V	Set by LWC	840 W	50 W	300 W	60 V
PCA-120BLS-M2 <sup>2</sup>	90 V	200 V	Set by LWC	1440 W	50 W	500 W	120 V
PCC-120BLS-M2 <sup>2</sup>	90 V	200 V	Set by LWC	1500 W	100 W	585 W	120 V
PCC-180BLS-M2 <sup>2</sup>	120 V	300 V	Set by LWC	2250 W	100 W	1023 W	180 V
PCC-240BLS-M2 <sup>2</sup>	220 V	380 V	Set by LWC	3000 W	100 W	1023 W	240 V

<sup>1</sup>Min Voltage is the minimum voltage which the unit must see in order to start the pump. If this voltage is not obtained, the unit will not attempt to start the pump. Voltages lower than this will not hurt the unit.

<sup>2</sup>All controller models have the same basic operating features, functionality and setup. A display screen and the voltage and power tolerances are the only differences of concern to the end user. This manual will only differentiate when necessary for clarity.

## 2.1 Controller Features

1. Current boosting for matching the load requirements of the pump.
2. Voltage regulation of the solar electric array at its maximum power point. (MPPT)
3. Over-current protection via integrated electronic circuit breaker.
4. Reverse polarity protection (10 amperes maximum) on the input terminals.
5. Voltage and current limiting to pump motor.
6. Transient protection and surge suppression.
7. Adjustable output motor power control for precision output flow.
8. Digital display indicating status, power, voltage, current and more. (PCC Series Only)
9. System ON/OFF switch.
10. LED indicators; 1. Power In, 2. Motor Run, 3. MPPT, 4. RS Stop, 5. Low Power, 6. Over-Current, 7. Fault Condition.
11. Weather resistant powder coated, die cast aluminum enclosure with a hinged door.
12. Rising clamp screw terminal blocks – no fork terminals required.
13. Pre-adjusted pump configuration and power source selection.
14. Remote switch interface – float switch or remote shutdown –Normally Open or Normally Closed, user selectable.
15. Sensor and Sensorless “Low Water” circuit
16. Low Power Shut Down circuit

## 2.2 Controller Application

The only application the PC series controllers are designed for is the interface between a solar module array and SunPumps Sensorless Brushless DC motors. Do not use this controller on a brush type or AC motor.

***No other applications or DC power sources are recommended or warranted unless written approval is provided by the SunPumps factory.***

## 3.0 Installation and Operation

The following sections are outlined in a step-by-step format to guide you through the installation and configuration of an SCP series pump and PC series controller. The procedure for installing the SCP series pool pump is the same as a standard AC pool pump. Any licensed pump contractor will be familiar with the proper installation procedures. Installation and operation should be in accordance with national and local electrical codes, regulations, accepted codes of good practice and common sense. This pump should be installed by a licensed professional pump installer.

**Before installing any pump system read all product manuals then review all system components to become familiar with the physical and electrical layout.** Check all equipment for any product damage. Refer to applicable figure(s) as a guide during the installation. Controller door must be closed during normal operation.

### **Warning**

***Reverse polarity on a panel system capable of producing over 20 amps will result in non-warranted product damage. Please check polarity before connecting power to the controller.***

***These controllers are for SunPumps Sensorless Brushless DC Motors only. Do NOT use this controller on Brush-Type motors, Sensor Type Brushless DC motors or on any AC motor. Damage to the controller will result.***

## **3.1 System Location**

As the majority of system installations vary greatly, only general comments can be made as to location. Prior to installing the system, it is suggested to make a system layout plan. During the system layout, take into consideration any potential shading of the solar electric modules, wire runs, wire size, conduit runs, trenching, controller accessibility, tank location, pump head etc. Shading even a small portion of the array can reduce the output of the entire array and thus reduce or completely stop the output of the pump. There is no substitute for a good plan!

For locating the pump, damp, non-ventilated locations should be avoided. Motors and controllers require free circulation of air to aid in cooling.

The PCA and PCC-series controllers can either be mounted indoors or outdoors. Locate all system equipment as close as possible to each other. The controller must be mounted in a vertical position for proper cooling and to keep the electronics dry. The controller should be located close to the pump if possible. This general physical layout is conducive to clean installation both aesthetically and electrically.

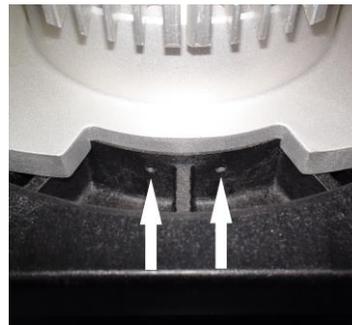
## **3.2 System Design Basics (Read carefully before installation)**

1. The pump discharge piping should be sized for efficient pump operation. Pipe size being too small will create greater friction losses which require more power to operate and thus a higher solar module cost.
2. Make sure the pool filter is size correctly for the flow rate of the pump. A filter sized too small will create higher friction losses and will increase the power requirements and thus the cost of the system.
3. For optimum pump performance make sure that the wire is sized properly for the length of run between the pump and the solar modules as specified by the National Electric Code. Wire sized too small will cause a decreased output from the pump. Keep the distance from the solar modules to the pump as short as possible. Refer to a DC wire loss chart for proper sizing. It is recommended to keep the voltage drop under 3%. Refer to the wire sizing guide on the SunPumps web site under Engineering. Always use liquid-tight flexible metallic conduit and liquid-tight fittings between the controller and the pump motor.
4. Never install the controller in direct sunlight. Direct sunlight on the controller may cause over-heating of the controller.
5. Never lay the controller on the ground or mount the controller in a horizontal position. **The controller should be mounted in a vertical position only.** The controller should be mounted as close to the pump as possible.
6. The controller should be grounded to the pump motor housing, the frame of the solar modules and to an 8-foot ground rod. Use only a copper lug to attach the ground rod. Always use a DC surge/lightning arrestor on the panel side of the controller. (Midnight Solar MN-SPD surge arrestor is recommended)
7. Do not ground the PV array positive or negative electrical wires.

### 3.3 Pump Installation

Your pump system has some warning labels included. These should be viewable to those near the system. Replacement warnings are available for purchase through your local pool/spa dealer or SunPumps, Inc.

The pump has two weep holes located on the underside of the pump end. This is designed to allow water to drain in the instance that the shaft seal fails and the pump end leaks. If you notice water draining from these holes, the seal may need to be replaced to prevent motor damage.



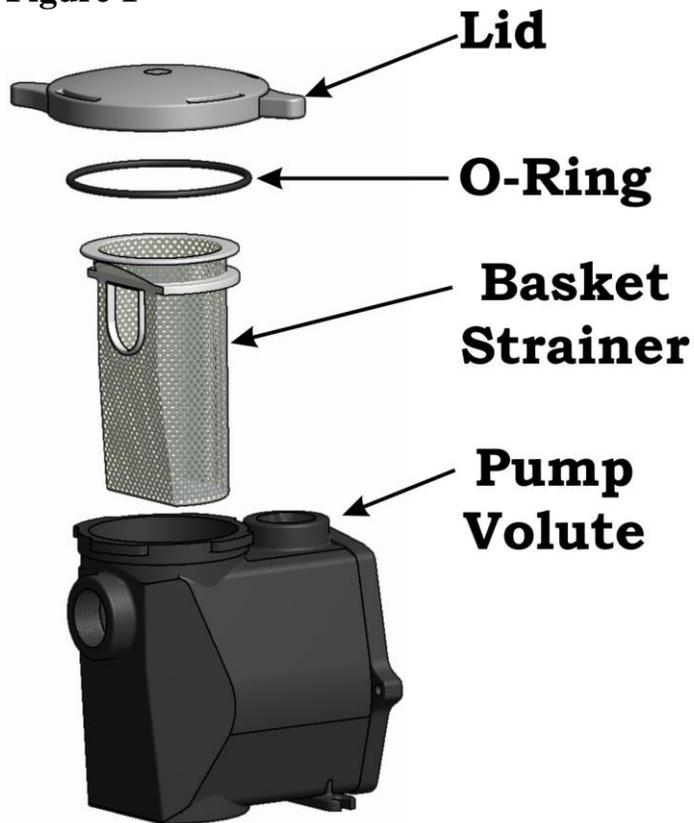
1. The pump should be located next to the pool filter in a sheltered location. It is highly recommend that you install unions on both the suction and the discharge ports for easy pump removal for future service. Never over tighten pipe connections. Use only pipe sealant formulated specifically for plastic.
2. Write the pump, motor and controller model number and serial number in the space provided on the last page in this Instruction Manual. This information will be needed when filling out the Warranty Card. And will aide in any troubleshooting which may be necessary.
3. Inspect all components for shipping damage and insure that you have all the components that are required for a complete installation.
4. Select a well-ventilated, shaded location in which to vertically mount the controller. Mount the controller far enough from the pool where it can not get wet.

### 3.4 Pump Basket Strainer

This pump has a basket strainer, sometimes called a “Hair and Lint Pot” located in the front section of the pump volute. Inside this chamber is a basket which must be kept clean of leaves and debris at all times. View the basket through the “See-Through Lid” to inspect for various accumulations of trash. Regardless of the length of time between filter cleaning, it is most important to visually inspect the basket at least once a week. A dirty basket will reduce the efficiency of the filter and also put an abnormal stress on the pump motor which could result in failure.

**Warning:** Do not open the strainer pot if the pump fails to prime or if the pump has been operating without water in the strainer pot. Pumps operated in these circumstances may experience a buildup of vapor pressure and may contain scalding hot water. Opening the pump may cause serious personal injury. In order to avoid the possibility of personal injury, make sure the suction and discharge valves are open and strainer pot temperature is cool to the touch, then with extreme caution, you can open the strainer lid. Do not open the strainer pot lid while the pump in operation.

**Figure 1**



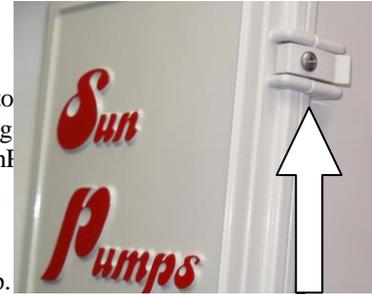
### **Strainer Cleaning Procedure**

1. Turn off motor at the controller and then disconnect the solar array power to the controller.
2. Relieve pressure in the system.
3. Turn the lid in a counter-clockwise direction until it stops.
4. Lift the lid and remove the basket.
5. Put the debris from the basket into the trash and rinse out the gasket. If the basket is cracked, it should be replaced.
6. Replace the basket and fill the pump volute up to the inlet port with water.
7. Clean the cover, O-ring and sealing surface of the pump volute. Grease the O-ring with Teflon or a Silicone lubricant.
8. Reinstall the lid.
9. Make sure the lid O-ring is properly placed. Seat the lid then turn clockwise until **hand tight** only. Do not over-tighten with tools.
10. Turn the power and then the controller "ON".
11. Open the manual air relief valve on top of the filter.
12. Stand clear of the filter and start the pump.
13. Bleed the air from the filter until a steady stream of water comes out. Close the manual air relief valve.

### 3.5 Wiring

Prior to connecting any wires to the controller, be sure you have a system wiring diagram to use as a reference (See Figure 2, 3 & 4). Guessing at polarity and connection points is not worth the risk of potential product damage and/or personal injury. Use copper conductors only. Flexible metal liquid-tight conduit and appropriate liquid-tight connectors should be used for all wiring, into, out of, and between electrical enclosures. The PV In and Pump Out connectors use the 1” holes to the front of the controller and the ½” holes are for auxiliary connections for the remote switch and low water sensor circuits. The provided plugs for unused holes are Heyco PG threaded plugs for standard ½” threaded holes. Plugs must be installed in order to weather proof the controller and prevent shock hazards.

The PC series controllers have a locking screw to prevent tampering. In order to be removed. Using a #2 Philips screwdriver, turning it left will loosen it and turning it right will tighten this screw it is only meant to hold the latch in place. If the screw is lost SunPumps it with a stainless steel pan head Philips #8 – 32 X 3/8” screw.



Ensure the wire sizes are of adequate diameter (gauge) to minimize voltage drop. Consult the manual or call your SunPumps dealer for assistance. Minimum wire size for PV interconnects is 12 AWG, minimum wire size for the combiner box or disconnect connection to the controller and the controller to the pump motor is 10 AWG. Insufficient wire gauge will cause excessive voltage losses to the motor and will reduce the flow rate of the pump. **A solid copper bonding wire, no smaller than 8 AWG (8.4mm<sup>2</sup>), shall be connected from the motor ground to all metal part of the swimming pool, spa or hot tub.** Wire may be rated for 60° C, 60°/75° C or 75° C. The brushless DC motor frame must be grounded to the control box.

All other system equipment should be installed before proceeding with wiring the controller. A fused combiner box or disconnect switch should be installed between the solar array and the PC series controller. SunPumps recommends an MNPV 6 for systems with 3 or 4 solar arrays in parallel or an MNPV 3 for systems with 1 or 2 solar arrays in parallel along with the appropriately rated MNDC breakers or MNTS fuse holders with appropriate MNFUSE fuses rated to be the lowest fuse which will allow for the short circuit current rating of your solar panels. Alternatively for systems with a single solar array, 30A NEMA 3R fused disconnects may be used with appropriate fuses. Double check polarity and wire termination tightness before powering up the system.

**CAUTION: Photovoltaic panels produce DC electricity when exposed to sunlight. Cover the panels with a blanket or with a non-opaque material before wiring. Install a disconnect switch between the solar modules and the controller.**

#### Chart 1

Controller Model No.	Max Current (A)	Nominal Voltage (V)	Min Supply Wire Size, Cu		Overcurrent Protection, Amps
			60°C	75°C	
PCA-60BLS-M2	14	48 – 60	12	12	20
PCA-120BLS-M2	12	60 – 120	12	12	20
PCC-48BLS-M2	40	48 – 52	8	6	50
PCC-120BLS-M2	12.5	90 – 120	12	12	20
PCC-180BLS-M2	12.5	120 – 180	12	12	20
PCC-240BLS-M2	12.5	180 – 240	12	12	20

Figure 2

PCA Controller Wiring Diagram

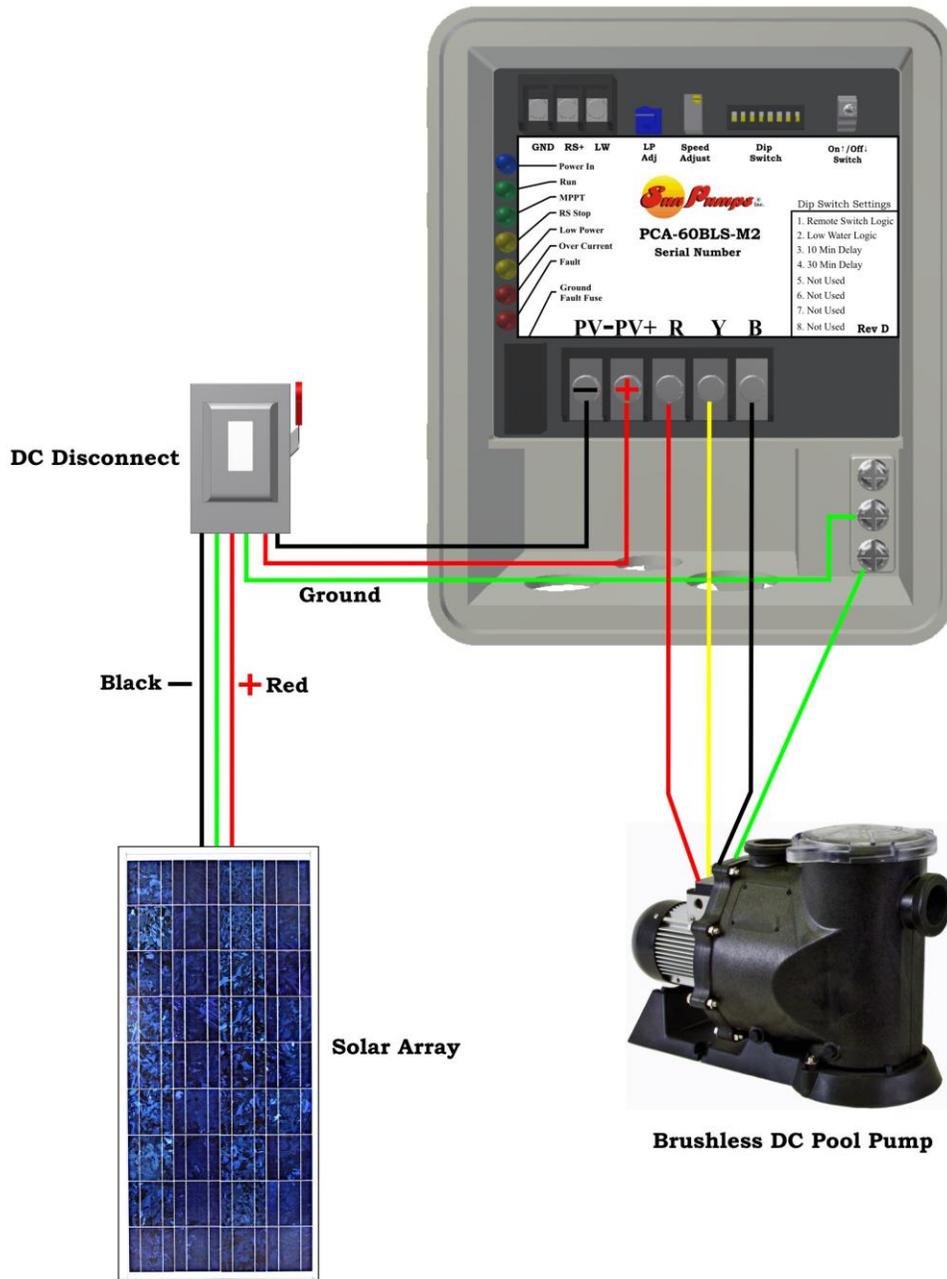


Figure 3

PCC Controller Wiring Diagram

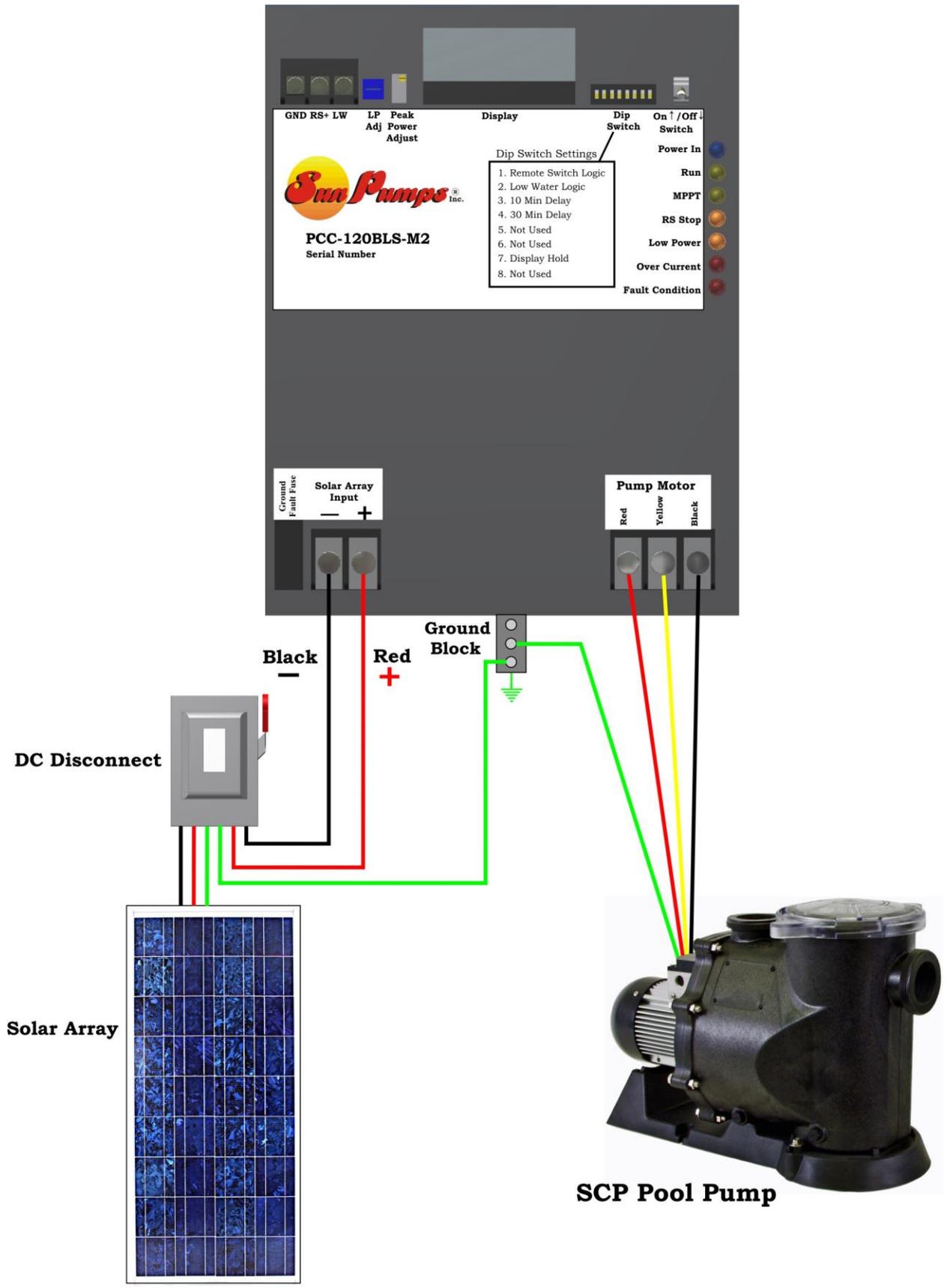
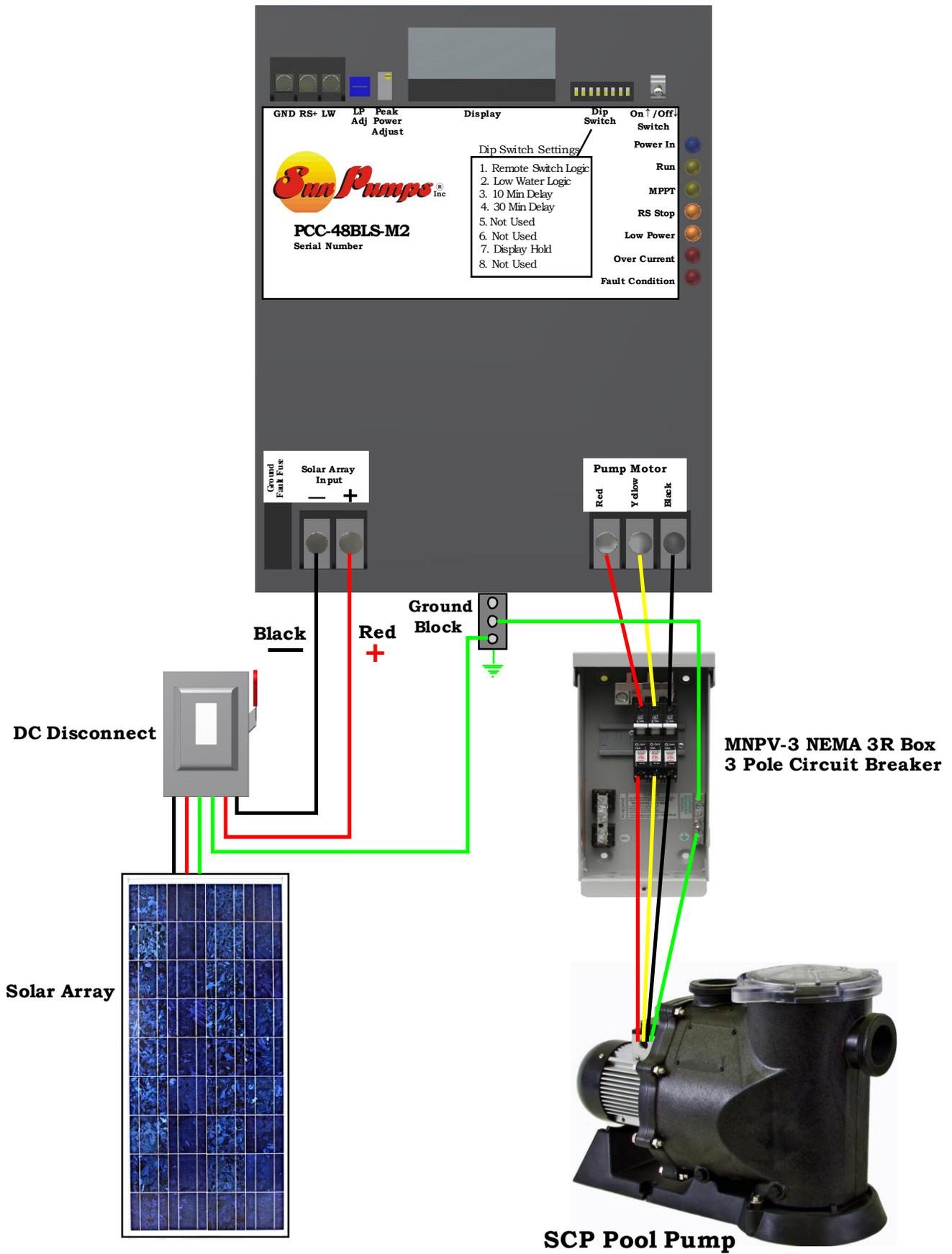


Figure 4

48 Volt PCC Controller Wiring Diagram

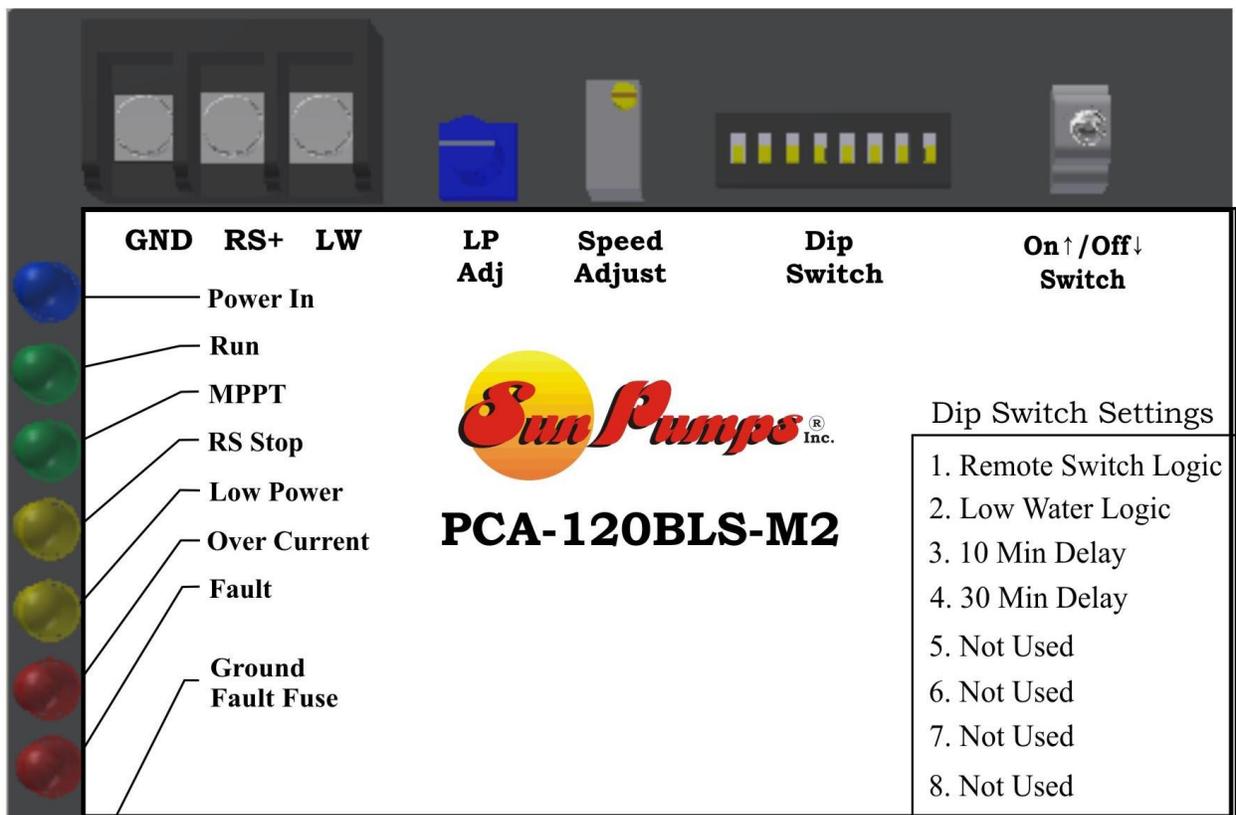


## Wiring Continued

1. After mounting the controller, make sure the on/off switch is in the OFF position.
2. If you are using a remote switch, like a float switch, set dip switch 1 to the correct position for the type of switch being used. (“Normally Open” or “Normally Closed”). If you are not using a remote switch leave switch 1 off.
3. Verify all remaining dip switches are off at this time.
4. Connect ground rod conductor to the controller chassis ground block. This pump system should be grounded to the same ground as the AC main ground of the facility, if present.
5. Connect solar module frame ground conductor to controller chassis ground block.
6. Connect the green pump ground conductor to controller chassis ground block.
7. Connect pump motor leads to the corresponding “Pump Motor” terminals on the controller. Red to “Red”, yellow to “Yellow” and black to “Black”. No other
8. Verify that the disconnect switch is in the off position. Connect the DC source supply negative (-), the black conductor, to one of the controller terminals labeled “Negative” on the “Solar Array Input”. (NOTE: The power should be connected to an electrical disconnect and it should be in the OFF position before connecting power to the controller).
9. Connect the DC source supply positive (+), the red conductor, to the controller terminal labeled “Positive” on the “Solar Array Input”. No other input power connections are supported. (NOTE: The power should be connected to an electrical disconnect and it should be in the OFF position before connecting power to the controller).
10. Refer to the next section for “Remote Switch” connections and “Adjustment Procedures” for configuration, if applicable.
11. At this point, all system components are installed and wired, double check conductor polarities, wire termination tightness and controller configuration. With a DC volt meter check the array open circuit voltage (Voc) on the array side of the disconnect switch and the module polarity. Record the Voc for future reference. You may do this on the Before Calling Sun Pumps Worksheet near the end of this manual. Check this voltage reading against the “Voc” range for your specific system in the chart below. (Figure 3)
12. After you have verified the voltage and polarity, switch the disconnect switch on - if the polarity is correct the first LED light will be on.
13. Turn the “On/Off” switch to the ON position. The system should be operational. If the system does not start and turns on any error lights or gives you an error message, proceed to the troubleshooting guide.

Figure 5

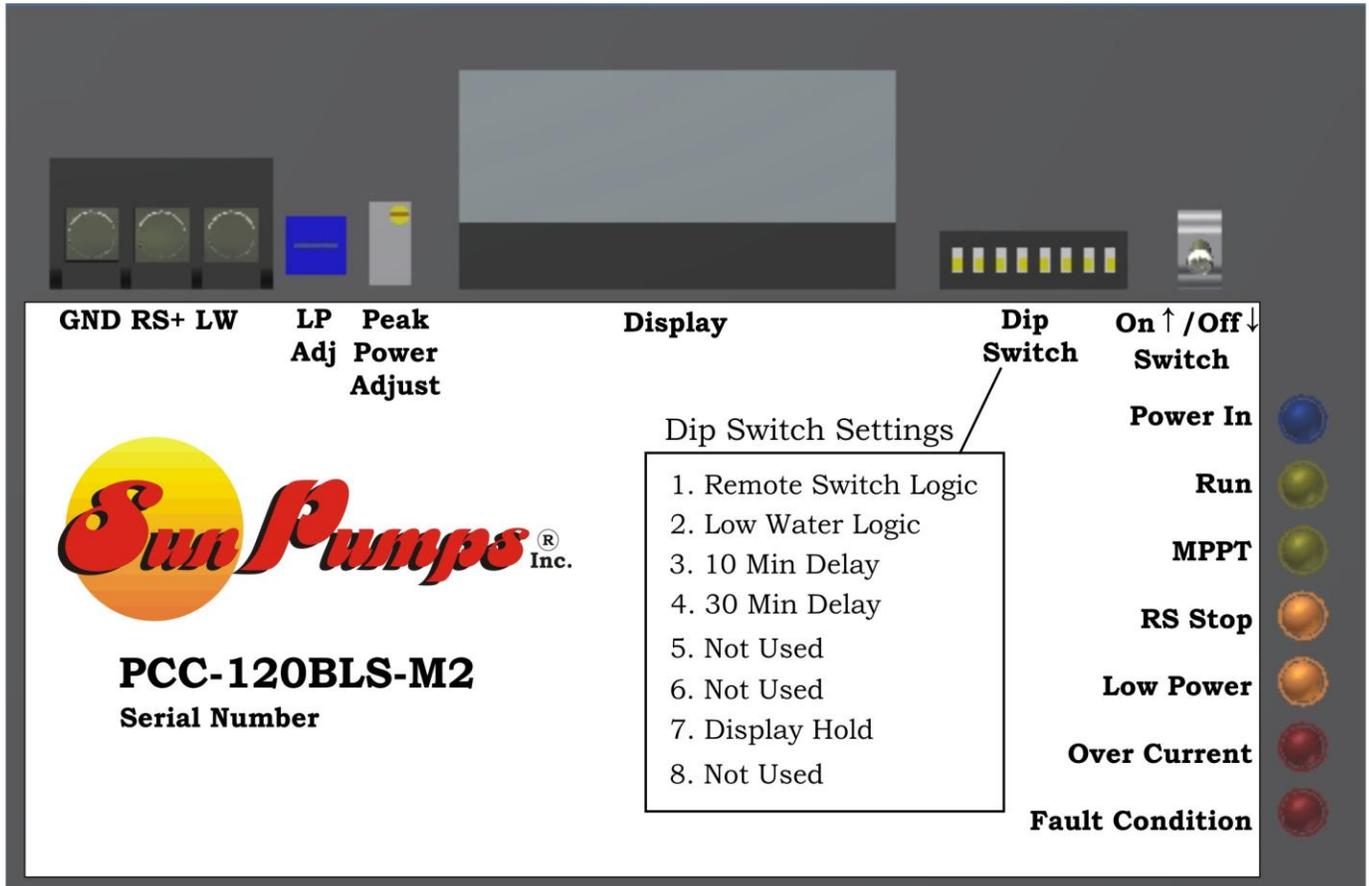
PCA Series Dip Switch Settings



Switch Number	Switch Position	Description	Function	Default Setting
1	OFF	Remote Switch Logic	Turns pump off when terminals connect.	OFF
1	ON	Remote Switch Logic	Turns Pump on when terminals connect.	OFF
2	OFF	Low Water Cutoff Logic	Turns pump off when terminals connect.	OFF
2	ON	Low Water Cutoff Logic	Turns pump on when terminals connect.	OFF
3	ON	10 Minute Delay	Increases turn on delay to 10 minutes	OFF
4	ON	30 Minute Delay	Increases turn on delay to 30 minutes	OFF
5,6,7,8	OFF	Not used at this time	Should be in the off position for proper operation	OFF

Figure 6

PCC Series Dip Switch Settings



GND RS+ LW

LP Peak  
Adj Power  
Adjust

Display

Dip  
Switch

On ↑ / Off ↓  
Switch



**PCC-120BLS-M2**  
Serial Number

Dip Switch Settings

- 1. Remote Switch Logic
- 2. Low Water Logic
- 3. 10 Min Delay
- 4. 30 Min Delay
- 5. Not Used
- 6. Not Used
- 7. Display Hold
- 8. Not Used

Power In

Run

MPPT

RS Stop

Low Power

Over Current

Fault Condition

Switch Number	Switch Position	Description	Function	Default Setting
1	OFF	Remote Switch Logic	Turns pump off when terminals connect.	OFF
1	ON	Remote Switch Logic	Turns Pump on when terminals connect.	OFF
2	OFF	Low Water Cutoff Logic	Turns pump off when terminals connect.	OFF
2	ON	Low Water Cutoff Logic	Turns pump on when terminals connect.	OFF
3	ON	10 Minute Delay	Increases turn on delay to 10 minutes	OFF
4	ON	30 Minute Delay	Increases turn on delay to 30 minutes	OFF
5,6		Not used at this time	Should be in the off position for proper operation	OFF
7	ON	Display Freeze	Holds display on current screen	OFF
8		Not used at this time	Should be in the off position for proper operation	OFF

## **3.6 Controller Settings**

The PCC series controllers have several settings (see figure 3). Most features include system configuration adjustments, some of which are user selectable by an eight position DIP-switch located on the face of the controller.

Switch 1 is the Remote Switch Logic. With this switch off (down), terminals “RS+” and “GND” must be connected to turn the controller off. With this switch on (up), terminals “RS+” and “GND” must be connected to turn the controller on.

Switch 2 is the Low Water Cutoff Logic. With this switch off (down), terminals “RS+” and “GND” must be connected to turn the controller off. With this switch on (up), terminals “RS+” and “GND” must be connected to turn the controller on. (This circuit is not used with pool pumps)

Switches 3 and 4 are delay timer adjustments. The delay timer is used for the remote switch and the low water cutoff. This timer by default is set for 10 seconds. Switch 3 will increase the timer to 10 minutes; Switch 4 will increase it to 30 minutes. See Remote Switch and Low Water Cutoff for more information. (This circuit is not used with pool pumps)

Switch 7 is used to control the user interface. When switch 7 is down, the LCD will display various screens conveying pump and controller operating parameters. The display will cycle through each screen at a predetermined rate. For troubleshooting and some setup features certain screens are desired. By turning the switch number 7 on, the display will stop cycling and the current screen will stay on the display. (Note: Switch 7 is not used on the PCA series controller.)

Switches 5, 6, and 8 are not used at this time and should remain down.

## **3.7 Auxiliary Control Circuits**

The auxiliary control circuits are configured and controlled with the “Dip Switches”, “LP Adj.”, “Speed Control” and the “RS”, “LW” and “GND” terminals. (See Figure 3)

These circuits offer expanded capability and are described here. The remote switch control is for float switches (storage tank level), pressure switches or a remote system “ON/OFF” toggle switch. The motor speed control is for adjusting the flow rate of the pump. There is also the low water cutoff, low power shut down and over current protection circuits. See each corresponding detailed description below.

**NOTE: Use only “Shielded Wire” to run from the remote switch to the controller and the ground wire must be grounded to the controller side only. The low voltage sensor wire insulation should be the same as the power wiring.** Induced voltages from lightning storms or two-way radio transmissions could damage the controller. (This circuit is not used with pool pumps)

### **Over-Current Shut Down Circuit**

The over-current shut down circuit will turn the controller off any time the current exceeds the current limit of the controller. When it turns the controller off it will remain off for 3 minutes and then turn on again. When it turns off an error light will light and the display will say Over-Current. When it turns on again, if it is still pulling excessive current it will continue to shut down for 3 minutes and try to restart.

### **Sensor Low Water Cutoff Circuit**

The sensor type low water cutoff circuit is designed as a safety feature to protect your pump from running dry or your tank from over flowing. This feature is designed for use in the submersible SCS systems with the ground wire installed. For use with the SCB or SCP systems contact SunPumps for assistance. The “LW” terminal of the controller should be attached to a low water sensor electrode which is mounted in your tank or well. The system can be used to detect low water or to detect high water depending on the position of switch 2 on the dip switch. When dip switch 2 is in the off position, the low water cutoff circuit expects not to touch water. If water comes into contact with it, and completes the circuit to ground, the pump will shut off until the water is removed and the delay timer times out. A one minute minimum timeout is default for this feature but is modifiable by switches 3 and 4 to 10 or 30 minutes respectively. At certain times the controller will be off for up to 14 minutes depending on various factors in the controller program. This timeout applies to remote switch and low water cutoff. (This circuit is not used with pool pumps)

## **Remote Switch** (This circuit is not typically used with pool pumps)

The Remote Switch interface can serve as an automatic system shutdown when used with a water storage tank mounted float switch, a pressure switch or it can also serve as a manual system shutdown with a remote system ON/OFF toggle switch. The remote logic circuit allows the use of standard “Pump-Up or Pump Down” float switches. Please refer to the following operation scenarios for configuration options.

With switch number 1 in the *OFF* position, the controller is configured to accommodate a Normally Open (N.O.) float switch or remote toggle switch. In this configuration the controller will operate as follows:

### **PUMP ON**

**float switch open = water tank low = pump ON**

### **PUMP OFF**

**float switch closed = water tank high = pump OFF**

With switch number 1 in the *ON* position, the controller is configured to accommodate a Normally Closed (N.C.) float switch, pressure switch or remote toggle switch. In this configuration the controller will operate as follows:

### **PUMP ON**

**switch closed = water tank low = pump ON**

### **PUMP OFF**

**switch open = water tank high = pump OFF**

A one minute minimum timeout is default for this feature but is modifiable by switches 3 and 4 to 10 or 30 minutes respectively. At certain times the controller may be off for up to 14 minutes depending on various factors in the controller program. This timeout applies to remote switch and low water cutoff.

## **Low-Power Shut-Down/Sensorless Low Water Cut-Off Circuit (LPLW)**

The Low-Power Shut-Down/ Low Water Cut-Off Circuit (LPLW) turns the pump off any time the controller output power drops below a functional level. This may be caused by lack of power from the solar panels or from running out of water. This protects the pump in stall conditions and saves wear on the system when no or very little water is being pumped. This feature must be adjusted for your specific application.

This feature is always monitoring the output of the motor. If you are not interested in using this feature turn the “LP Adj” trim pot fully counter-clockwise. This will give the pump the minimum low power set point possible. SCP Pool Pumps do not normally use this feature.

### **LPLW Adjustment**

The Low Water Cut-Off Circuit and the Low Power Shut-Down circuit are adjusted using the same trim pot labeled “LP Adj.” on the controller. The default is the arrow pointing straight up. This is sufficient for most systems but adjustment will maximize the life and output of your system. Follow the steps below to adjust this feature.

1. Turn the “LP Adj.” trim pot fully counter clockwise.
2. Turn the “Speed Control” trim pot counter clockwise until the pump is pumping the desired minimum flow. This may be down to 0 gal/min but is not recommended for proper pump cooling.
3. Turn the “LP Adj.” trim pot clockwise until the pump shuts off.
4. Reset the “Speed Control” trim pot back to the desired position.

## **Output Power Limit Circuit (Motor Speed Control)**

The Output Power Limit Control circuit is used to control the speed of the pump motor and thus the flow rate of the pump. It is primarily used for low producing wells where the pump output is matched to the production rate of the well. However it can also be used any time specific flow rates are required.

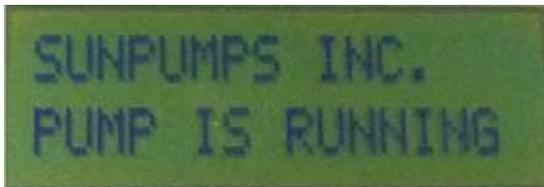
### **Output Power Limit Adjustment**

The purpose of this procedure is to adjust the output power of the controller and thus reduce the water flow of the pump. If tests have shown the pump will not produce the well capacity, then the controller "Speed Control" feature can be used to match the flow rate of the pump to the production of the well.

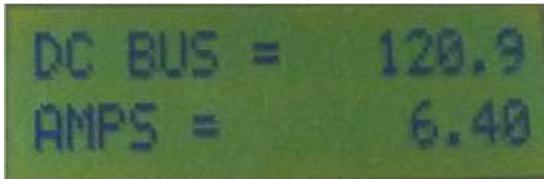
1. With the system installed and controller properly configured, allow the pump to run at full power at mid-day until the pump starts surging.
2. Slowly turn the "Speed Control" trim pot located on the face of the controller counter clockwise until the pump stops surging. This is the point where the pump flow rate equals the well production. This process will probably take a few attempts to "balance" the system for optimum water production. If maximum water is not a critical issue you may want to reduce the pumps flow rate an additional 5% to 10% to insure the pump will not run dry.

(NOTE: The trim pot has a 15- turn range. It may take multiple complete turns in a counter-clockwise direction before you will notice any change in water output or output power on the display).

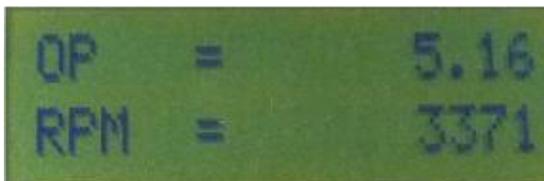
**Figure 7 Display Screens (For PCC Series Controller Only)**



Status Screen may show additional information regarding system status and especially errors.



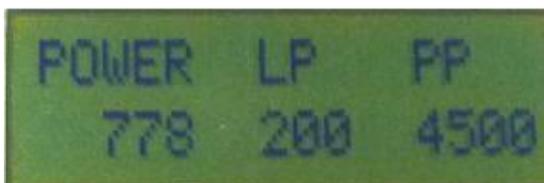
Shows the voltage of the DC input and the current consumed by the pump.



Displays OP which is an internal parameter which may be needed during trouble shooting and also shows the rpm of the motor.



Displays the current duty cycle of the motor, and the maximum duty cycle allowed by the peak power adjustment pot.



Shows the power consumed by the motor, the low power set point and the peak power allowed.

The display cycles through various screens showing information about the status of your system.

**NOTE:** Dip switch 7 will freeze the display on the current screen. If the system is powered up with switch 7 on, the display will only show the SUNPUMPS, INC screen. Turn off switch 7 to unfreeze the display.

## **4.0 Troubleshooting**

Sun Pumps, Inc. is dedicated to its customers and will gladly help you trouble shoot any problems with your system. However, especially during the busy summer pumping season, we may not be able to help you right away. Using this trouble shooting guide as your first resource when your system is not working properly can save you valuable time in getting your system fully functional. If at any time however, you are not comfortable performing any of these tasks, or do not fully understand the system, it is better to call than to guess. **Before calling please go through the section below labeled “Before Calling Sun Pumps” and complete the steps there.**

### ***CONTROLLER DOES NOT TURN ON***

1. Check the LED's on the face of the controller. The top LED, labeled “Power In”, should be on. This indicates power is connected to the controller and the polarity is correct. If it is not on, verify that the controller is properly wired, including polarity, and that the input terminals have at least 60 volts. Less than 60 volts at the input terminals and the unit may show no signs of operation. If you do have at least 60 volts in the right polarity, contact Sun Pumps for further assistance.
2. If the expected voltage is not present, disconnect the panels from the controller using the disconnect, and check any fuses and breakers in the system. Replace blown fuses and reset tripped breakers.
3. If there are no blown fuses and no tripped breakers, check the open circuit voltage of your array. If the open circuit voltage is not correct trouble shoot the array to find the problem. If the open circuit voltage is correct, call Sun Pumps for further assistance.

### ***CONTROLLER TURNS ON BUT PUMP DOES NOT RUN***

1. Make sure the On/Off switch is in the up position. (On)
2. The second LED is labeled “Run”. This indicates the pump is running. If it is on, go to the bore hole and listen for the sound of the motor. Check for breaks in the pipe. If you cannot find a problem call Sun Pumps for further assistance.
3. Check the fourth LED, labeled “RS Stop”; this is the remote switch shutdown indicator. If it is on, the remote circuit or low water cutoff circuit is preventing the controller from running the pump. Set the #1 and #2 dip switches to off and disconnect the remote switch and low water cutoff. If the pump starts, troubleshoot the remote switch and low water cutoff individually. If the pump does not start and the LED is still lit, call Sun Pumps for further assistance.
4. Check the fifth LED, labeled “Low Power”; this is the low power shutdown indicator. If it is on, the controller detected a low power or low water condition. The low power shut down is a common occurrence on days which have clouds which block the sun momentarily. First check the input voltage to the controller. This will be shown on the LCD screen called DC BUS. Verify that this exceeds the minimum voltage in Table 1. If it does not meet or exceed the minimum voltage, you do not have enough power to start your pump. **Note:** To accurately trouble shoot this feature there should be absolutely no clouds blocking the sun at any time during the following tests. If you have enough input voltage, turn the controller off then on again to reset this fault. If the low power or low water condition still exists then the controller will start but shut down again. Verify power using the LCD screen. Wait for the screen to cycle to the power reading and turn on dip switch # 7. Note the number underneath the “LP” on the display. Cycle the pump off then on and watch the power reading. If the power reading goes higher than the LP set point, the controller is shutting down due to a low water condition. If the number is not higher than the set point, skip to step 7. Check to verify the pump is not running out of water. If your pump is not running out of water, call Sun Pumps for further assistance.
5. If the sixth LED, labeled “Over Current” is on, the controller has exceeded its current limit and shut down. Turning the controller off then on again will reset this fault. If the controller continues to need high current, it will turn itself off again. Check the pump for a short to ground using an ohm meter and call Sun Pumps for further assistance.

6. If the seventh LED, labeled “Fault Condition”, is on, this indicates a motor or ground fault fuse error. Check the controller display for the type of fault. Check motor wiring and connections. If the screen displays “GF FUSE OPEN” the ground fault fuse has been blown. Check your system for ground loops and replace the fuse with a 500 VDC 1A rated fuse by pulling directly on the small rectangular fuse holder. Slide out the old fuse and slide in a new one. Replace the fuse holder. If this does not solve the issue, contact Sun Pumps for further assistance.
7. Check for proper dip switch settings on your controller. Switches 5, 6, and 8 must be in the off position for proper operation.
8. Check for proper controller input voltage. A quick look at the controller display (PCC Controller Only) will verify the array voltage. For the PCA controller you will need to use a DC volt meter. If the pump is not running the display should be reading the array open circuit voltage, (Voc). Verify that this voltage is below the maximum input voltage allowed for your controller (Model Dependent See Table 1). Check the Voc on the label on the back of the solar modules and multiply this figure times the number of modules that are connected in series. This number should be + - 10% of the display reading. If it is not then confirm all electrical terminations are tight and secure. Use a DC volt meter to check each solar module for proper open circuit voltage (Voc). One bad module will drop the voltage on the complete series string.

### ***PUMP IS RUNNING BUT THE OUTPUT IS LOW***

1. Make sure you have full sun light at midday, that there are no clouds and no shadows on any part of the array. Then verify power coming out of the controller. Look at the LCD screen and read the voltage, current and power. Check this against the pump chart for your specific application.
2. If the power is correct for your pump model and array size then make sure the pump wires are connected to the proper terminals. If two wires are reversed the motor will be running in reverse. It may still pump but not at the full rated output.
3. If the wires are correct verify that your system does not have any leaks where water can be lost. If you cannot determine the problem, contact Sun Pumps for further assistance.

### ***PUMP DRAWS EXCESSIVE CURRENT (More than the rating of the pump motor, but less than the rating of the controller)***

1. Check wiring diagram for proper connection.
2. Check for skinned wires or faulty underwater splice.
3. Check for locked motor armature. With the pump out of the system, remove the pump end from the motor (if this is not feasible skip this step and contact Sun Pumps). Allow the controller to attempt to start the motor. If the motor still does not run. Contact the Sun Pumps for further assistance.

**BEFORE CALLING SUNPUMPS**

If at all possible when calling Sun Pumps for technical support there are a few things which will help to speed up the process and help us determine the cause of and solution to the system failure. The best way to get help is to call while you are physically at the location of your pump, have good sunlight, and have a multimeter and a screwdriver with you.

Furthermore, please fill out the form below before calling. This information will provide us with most of the preliminary information we need to help you. If you cannot physically be at the site, filling out the worksheet is a must.

Pump Model Number: \_\_\_\_\_  
Pump Serial Number: \_\_\_\_\_  
Motor Serial Number: \_\_\_\_\_

Controller Model Number: \_\_\_\_\_  
Software Version \_\_\_\_\_

Date Purchased: \_\_\_\_\_

Solar Module Specifications:  
Model Number \_\_\_\_\_  
Rated Watts \_\_\_\_\_  
Voc \_\_\_\_\_  
Vmp \_\_\_\_\_  
Isc \_\_\_\_\_  
Imp \_\_\_\_\_

Solar Modules Connected in Series \_\_\_\_\_ X Voc \_\_\_\_\_ = \_\_\_\_\_ Array Voc

Solar Modules Connected in Series \_\_\_\_\_ X Vmp \_\_\_\_\_ = \_\_\_\_\_ Array Vmp

Series Strings Connected in Parallel \_\_\_\_\_ X Isc \_\_\_\_\_ = \_\_\_\_\_ Array Isc

Series Strings Connected in Parallel \_\_\_\_\_ X Imp \_\_\_\_\_ = \_\_\_\_\_ Array Imp

# Warranty Statement

*SCP Series Pool Pumps  
PC Series Pump Controllers  
Limited Warranty – Twenty Four Months*

SunPumps warrants to the original consumer that its products shall be free from defects in material and workmanship under normal applications and service conditions for a period of twenty-four (24) months after the original date of purchase, but not to exceed thirty (30) months from the date of manufacture.

At its option, SunPumps will repair or replace any SunPumps product, which has failed due to a defect in material or workmanship during this warranty period. A SunPumps PC series controller must be installed in conjunction with the pump to validate the warranty. This limited warranty shall not apply if the SunPumps product has been damaged by unreasonable use, accident, negligence, mishandling, misapplication, alteration, modification, abrasion (sand damage to pump), shipping, service or modification by anyone (other than by SunPumps), or failure which are caused by products not manufactured by SunPumps, or should the products serial number being altered, or by damage that is attributable to an act of God, or by any other causes unrelated to defective materials or workmanship. Any disassembly whatsoever of the product voids all warranty.

The original purchaser MUST complete and send in the warranty registration card, with the pump serial number and the controller serial number for warranty validation. ***No warranty performance will be rendered without a valid warranty card on file at the SunPumps factory.***

There are no express warranties except as listed above. SunPumps shall have no responsibility for damage to property, persons, animals, or other loss or injury resulting from the use of a SunPumps product. The purchaser's exclusive remedy shall be only as stated herein. This warranty is in lieu of all other warranties expressed or implied.

Except for the warranty that the products are made in accordance with the specifications therefore supplied or agreed to by customer, SunPumps makes no warranty expressed or implied, and any implied warranty of merchantability or fitness for a particular purpose which exceeds the forging warranty is hereby disclaimed by SunPumps and excluded from any agreement made by acceptance of any order pursuant to this quotation.

***UNDER NO CIRCUMSTANCES WILL SUNPUMPS BE LIABLE FOR ANY CONSEQUENTIAL OR INCIDENTAL DAMAGES, LOSS OR EXPENSE ARISING IN CONNECTION WITH THE USE OF OR THE INABILITY TO USE ITS GOODS FOR ANY PURPOSE WHATSOEVER. ALL PRODUCTS ARE SOLD AS IS WITH ALL FAULTS. SUNPUMPS MAXIMUM LIABILITY SHALL NOT IN ANY CASE EXCEED THE PURCHASE PRICE FOR THE GOODS CLAIMED TO BE DEFECTIVE OR UNSUITABLE.***

SunPumps is not responsible for labor, transportation, and related costs incurred by the customer to make allegedly defective equipment available to the factory for inspection re-installation, lost profits or costs caused by interruption of service. SunPumps is not responsible for loss or damage to products, owned by customer and located on SunPumps premises, caused by fire or other casualties beyond SunPumps control.

This equipment is not to be used for anything other than its intended purpose as stated in this manual.

**For future reference, please list your system data before installing the pump.**

Installation Date \_\_\_\_\_  
Pump Model \_\_\_\_\_  
Pump Serial No. \_\_\_\_\_  
Controller Model \_\_\_\_\_  
Controller Serial No. \_\_\_\_\_  
Warranty Card No. \_\_\_\_\_