

OPERATION AND INSTALLATION MANUAL

**SCS 1, 1 1/2 & 2 HP SERIES
SOLAR ELECTRIC PUMPS**

MANUFACTURED & SERVICED BY:

SUNPUMPS

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3.0 Introduction

Thank you for selecting a SunPumps SCS series solar pump system. The SCS series pump and PCB series 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 remote homes, wildlife and stock watering problems without violating the environment.

SunPumps SCS series pumps are multi-stage centrifugal, DC powered, submersibles constructed of high quality marine bronze and stainless steel. These pumps were designed specifically for water delivery in remote locations.

The PCB-series controllers are micro-processor-based, solid-state DC power converters designed as the interface between a solar module array and a DC pump motor. The purpose of the controller is to 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 SCS series pump systems are easy to install, please read this manual to become familiar with the controller features, functions, connection points and various configurations. For future reference, keep this manual and other relevant product information in a safe place.

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.**
- **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 and power rating of the controller.**
- **Do not splash water on the controller when the cover is open.**
- **Mount the controller in a shaded, well vented, vertical position.**
- **Installation of this system, should be done by a licensed Solar Pump Contractor.**

4.0 Product Overview

SunPumps PCB-BL series controllers were primarily designed for the 1 through 2 HP SCS-series, brushless DC submersible pumps. When properly installed and configured, the unique features incorporated into this stand-alone system will automatically control and protect your pump system permitting many years of dependable, trouble free service.

2.1 Controller Features

3. Current boosting for matching the load requirements of the pump.
4. Voltage regulation of the solar electric array at its maximum power point.
5. Over-current protection via integrated electronic circuit breaker.
6. Reverse polarity protection (10 amperes maximum) on the input terminals.
7. Voltage and current limiting to pump motor.
8. Transient protection and surge suppression.
9. Adjustable pump motor voltage control for precision output flow.
10. Adjustable input voltage for system optimization or solar modules.

11. System ON/OFF switch.
12. LED indicators
13. Weather resistant cast aluminum enclosure with hinged door.
14. Rising clamp screw terminal blocks – no fork terminals required.
15. User selectable pre-adjusted input voltage configuration and power source selection.
16. Remote switch interface – float switch or remote shutdown –Normally Open or Normally Closed user selectable.
17. Sensor-less Low Water Cut-Off circuit

2.2 Application

The only application the PCB-BL series controllers are designed for is the interface between a solar module array and a DC motor as well as various peripheral pump system signal devices.

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

5.0 Installation and Operation

The following sections are outlined in a step-by-step format to guide you through the installation and configuration of an SCS series pump and PCB series controller. The procedure for installing the SCS submersible pump is the same as a standard AC submersible pump. Any licensed pump contractor will be familiar with the proper installation procedures. The installation and operation should be in accordance with local 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 and 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 10 amps will result in non-warranted product damage. Please check polarity before connecting power to the controller.

3.1 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!

The PC-series controller can either be mounted indoors or outdoors. Locate all system equipment as close as possible to each other. Generally the controller is mounted on the north side of a pole which has solar electric modules mounted on top of it. The controller must be mounted in a vertical position for proper cooling and to keep the electronics dry. The pole should be located close to the well (bore hole). This general physical layout is conducive to clean installation aesthetically and electrically.

3.2 System Design Basics (Read carefully before installation)

3. The pump discharge piping should be sized for efficient pump operation. We suggest using the Friction Loss Tables to calculate the Total Dynamic Head using different pipe sizes. As a rule of thumb use 1" for up to 8 GPM, 1 ¼" for up to 25 GPM and 1 ½" for up to 40 GPM.
4. For optimum pump performance make sure that the wire is sized properly for the length of run between the pump and the solar modules. 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%.
5. Due to the aggressive action of DC power, it is essential that any under-water splice be made correctly. This splice must be watertight. Improper sealing of the splice will cause poor pump performance and may cause damage to the system. A SunPumps splice kit S-703 is recommended for this watertight connection.
6. Never rest the pump on the bottom of the well (bore hole). This can cause the pump to fill with mud and damage the impellers. Suspend the pump five feet (1.5 meters) or more above the bottom of the well (bore hole). If possible, install the pump above the well casing perforations. This will allow any sand intrusion to settle below the pump.
7. Never install a pump in a well that has had an oil-lubricated line shaft turbine in it without cleaning it first. Any drip oil remaining in the water may damage the pump shaft bearing sleeves.
8. On deep wells, a check valve should be installed every 200' of vertical lift.
9. Never install the controller in direct sunlight. Direct sunlight on the controller may cause overheating of the controller.
10. 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. A convenient place to mount the controller is on the north side (shaded side) of the solar module array.
11. The controller should be grounded to the pump motor housing, the frame of the solar modules and to an 8-foot ground rod. If the well casing is steel it may be used as the ground rod. Drill and tap a hole in the casing or weld a bolt to the casing for the ground lug. Use only a copper lug to attach the ground wire. The cemented support structure pole will not provide an adequate ground. Do not ground the positive or negative electrical wires.
12. Do not ground the positive or negative electrical wires.

3.3 Well Measurements

Before installing the pump measure the depth of the well (bore hole) and static water level. The static water level is the distance from the top of the well casing to the water level in the well (bore hole). This information is necessary in determining the pump setting. (See Figure 1).

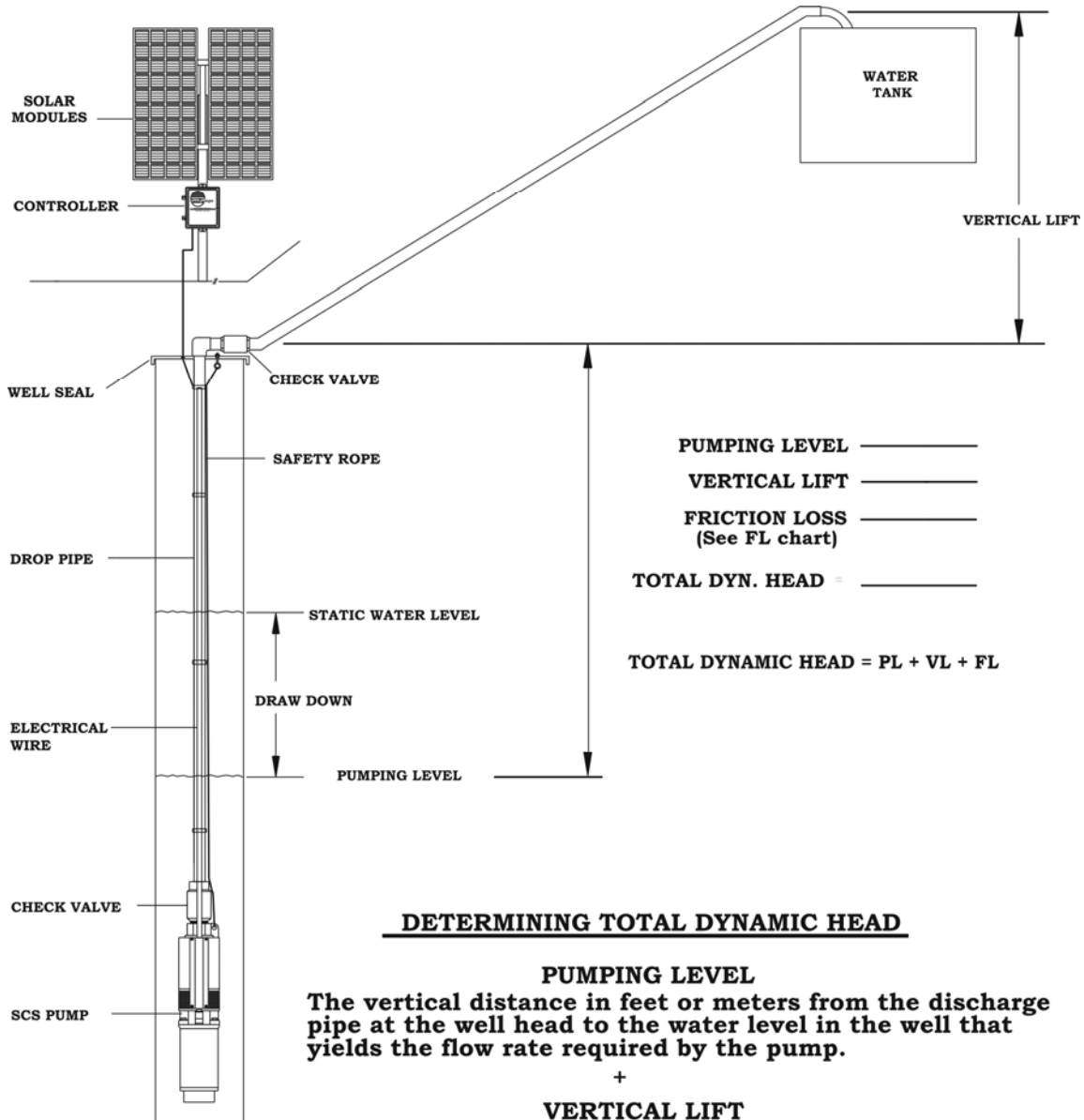
3.4 Pump Installation

3. The well should be clean and disinfected before the pump is installed. You should always develop the well before installing the pump.
4. Write the pump 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.

5. Inspect all components for shipping damage and insure that you have all the components that are required for a complete installation.
6. Select a well-ventilated, shaded location in which to vertically mount the control box. The north side of the Solar Panel Tracker mounting pole is usually a convenient place.
7. If using unthreaded discharge pipe install a stainless steel or brass adapter fitting into the pump discharge head. Consult your pump supplier for other available adapter materials. **Do not use galvanized connections on stainless steel or bronze discharge heads as galvanic corrosion will occur.** Connect the drop pipe, safety rope and sand shroud (if used) to the pump. Barbed type connectors should always be double clamped.
8. Splice the drop cable to the motor lead using an under water splice kit. (See wire splicing instructions provided with splice kit.) Match the drop cable wire colors to the pump motor leads or identify the leads to insure correct connections at the controller. (Red is positive, Black is negative and Green is ground).
9. You can now lower the pump into the well. Set the pump at least 10' off the bottom. **Never rest the pump on the bottom of the well. Never lower the pump by the wires.**
10. Tie the drop pipe, drop cable and safety rope together every ten feet with plastic wire ties or high quality electrical tape. Make sure that the tape does not loosen as it will block the pump suction if it falls down the well. The use of the safety rope is at the discretion of the installer.
11. Slide the well seal over the discharge end of the pipe, connect the discharge fitting, pull the drop wire through the well seal and connect the safety rope to the I-bolt on the inside of the well seal.
12. Finish lowering the pump and pipe assembly into the well (bore hole) positioning the well seal over the top of the casing. Connect the discharge pipe to the fitting on top of the well seal and run the pump wires to the controller.

Figure 1

System Installation Layout



PUMPING LEVEL _____
 VERTICAL LIFT _____
 FRICTION LOSS _____
 (See FL chart)
 TOTAL DYN. HEAD = _____

 TOTAL DYNAMIC HEAD = PL + VL + FL

DETERMINING TOTAL DYNAMIC HEAD

PUMPING LEVEL

The vertical distance in feet or meters from the discharge pipe at the well head to the water level in the well that yields the flow rate required by the pump.

+

VERTICAL LIFT

The vertical distance in feet or meters from the discharge pipe at the well head to the top of the water tank.

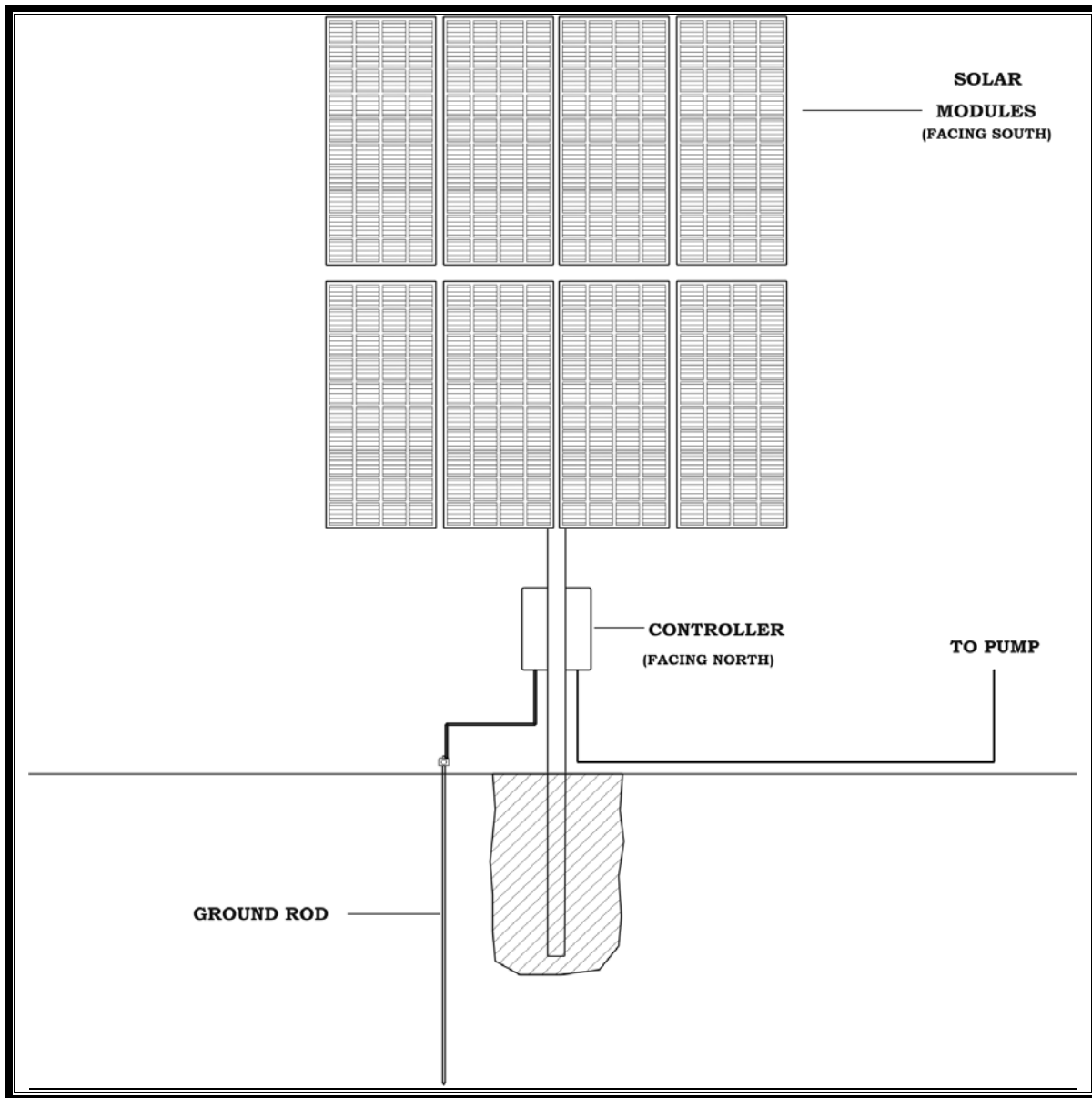
+

FRICTION LOSS

Water flowing through pipelines will lose head depending on the size, type and length of the piping, number and type of fittings and the flow rate. (Refer to friction loss tables.)

Figure 2

Top of Pole Mount Rack Diagram



3.5 Wiring

Prior to connecting any wires to the controller be sure you have a system wiring diagram to use as a reference. Generic system wiring diagrams are included in the controller manual for your convenience. Guessing at polarity and connection points is not worth the risk of potential product damage and/or personal injury.

Ensure the wire sizes are of adequate diameter (gauge) to minimize voltage drop. Please refer to a DC voltage loss table or call your SunPumps dealer for assistance.

All other system equipment should be installed before proceeding with wiring the controller. Pre-configure the controller switches prior to wiring. . (See **Controller Manual**) Refer to “Adjustment Procedures” for details. 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 an opaque material before wiring. Install a disconnect switch between the solar modules and the controller.

3. Switch the controller to the OFF position.
4. Connect ground rod conductor to the controller chassis ground block.
5. Connect solar module frame ground conductor to controller chassis ground block.
6. Connect pump ground conductor to controller chassis ground block.
7. Connect pump motor negative (-), black conductor to controller terminal labeled “LD-”.
8. Connect pump motor positive (+), red conductor to controller terminal labeled “LD+”.
9. Connect the DC source supply negative (-), black conductor to the controller terminal labeled “PV-“.
(NOTE: If a fused disconnect is used, the power should be connected to it first and then to the controller).
10. Connect the DC source supply positive (+), red conductor to the controller terminal labeled “PV+“.
(NOTE: If a fused disconnect is used, the power should be connected to it first and then to the controller).
11. Refer to the next section for “Remote Control” connections and “Adjustment Procedures” for configuration (if applicable) and then return to this point.
12. At this point, all system components are installed and wired, double check conductor polarities, wire termination tightness and controller configuration. If you have a volt meter check the open circuit voltage and the module polarity before connecting power to the controller.
13. Switch the disconnect on and if the polarity is correct the red light will be on.
14. Turn the “ON/OFF” switch to the ON position. The system should be operational. If the system is not working refer to the “Troubleshooting” section.

3.6 Auxiliary Control Circuits

The PCB controllers feature remote peripheral interface functions with easy programming. The remote switch interface supports float switches (storage tank level), pressure switches or a remote system “ON/OFF” toggle switch. **Use only “Shielded Wire” to run from the remote switch to the controller.** Induced voltages from lightning storms or two-way radio transmissions could damage the controller.

Remote Switch

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 5 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 5 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

Low Water Cut-Off Circuit

The Low Water Cut-Off Circuit is actually a low current cut-off circuit. It monitors the current draw of the motor and turns the pump off when the current drops below the set point. This circuit has a sensitivity adjusting pot on the face of the controller for various types of motors. It may not work on all types of pumps. It was primarily designed for the SCS series brushless DC submersible motors.

With switch number 6 in the ON position, the low water cut-off circuit interface serves as an automatic system shutdown when water in the well drops below the pump intake. When the LWC circuit is activated one of the amber lights will flash and the pump will turn off. The pump will stay off for approximately 25 to 30 minutes and then turn back on. This cycle will repeat any time the water drops below the pump intake. See section 3.6 for LWC adjustment procedures.

With switch number 6 in the OFF position, the LWC circuit is disabled. The pump will continue to operate even if it runs dry.

LWC Sensitivity Adjustment

The purpose of this procedure is to adjust the Low Water Cut-Off circuit to turn the pump off as the pump breaks suction. (Pump runs dry). This feature is only used for low producing wells where the pump output exceeds the production rate of the well.

The controller has already been adjusted at the factory to fit most SCS series submersible pumps and no further adjustments are necessary. If a different pump is being used, the LWC should be tested to verify that it is adjusted properly. The best way to test it is by pulling the pump out of the water while the pump is operating. If the pump does not turn off within 5 seconds then the sensitivity must be adjusted. **CAUTION: Do not run an SCS series pump dry over 20 seconds or damage to the pump could occur.** (Please note that if the pump is at very low power, it may take up to 15 seconds for the pump to turn off. This procedure should be performed at full or close to full power).

This adjustment procedure can be done with the pump outside the well in a bucket of water before installation or with the pump installed in the well. Either way will work but it is usually easier to use the bucket method.

LWC Adjustment Procedures

3. The system should be wired and the pump or suction pipe set slightly below the water level.
4. Turn the "LWC" trim pot counter-clockwise until it stops. (Less than a turn).
5. Turn number 6 dip switch on.
6. With the pump turned on and pumping water, pull the pump or suction pipe out of the water. (CAUTION: Do not let the pump run dry for more than 20 to 30 seconds or damage could occur. Consult the pump manufacturer for specific pump dry run recommendations).
7. Very slowly turn the "LWC" trim pot clockwise until the pump turns off. This is now the set-point where the pump will turn off.
8. To verify your adjustment, put the pump back in the water and turn the switch off and back on again to reset the controller. If the adjustment is correct the pump will remain running while pumping water and if pulled out of the water it should turn off.

9. Once the pump turns off, it will not turn on again for approximately 25 to 30 minutes, unless manually reset.

4.0 Troubleshooting

PUMP DOES NOT RUN

3. Check wiring diagram for proper connections. Confirm all electrical terminations are tight and secure.
4. Check for proper voltage selector switch settings on your DC source input. If the incoming voltage is less than the set point voltage, the controller will not turn on.
5. Check for proper controller input and output with a DC volt-meter. A quick look at the LED indicator lights will verify power coming from the DC source supply going to the controller (red), power going from the controller to the pump (green). If any of the three amber lights are flashing the pump will be turned off. They are over-current shut down, low water cut-off or remote switch cut-off.
6. If the red light is on and the green and amber lights are not, make sure the system on/off switch is on, disconnect the remote switch wires and turn switch 5 off. If the green light is still not on, disconnect the pump wires, LD- and LD+. If the green light does not turn on then check voltage on LD- and LD+ with a volt-meter to confirm no output voltage. If there is still no output voltage the controller is faulty and must be sent back to the factory for repair. If the green light turns on and the output voltage is now equal to the input voltage, there is short circuit either in the wiring or the motor.
7. For additional pump test, if the red light is on, connect a jumper wire across terminals PV+ and LD+. This will bypass the controller and allow the pump to run directly from the DC source. This step will confirm pump operation. **If the DC source is a solar array, the test must be conducted when full sunlight is available for a valid test.**

RED AND GREEN LIGHTS ARE ON, AMBER LIGHTS ARE OFF AND THE PUMP DOES NOT RUN

To verify power coming out of the controller, connect a DC voltmeter across LD+ and LD-. If 60 Volts or more is coming out then:

3. Check the splice above the pump for proper connections.
4. Check for broken wire leading to the pump.

NO VOLTAGE AT THE LD+ AND LD- TERMINALS

3. Make sure the system ON/OFF switch is ON.
4. Make sure none of the amber lights are flashing.
5. Check to see if the float switch, if used, is functioning properly.
6. Check the controller for proper programming and adjustment. If the voltage setting on the controller is higher than the incoming voltage, the controller will not turn on. (See controller adjustment section)

EXCESSIVE CURRENT DRAW (More than the rating of the pump, but less than the rating of the controller)

3. Check wiring diagram for proper connection.
4. Check for skinned wires or faulty underwater splice.
5. Check for locked motor armature. With the pump out of the well, bypass the controller and connect power directly to the motor leads. If the pump still does not run and the current is over 5 amps, the pump is in a loaded or locked rotor condition and must be repaired.

Warranty Statement

SCS Series Submersible Pumps

Limited Warranty – Twelve 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 twelve (12) months after the original date of purchase, but not to exceed eighteen (18) 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 PCB 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_____	Static Water Level_____
Pump Model_____	Pumping Level_____
Pump Serial No._____	Additional Vertical Lift_____
Controller Model_____	Pump Depth_____
Controller Serial No._____	Total Dynamic Head_____
Warranty Card No._____	Well Depth_____