

# LORENTZ

## PS200

## PS600

## PS1200

### SOLAR WATER PUMP SYSTEMS

### INSTRUCTIONS FOR INSTALLATION OPERATION SERVICE

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## 1 WARNINGS

Open circuit (no-load) voltage above 100V for PS200-, above 150V for PS600- and above 200V for PS1200 controllers will destroy the controller. This may occur if the solar array is wired incorrectly. (See Solar Array Wiring, Section 5.3.)

Do not attempt to run the Motor without the PSXXX controller.

Do not attempt to use the controller for any purpose other than LORENTZ PS-Pump Systems.

To be installed, connected and serviced by qualified personnel only. Ensure all power sources are disconnected when making connections. Follow all appropriate electrical codes. There are no user serviceable parts inside the motor or the controller.

Solar pumps run at low flow rates, and have closer tolerances than conventional pumps. Extreme sand or silt concentration (greater than 2% by volume) may cause the pump to stop, or the pipe to fill with sand. Do not use *the pumps* to clean out a dirty well. (See Section 6.6. for advice about dirty water.)

Helical rotor pumps are sensitive to heat. Protect the pump from sunshine or other source of heat, or it may lock temporarily. If the water source is, or will be warmer than 72° (22°C), a special model may be required. (See Section 6.4.)

Undersized wire will cause failure to start.

Do not touch the controller input or pump wires together to test for a spark.

Do not run the pump dry. Exception: to test direction of rotation, for maximum 15 seconds

Test the direction of motor rotation before installing the pump (counter-clockwise looking down). If direction is reversed, exchange the connection of any two of the three power wires to the pump.

When pump is stopped by a shadow or by action of float switch, it will restart after a 120 seconds.

The low water probe must be submersed, or the pump will stop for 20 minutes. If the probe is not to be used, connect the probe terminals together in the controller box.

Helical rotor models (without a C in the model #) are not self-draining. If drainage is required for freeze-protection, install a weep hole or draining device below freeze level.



**Failure to follow these instructions will void the warranty.**

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Install this system in accordance with local regulations and accepted codes of professional practice.

This manual is the property of the *LORENTZ Pump* owner.

Please give it to the owner or maintenance personnel when you are finished!

Request copies from your *pump* supplier or download from [www.Lorentz.de](http://www.Lorentz.de)

This manual is for controller models PS1200, PS600, PS200 as illustrated on the cover. For earlier models (before July 2003) refer to Version 1 and 2

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## 2 ELECTRICAL INSTALLATION

### 2.1 Controller and Conduit

**Protection from solar heat** Electronic devices are most reliable when they are protected from heat. Mount the controller in the shade of the mid-day sun. An ideal location is directly under the solar array, on the north side of the mounting pole. If shade is not available, cut a piece of sheet metal and bolt it behind the top of the controller. Bend it over the controller to provide shade. This is especially important in extremely hot locations. Extreme heat may trigger a thermal switch in the controller and cause it to turn off.

**Location of controller** Mount the controller vertically to keep out rainwater. It is preferable to mount it ON THE NORTH SIDE of a pole or other structure, to help reduce solar heating. This may also allow easiest access without hitting your head on the lower (south) edge of the array.

**Electrical conduit is recommended** We urge you to use electrical conduit (pipe) to protect outdoor wiring from the weather, from human activities, and from chewing animals. See photos on the following pages. If you don't use conduit, use strong, high-quality outdoor cable. Where cables enter the junction box, install sealed strain-relief cable clamps.

**Keep the controller box sealed** Unused holes must be sealed to keep out animals, insects, water and dirt. Each hole is supplied with a rubber plug that can be kept in place for this purpose.

**Battery system** Batteries must be in a cool location for best longevity, and in a protective enclosure for cleanliness and safety. Place the controller near the batteries but NOT in the same enclosure. They must be safely isolated from the battery terminals and from corrosive gasses.

**WARNING TEST THE VOLTAGE** before connecting power to the controller. Voltage (open circuit) must not exceed 100V for PS200-, 150V for PS600 and 200V for PS1200 systems. (Even in cloudy weather, the open circuit voltage will be near maximum.)

**WARNING** Do not apply a direct connection or an amp meter between + and – when the controller is connected. A short circuit here will cause a strong discharge.

**WARNING SOLAR-DIRECT systems only — Do not connect any electrical load to the solar array if it is not part of the LORENTZ Pump system.** Connection of a battery charger, active solar tracker controller, electric fence charger, or other load simultaneously with LORENTZ PS systems may “confuse” the controller and prevent proper operation.

**System Wiring Diagram** For solar-direct systems, refer to the System Diagram at the end of this manual and wire accordingly

**POWER IN** Ensure that the solar array DISCONNECT SWITCH (or battery fuse or circuit breaker)- is OFF. IN case that no disconnect switch is used, make shade or cover the solar array. Connect the power from the solar array to the input terminals in the controller box. Observe polarity. If your wires are not clearly marked +/-, test them using a DC voltmeter or multimeter.



**WARNING** To be installed, connected and serviced by qualified personnel only. Ensure all power sources are disconnected when making connections to the controller. Follow all appropriate electrical codes. There are no user serviceable parts inside the motor or the controller.



**CAUTION** Loose connections are the most common cause of system failures.

Pull on each connection to confirm that it is secure.

### 3. Wiring Order for Correct Rotation

The power wires on the pump are black with white lettering to indicate L1, L2 and L3. WRITE DOWN the colors that you splice to L1/ L2 / L3 so you can match them with the L1/ L2 / L3 terminals in the pump controller.

If your pump cable has the standard RED, BLACK and YELLOW colors, use this sequence:

RED	BLACK	YELLOW	GREEN
L1	L2	L3	Ground

The power wires on the pump may also be brown-black-grey for Motors delivered Q2 2005. Then use brown as L1, black as L2 and grey as L3

**Testing the pump for direction** Helical rotor pumps will produce water flow only if they are rotating in the right direction. If you place it in a water tank or a bucket, you will observe flow if the rotation is correct. (Submerge at least 75% to observe full flow).

**Alternative, dry test** If you don't have a water vessel to test the pump in, you can test it dry by watching the pump shaft and running it for only a few seconds. The metal label on the pump has an arrow to indicate the proper direction of rotation. If the pump is new from the factory, it is lubricated so it can run dry for about 90 seconds without risk. If the pump is not new, it can be run dry safely for about 15 seconds. Either way, this is more than enough time to observe the direction of the shaft.

If you did not write down the color match (or the wind blew your note away) connect the three power wires to the controller in ANY random order. Apply power. Observe the pump shaft rotation, then turn the power off. If

the direction is wrong, exchange ANY TWO of the power wires at the controller. In any case, when you are finished connecting the pump to the controller, test it to assure the proper direction.

**Did you install the pump in the well without checking the wiring order or the direction? OR – Is it running but not pumping?**

**HELICAL ROTOR pump (model number does NOT contain "C")** Turn the pump on. Observe if air is rising from the pipe. If it isn't, reverse any two motor wires and observe again. If you cannot observe air rise, chose whichever direction is quieter (less vibration). There is risk of dry-run damage if it runs too long in reverse. If the pump is new from the factory, it is lubricated so it can run dry for about 90 seconds without risk. If the pump has been used, it must not be run for more than about 15 seconds. In many cases, a pump that is reversed will turn off due to overload.

**CENTRIFUGAL pump (model with C in the name)** In reverse, it will produce no flow (or very little). This will NOT damage the pump. If the flow is not normal, reverse any two motor wires.

**Question** *The motor shaft is hard to turn by hand, and moves in a bumpy manner. Is this normal?*

**Answer** YES. This is caused by permanent magnets in the motor. It is especially hard to turn when it is connected to the controller, or if the pump wires are connected together.



**WARNING** If the pump wires are in the wrong order, the motor will run in reverse and the pump will not function. Damage may result. Check the direction BEFORE installing the pump. The proper direction is COUNTER-CLOCKWISE when viewed from above.



**WARNING** When testing for direction, do not run the pump dry for more than 15 seconds.



## 4. Battery-Based Systems

**PS-XXX pump systems can be operated from batteries.**

Install a jumper wire between terminals 6 and 7 to set the controller to battery mode.

This will de-activate the MPP-Tracking function and activate the Low Voltage Disconnect.

**Wiring:** Connect the battery directly to the PS-XXX controller and NOT to the load terminals of the charger. They may not be strong enough to deliver the load spike during starting of the pump. The PS-XXX controller has a Low Voltage disconnect function to protect the battery from being over discharged.

Some charge controller monitor the capacity of the battery and regulate the charging accordingly. That does not work when the battery is connected to the PS-xxx controller. In order to provide correct charging the charger should be set to voltage orientated regulation. This may require a jumper to be set in the charger. Check with the manuals of the charger manufacturer

**Overload protection** Install a fuse or circuit breaker near the power source. For either 24 or 48V , use a 25 amp circuit breaker ( PS200 or PS600 Systems) or a time-delay (slow blow) fuse. The purpose of this protection is for safety in case of a wiring fault, and to provide a means of disconnect when installing or maintaining the system. PS-XXX controllers have electronic over-current protection against motor overload.

**Wire Sizing for the DC circuit** Wire must be sized for no more than 5% voltage drop at 20 amps (starting).

Refer to a wire sizing chart specifically for 24V or 48V, or follow these examples:

24V SYSTEM:

#10 wire to maximum distance of 30 ft.

Metric: 6 sq. mm to max. 10m

48V SYSTEM:

#12 wire to maximum distance of 22 ft.

Metric: 4 sq. mm to max. 13m

**GREATER LENGTHS** For each 150% increase, use next larger wire size.

**ON/OFF switching** You can switch either the primary power to the controller, or the remote (float switch) control circuit.

**Low-voltage disconnect function.** Lead-acid batteries can be permanently damaged by over-discharge when the voltage falls below a critical point. To prevent this, the PS battery-system controller will turn off at low voltage, and turn back on only after the battery has recovered significantly. The set points are:

24V SYSTEM: OFF at 22V ON at 24V

48V SYSTEM: OFF at 44V ON at 48V

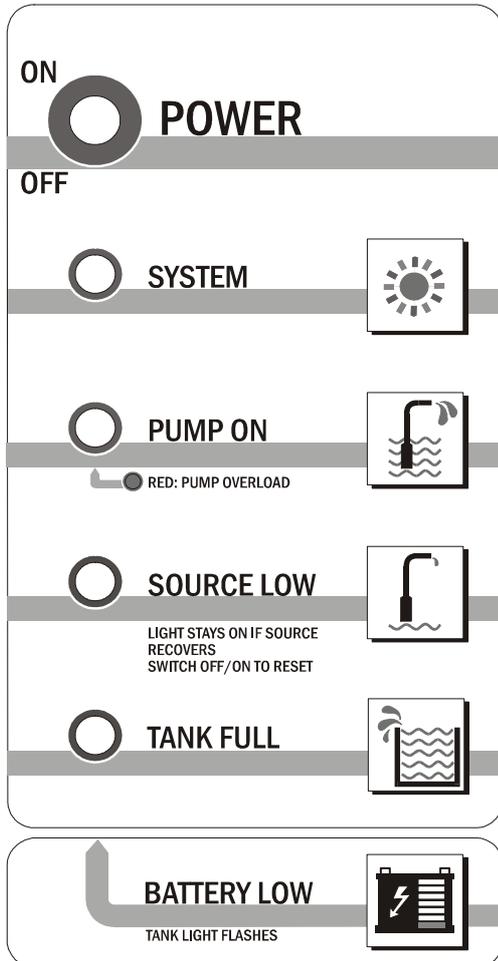
A controller in disconnect mode can be reset manually by turning off/on, but it will quickly disconnect again if the battery is not gaining a substantial recharge.



**CAUTION** The PS-XXX controller is NOT a battery charge controller. A charge controller prevents battery overcharge. It is a normal part of any renewable energy battery charging system. Be sure the charge controller is appropriate to the type of batteries used. (Sealed batteries use lower voltage settings than liquid-filled batteries.)

## 5 OPERATING THE PUMP

This explains the function of the switch and the indicator lights on the pump controller.



### SWITCH

#### POWER ON/OFF

When switched off/on during operation, it resets all system logic.

#### Indicator lights

##### SYSTEM (green)

The controller is switched on and the power source is present. In low-power conditions, the light may show even if there is not enough power to run the pump.

##### PUMP ON (green)

Motor is turning. Sequence of flashing indicates pump speed. See below sequence

##### PUMP OVERLOAD (green changes to red)

##### SOURCE LOW (red)

The water source dropped below the level of the low-water probe. After the water level recovers, the pump will restart, but this light will slowly flash until the sun goes down, power is interrupted, or the POWER switch is reset. This indicates that the water source ran low at least once since the previous off/on cycle.

##### TANK FULL (red)

Pump is turned off by action of the remote float switch (or pressure switch or manual switch, whichever is wired to the "remote float switch" terminals.

##### BATTERY LOW (tank light flashes)

**Battery systems only** – battery voltage fell to 44 / 22V, and has not yet recovered to 48/24V.

**RPM indication:** Pump speed can be read off by the flashing sequence of the Pump ON LED.

LED ON	> 900
One flash	> 1200
Two flash	> 1600
Three flash	> 2000
Four flash	> 2400
Five flash	> 2800

## Operating the Pump continued

**Starting the pump** Be sure there is not a closed valve or other obstruction in the water line. Switch on the array disconnect switch in the junction box, and toggle the power switch on the controller. It is normal to leave the switches on at all times, unless you desire to have the system off.

A solar-direct pump should start under the following conditions

1. clear sunshine at an angle of about 20° or more from the surface of the solar array
2. cloudy conditions, if the sunshine is bright enough to cast some shadow
3. low-water probe submersed in the water source (or bypassed in the controller) – Water-Low light OFF
4. full-tank float switch is not responding to a full tank – Tank-Full light OFF
5. battery system only – voltage is higher than the low-voltage disconnect point (22V or 44V)

**When sunshine is insufficient** When sunshine on the array is present, but too weak for the pump to run, it will attempt to start about every 90 seconds. During each attempt, you will see the PUMP ON light come on.

When pump runs slowly (PUMP ON) under weak sun conditions

1. *PS-Pump* models that have “C” in the model number — These use a centrifugal pump end. In weak sun, the pump may spin without lifting water all the way to the outlet. This is normal.
2. *PS-Pump* models that do NOT have “C” in the model number – These use a helical rotor (positive displacement) pump end. If the pump is turning, even slowly, water will be delivered at a slow rate.

When pump stops from a sudden shadow on the solar array

If a shadow suddenly passes over the array, like if you walk in front of it, the controller will lose track of the input voltage. It may make rapid on/off noises and a high-pitched noise, then stop. This does NOT indicate a problem. The pump will attempt to restart after the normal delay.

## Time delays

1. After pump stops due to insufficient sunshine – 120 SECONDS
2. After full-tank float switch resets – 2 to 3 SECONDS
3. After low-water probe regains contact with water in the source — 20 MINUTES but the indicator light will slowly flash for the rest of the solar day, or until power is disrupted or the controller is turned off/on.
4. Battery systems – after low voltage disconnect point is reached, delay to stop pump – a few SECONDS. After voltage recovers, delay to re-connect – a few SECONDS

**To force a quick start** To test or observe the system, you can bypass the normal time delays. Switch the POWER switch off then on again. The pump should start immediately if sufficient power is present.

**Pump vibration** Most *PS-Pump* models use a HELICAL ROTOR pump end (those that do NOT have a “C” in the model number. A slight vibration is normal with these pumps. If noise is disturbing, try changing the position of the pump. *PS-Pump* models that have a “C” in the model number use a CENTRIFUGAL pump end similar to conventional pumps. They should produce no significant vibration.

**PUMP OVERLOAD (PUMP ON light shows red instead of green)** The system has shut off due to an overload. This can happen if the motor or pump is blocked or very difficult to turn and is drawing excessive current (hard to turn). Overload detection requires at least 250 Watt output of the solar array. This can be caused by a high concentration of solids in the pump, high water temperature, excessive pressure due to high lift or a restriction in the pipe, or a combination of these factors. The controller will make 3 start attempts before shutting down the system. The System ON LED will be OFF and the red OVERLOAD LED ON. The system will not reset until the ON / OFF switch is turned OFF and ON again. See Troubleshooting, Section 9.3 “HIGHER CURRENT”.

## 6 TROUBLE SHOOTING

Please read this section before calling for help.

If you call for help, please refer to the model and serial numbers.

### 6.1 If The Pump Doesn't Run

Most problems are caused by wrong connections (in a new installation) or failed connections, especially where a wire is not secure and falls out of a terminal. The *System ON* light will indicate that system is switched on

and connected to the controller. It indicates that VOLTAGE is present but (in a solar-direct system) there may not be sufficient power to start the pump. It should attempt to start at intervals of 120 seconds.

#### **Pump attempts to start every 120 seconds but doesn't run**

The controller makes a slight noise as it tries to start the pump. The pump will start to turn or just vibrate a little.

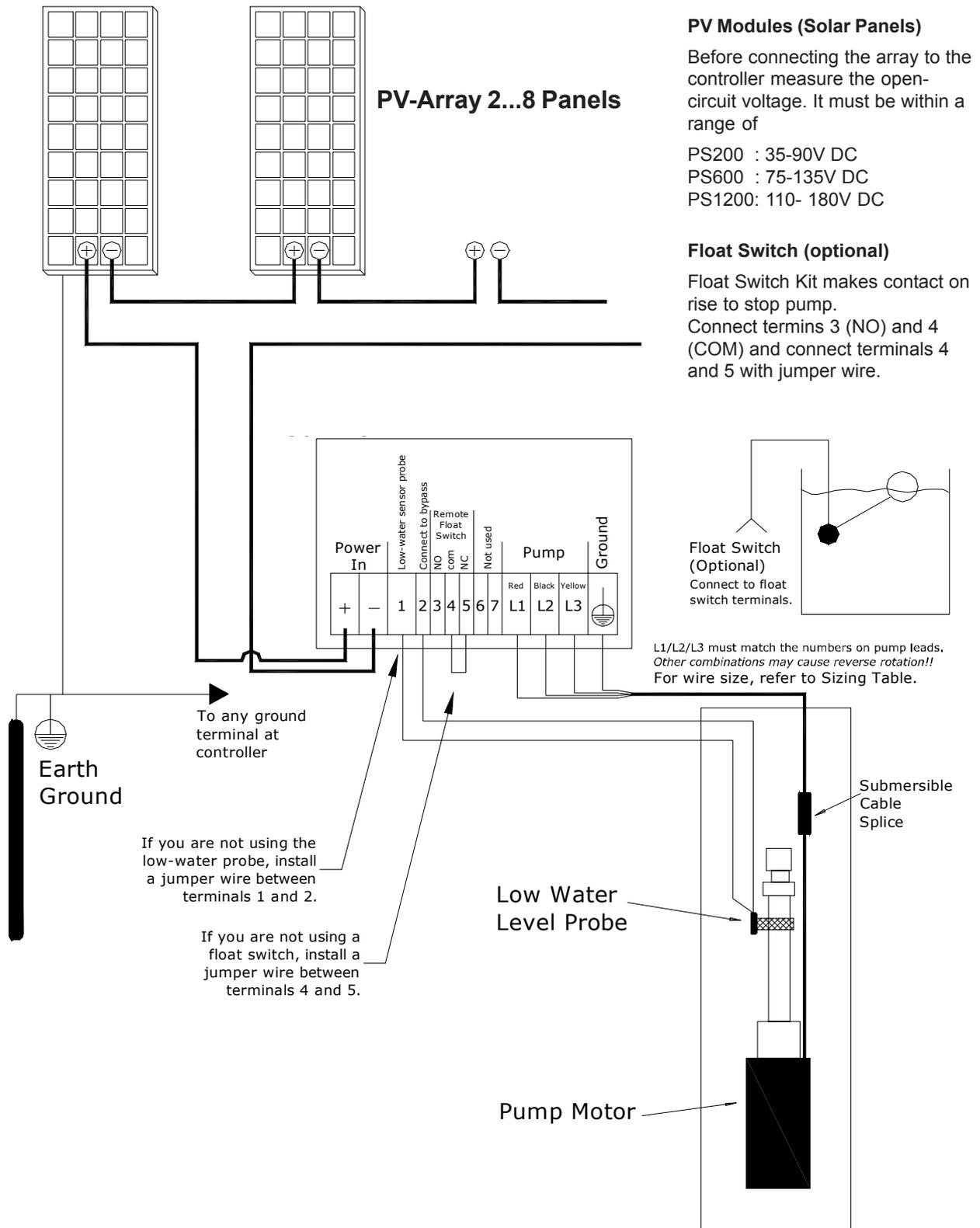
1. There may be insufficient power reaching the controller. A solar-direct (non-battery) system should start if there is enough sun to cast a slight shadow. A battery system should start if the supply voltage is greater than 22V (24V system) or 44V (48V system).
2. If the pump was recently connected (or reconnected) to the controller, it may be running in reverse direction due to wiring error. See Section 3.
3. If the motor shaft only vibrates and will not turn, it may be getting power on only two of the three motor wires. This will happen if there is a broken connection or if you accidentally exchanged one of the power wires with the ground wire.
4. The pump or pipe may be packed with mud, clay, sand or debris.
5. Helical rotor models: The pump may have run dry. Remove the pump stator (outer body) from the motor, to reveal the rotor. If there is some rubber stuck to the rotor, the pump end must be replaced.
6. Helical rotor models: The check valve on the pump may be faulty or stuck, allowing downward leakage when the pump is off. This can prevent the pump from starting.



**CAUTION DO NOT REMOVE THE CHECK VALVE from the pump.** *If you want to look for dirt stuck inside the pump, it is preferable to unbolt the pump body and pull it from the pump. IF YOU MUST REMOVE THE CHECK VALVE, use a hardening adhesive sealant on the screw threads when you replace it. Epoxy glue is good. The threads are not tapered. They will leak if a hardening sealant is not used. Teflon tape will make a good seal, but it may not prevent the joint from unscrewing.*

**PUMP OVERLOAD (PUMP ON light shows red instead of green)** The system has shut off due to an overload. This can happen if the motor or pump is blocked or very difficult to turn and is drawing excessive current (hard to turn). Overload detection requires at least 250 Watt output of the solar array. This can be caused by a high concentration of solids in the pump, high water temperature, excessive pressure due to high lift or a restriction in the pipe, or a combination of these factors. The controller will make 3 start attempts before shutting down the system. The System ON LED will be OFF and the red OVERLOAD LED ON. The system will not reset until the ON / OFF switch is turned OFF and ON again.

## 7. System Wiring Diagram for Solar-direct (non-battery) System



## 8 SYSTEM REPORT FORM

### *System and Components*

System Voltage  V

Date of Purchase

Purchased from

Battery System?  yes  no

if not: Quantity of Solar Modules (panels)

Solar Module Brand

Module Model #

Controller Model  PS1200  
 PS600  
 PS200  
 other, i.e.:

Controller Serial #

Pump End Model #

Pump End Serial #

### **Temperature Range**

Helical rotor pumps (without C in the model number) work optimally only in a specific temperature range. Last digit of Pump End Model # indicates temperature class. If a special temperature range was not specified, the last digit of model number (X) will be 1.

- Class 0 32 °F to 54 °F 0 °C to 12 °C
- Class 1 46 °F to 72 °F 8 °C to 22 °C
- Class 2 64 °F to 90 °F 18 °C to 32 °C
- Class 3 82 °F to 108 °F 28 °C to 42 °C
- Class 4 100 °F to 126 °F 38 °C to 52 °C

**Class 1 is the standard class.**

*See Section 12 for more about temperature specifications.*

System Report Form continued

**Installation Report**

Installation Date	<input type="text"/>	
by	<input type="text"/>	
Well Depth	<input type="text"/>	m / ft
Pump depth	<input type="text"/>	m / ft
Additional Vertical Lift (up to top of tank)	<input type="text"/>	m / ft
Static Water Level	<input type="text"/>	m / ft
Drawdown level	<input type="text"/>	m / ft
Drop Pipe (vertical from the pump)		
Size	<input type="text"/>	mm <sup>2</sup> / inch
Type	<input type="text"/>	
Length	<input type="text"/>	m / ft
Additional Pipe Length (to tank)		
Size	<input type="text"/>	mm <sup>2</sup> / inch
Type	<input type="text"/>	
Length	<input type="text"/>	m / ft
Submersible Pump Cable		
Wire size	<input type="text"/>	mm <sup>2</sup> / AWG
Total Length (controller to pump)	<input type="text"/>	m / ft

**MAX RPM CONTROL**

(See Section 5.6) Factory setting is Maximum.  yes  no

If this setting was reduced, enter setting here: