



Failure to follow these instructions will void the warranty.

SOLAR-POWERED SUBMERSIBLE PUMP SYSTEMS PS200, PS600, PS1200, PS1800 MANUAL FOR INSTALLATION, OPERATION, SERVICE

1 WARNINGS

READ AND FOLLOW ALL INSTRUCTIONS!

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



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



WARNING – To reduce the risk of electric shock, replace damaged cord immediately.



WARNING – It must be assured that all grounding connections are properly made and that the resistances do meet local codes or requirements.

RETAIN THESE INSTRUCTIONS FOR FUTURE USE!

General Warnings

- **The manual contains basic instructions which must be observed during installation, operation and maintenance. The manual should be carefully read before installation and start-up by the person in charge of the installation. The manual should also be read by all other technical personnel/operators and should be available at the installation site at all times.**
- **Personnel Qualification and Training** – All personnel for the operation, maintenance, inspection and installation must be fully qualified to perform that type of job. Responsibility, competence and the supervision of such personnel must be strictly regulated by the user. Should the available personnel be lacking the necessary qualification, they must be trained and instructed accordingly. If necessary, the operator may require the manufacturer/supplier to provide such training. Furthermore the operator/user must make sure that the personnel fully understands the contents of the manual.
- **Dangers of Ignoring the Safety Symbols** – Ignoring the safety directions and symbols may pose a danger to humans as well as to the environment and the equipment itself. Non-observance may void any warranties. Non-observance of safety directions and symbols may for example entail the following: Failure of important functions of the equipment/plant; failure of prescribed methods for maintenance and repair; endangerment of persons through electrical, mechanical and chemical effects; danger to the environment because of leakage of hazardous material; danger of damage to equipment and buildings.
- **Safety-oriented Operation** – The safety directions contained in the manual, existing national regulations for the prevention of accidents as well as internal guidelines and safety-regulations for the operator and user must be observed at all times.
- **General Safety Directions for the Operator/User** – If hot or cold equipment parts pose a danger then they must be protected by the operator/user against contact with people. Protective covers for moving parts (e.g. couplings) must not be removed when the equipment is running. Leaks (e.g. at the shaft seal) of hazardous pumping media (e.g. explosive, toxic, hot liquids) must be disposed of in such a way that any danger to personnel and the environment is removed. All government and local regulations must be observed at all times. Any danger to persons from electrical energy must be excluded by using good installation practices and working to local regulations. (For example VDE in Germany).
- **Safety Directions for Maintenance, Inspection and Assembly Work** – It is the user's responsibility to make sure that all maintenance, inspection and as-

sembly work is performed exclusively by authorized and qualified experts sufficiently informed through careful perusal of the Operating Instructions. The accident prevention regulations must be observed. All work on the equipment should be done when it is not operational and ideally electrically isolated. The sequence for shutting the equipment down is described in the manual and must be strictly observed. Pumps or pump units handling hazardous liquids must be decontaminated. Immediately upon completion of the work, all safety and protective equipment must be restored and activated. Before restarting the equipment, all points contained in chapter "Initial Start-up" must be observed.

- **Unauthorized Changes and Manufacturing of Spare Parts** – Any conversion or changes of the equipment may only be undertaken after consulting the manufacturer. Original spare parts and accessories authorized by the manufacturer guarantee operational safety. Using non-authorized parts may void any liability on the part of the manufacturer.
- **Unauthorized Operation** – The operational safety of the equipment delivered is only guaranteed if the equipment is used in accordance with the directions contained in this manual. Limits stated in the data sheets may not be exceeded under any circumstances.
- **Cited Standards and other Documentations** – DIN 4844 Part 1 Safety marking; Safety symbols W 8, Supplement 13; DIN 4844 Part 1 Safety marking; Safety symbols W 9, Supplement 14
- **Transportation and Intermediate Storage** – Prolonged intermediate storage in an environment of high humidity and fluctuating temperatures must be avoided. Moisture and condensation may damage windings and metal parts. Non-compliance will void any warranty.

Specific Warnings for Installation of PS Pumps

- **Open circuit (no-load) voltage above 100 V for PS200, above 150 V for PS600 and above 200 V for PS1200 and PS1800 controllers will destroy the controller. This may occur if the solar array is wired incorrectly. (See section Wiring, section 7.)**
- **Do not attempt to run the motor without the PS controller.**
- **Do not attempt to use the controller for any purpose other than LORENTZ PS pump systems.**
- **The black rubber caps on the bottom of the controller casing are only transportation covers and must be replaced by code compliant conduit fittings.**
- **Submersible motors are delivered with a rubber**

2 ELECTRICAL INSTALLATION

boot on the bottom of the motor. This is only a transportation measure and must be taken off before installation.

- **Motor cable strain relief:** Submersible motors must use a safety rope or cable to act as a strain relief for the motor cable and to avoid losing the pump in the well if the pipe breaks.
- **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.
- **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° F (22° C), a special model may be required.**
- **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 not longer than 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 a 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 no probe is used, connect the probe terminals in the controller box.
- **Helical rotor models (without "C" in the model number) are not self-draining.** If drainage is required for freeze-protection, install a weep hole or draining device below freeze level.
- **Install this system in accordance with local regulations and accepted codes of professional practice.**



WARNING The black rubber caps on the bottom of the controller casing are only transportation covers and must be replaced by code compliant conduit fittings.

Protection from solar heat Electronic devices are most reliable when they are protected from heat. Mount the controller in the shade of the midday sun. An ideal location is directly under the solar array, on the North side of the mounting pole. If no shade is 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.

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. If you do not 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 small 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 and PS1800 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 PS 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 in this manual (section 7) and wire accordingly.

POWER IN Ensure that the solar array DISCONNECT SWITCH (or battery fuse or circuit breaker) is OFF. A solar disconnect switch must always be fitted. 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 MultiMate.



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. 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 of the pump have a marking to allow correct wiring. Connect the power wires using this sequence:

- L1
- L2
- L3
- Ground



No disconnect switches must be installed between the motor and the pump controller. Connecting the motor wire to the switched-on controller might irreparably damage it. Such damages are excluded from the warranty.



CAUTION! When splicing the pump cable, carefully take a note of the markings of the cables you have connected.

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 do not have a water vessel to test the pump in, you can test it dry by watching the pump shaft and run it for a few seconds. The metal label on the pump has an arrow to indicate the proper direction of rotation. It can be run dry safely for about 15 seconds. This gives more than enough time to observe the direction of the shaft.

If you did not write down the colour match 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. 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 (no "C" in the model number) Turn the pump on. Observe if air is rising from the pipe. If it is not, 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 (with "C" in the model number) 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

LORENTZ PS 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 deactivate the MPP tracking function and activate the low-voltage disconnect function.

Wiring Connect the battery directly to the LORENTZ PS 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 LORENTZ PS 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 LORENTZ PS 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 24V or 48V, use a 25A 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. LORENTZ PS 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 20A (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 mm ² to max. 10 m
48V SYSTEM	#12 wire to maximum distance of 22 ft Metric: 4 mm ² to max. 13 m

Greater lengths For each 150% increase in length, 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:

System	OFF	ON
24VDC	22VDC	24VDC
48VDC	44VDC	48VDC

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.

PS1200 and PS1800 systems These systems require min. 96VDC to run the pump near nominal speed. For these systems battery chargers are not very common and battery operation should not be taken into consideration.



CAUTION! The LORENTZ PS controller is NOT a battery charge controller. A charge controller prevents battery over-charge. 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 chapter explains the function of the switch and the indicator lights on the pump controller.

CONTROLLER TYPES

Two controller types are used to control the pumping systems.



- The smaller controller **PS200** (see left picture) can easily be recognised by its transparent plastic housing. All indicator lights are on the board. The power on/off switch is located at the bottom of the housing, next to the cable notches.
- The controllers **PS600, PS1200 and PS1800** (see right picture) have an aluminum housing with indicator lights and power on/off switch on the front.

Both controller types operate in the same way.

CONTROL ELEMENTS

POWER ON/OFF SWITCH

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

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

LED ON	>	900
1 flash	>	1,200
2 flashes	>	1,600
3 flashes	>	2,000
4 flashes	>	2,400
5 flashes	>	2,800

If the **PUMP OVERLOAD, green changes to red.**

- **SOURCE LOW (red)** The water source has 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 22V or 44V respectively, and has not yet recovered to 24V or 48V (depending on the system voltage).

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. under 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. for battery systems 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 120 seconds. During each attempt, you will see the PUMP ON light come on.

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

1. **for centrifugal pumps** (with "C" in the model number) – in weak sun, the pump may spin without lifting water all the way to the outlet. This is normal;
2. **for helical rotor pumps** (without "C" in the model number) – 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, e.g. 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 only – after low voltage disconnect point is reached, delay to stop pump – a few seconds. After voltage recovers, delay to re-connect – a few seconds.

6 TROUBLE SHOOTING

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 (without "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.

Please read this section before calling for help. If you call for help, please refer to the model and serial numbers.

If the pump does not run Most problems are caused by wrong connections (in a new installation) or failed connections, especially where a wire is not tightened properly and falls out of a terminal. The System ON light will indicate that the 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 does not 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.
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. Was the pump stored in water for more than three months? This might cause the pump to seize. Pumps will not be damaged, but might have to be pulled to free them again. Let stored pumps run every 2–3 months in order to avoid seizure.
6. Helical rotor models: The rubber stator may be expanded from heat, due to sun exposure or pumping water that is warmer than 72°F (22°C). This may stop the pump temporarily, but will not cause damage.
7. 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.
8. 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.
9. Is the pump installed in a negative suction head application? This is an abnormal situation and will pull the rotor out of the pump stator causing possible damage inside the motor as this is an abnormal working direction for all pumps. Negative suction head means that you do not need a pump at all since the delivery point is below the water source level in

the source (wells, ponds etc.)

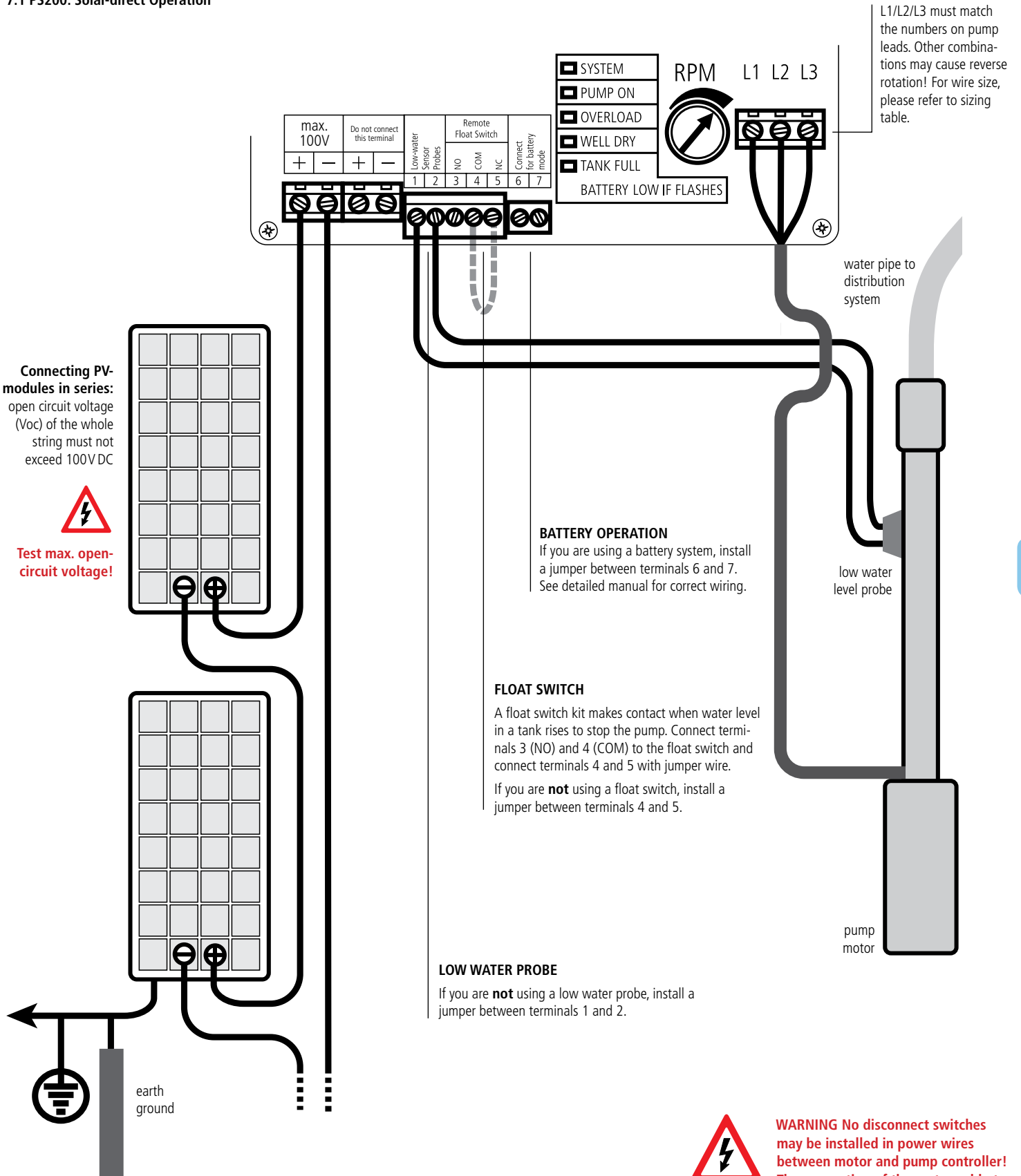
PUMP OVERLOAD (PUMP ON light shows red instead of green) The system has shut off due to an overload. This can happen if the motor or pump is blocked or very difficult to turn and is drawing excessive current (hard to turn). Overload detection requires at least 250 W output of the solar array. This can 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.



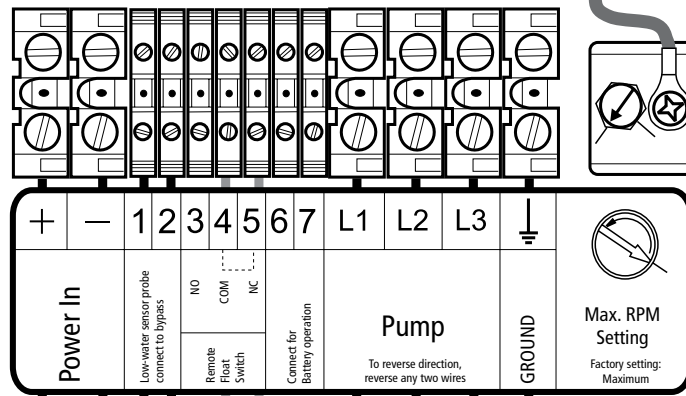
CAUTION! DO NOT REMOVE THE CHECK VALVE from the pump. If you want to look for dirt stuck inside the pump, it is preferable to unbolt the pump body and pull it from the pump. IF YOU MUST REMOVE THE CHECK VALVE, use a hardening adhesive sealant on the screw threads when you replace it. Epoxy glue is good. 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.

7 WIRING DIAGRAMS

7.1 PS200: Solar-direct Operation



7.2 PS600, PS 1200, PS1800: Solar-direct Operation



L1/L2/L3 must match the numbers on pump leads. Other combinations may cause reverse rotation! For wire size, please refer to sizing table.

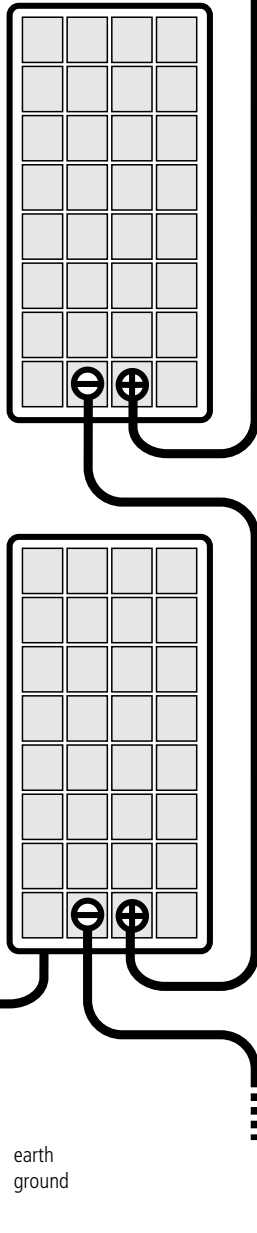
Connecting PV-modules in series:
open circuit voltage (Voc) of the whole string must not exceed the limits given in the table below the wiring diagram



See allowed max. open-circuit voltages for different systems below.



Test max. open-circuit voltage!



BATTERY OPERATION

If you are using a battery system, install a jumper between terminals 6 and 7. See detailed manual for correct wiring.

FLOAT SWITCH

A float switch kit makes contact when water level in a tank rises to stop the pump. Connect terminals 3 (NO) and 4 (COM) to the float switch and connect terminals 4 and 5 with jumper wire.

If you are **not** using a float switch, install a jumper between terminals 4 and 5.

LOW WATER PROBE

If you are **not** using a low water probe, install a jumper between terminals 1 and 2.

water pipe to distribution system

low water level probe

pump motor

Max open-circuit voltage for PV modules

PS200	100 VDC
PS600	150 VDC
PS1200	200 VDC
PS1800	200 VDC



WARNING No disconnect switches may be installed in power wires between motor and pump controller! The connection of the motor cable to switched-on controller might cause irreparable damages which are excluded from warranty!

8 SYSTEM AND COMPONENTS

System voltage V

Date of purchase

Purchased from

Battery system yes no

Quantity of solar modules

Solar module brand

Module model #

Controller model PS1800 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 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 1 is the standard class)

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

9 INSTALLATION REPORT

Installation date

by

Well depth m | ft

Pump depth m | ft

Additional vertical lift (to top of tank) m | ft

Static water level m | ft

Drawdown level m | ft

Drop pipe (vertical from the pump)

Size mm² | inch

Type

Length m | ft

Additional pipe length (to tank)

Size mm² | inch

Type

Length m | ft

Submersible pump cable

Wire size mm² | AWG

Length (controller to pump) m | ft

Max. RPM control
 Factory setting is maximum. yes no

If this setting was reduced, enter setting here:

This manual is the property of 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

This manual is for controller models PS200 HR/C, PS600 HR/C, PS1200 HR/C, PS1800 HR/C. For earlier models (before July 2003) refer to Version 1 and 2.

Copyright ©2002-2011 by BERNT LORENTZ GmbH & Co. KG; all rights reserved.