PSk2 C-SJ Series
Solar Submersible Pump Systems

Manual for Installation, Operation, Service

Sun. Water. Life.

V150107

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1 Introduction

Thank you for purchasing a LORENTZ pump system.

Before you begin – All pump systems are equipped with nameplates which contain all important data. Check the model numbers of all the components of your system to verify that they are items that you ordered and ensure that the packaging is undamaged and complete.

Check against the pump specifications to be sure the system is appropriate for your application.

Please fill in the SYSTEM REPORT!
This will be essential information if any problems occur. The system report can be found at the end of this manual.

2 Declaration of Conformity

We, BERNT LORENTZ GmbH & Co. KG Germany, declare under our sole responsibility that the products

PSk2 C-SJ Series

to which the declaration relates, are in conformity with the Council Directives on the approximation of the laws of the EC Member States relating to:

- Machinery (2006/42/EC)
- Electromagnetic compatibility (2004/108/EC)
- Electrical equipment designed for use with certain voltage limits (2006/95/EC)

Henstedt-Ulzburg, Germany
1 January 2013

Bernt Lorentz, CEO

3 PSk2 Setup with PumpScanner

PumpScanner for Android® is an important tool for correct PSk2 controller setup. Setting up the pump and mandatory accessories, e.g. the SunSwitch, is required for full performance and to not void the warranty.

The PSk2 controller is a new generation solar pump controller for LORENTZ PSk submersible and PSk surface pumps. It utilizes a wireless Bluetooth® connection to connect to an Android®-based smartphone or tablet running the LORENTZ PumpScanner software.

PumpScanner is available through our partner extranet website "partnerNET". The PumpScanner software makes configuration quick and simple.

Every PSk2 controller is shipped with the same default setup and must be configured by the installer using PumpScanner.

PumpScanner holds the latest versions of pump system firmware as well as new features. We highly recommend you update PumpScanner prior to each system install to ensure you have the latest version.

There is a logical process to follow when installing PSk2 systems:

1. Make sure the latest version of PumpScanner is installed on your Android device
2. Make sure you have registered the PSk2 system on Sites in partnerNET and updated your license list in PumpScanner
3. Complete the physical installation as per the PSk2 manual
4. Connect power but do not start the pump (toggle switch on controller is in position "OFF")
5. Connect to the pump controller using PumpScanner as per the PumpScanner manual
6. Check the controller Firmware version as per the PumpScanner manual and update it if asked to do so by PumpScanner
7. Configure the pump controller using PumpScanner as per the PSk2 manual and PumpScanner manual
8. Switch on the controller
9. **Optional**: Install the PS Communicator as per the PS Communicator manual

PSk2 configuration – PSk2 simplifies the installation process by using our PumpScanner Android® App to program the parameters of the controller. This programing is very simple and only requires the correct controller and pump to be selected as well as the setup of parameters according to the COMPASS report. The PSk2 incorporates the PS DataModule that stores running data and allows programming of additional features. Using PumpScanner you can look at the real-time and historic performance of the pump.

PumpScanner – You will need to install PumpScanner on an Android® device (smartphone or tablet). No SIM card or contract is required, the communication is via Bluetooth®. You can download and license PumpScanner here:

http://www.lorentz.de/pumpscannerapp

or use the following QR code:

Read the PumpScanner manual to understand how to link the controller to your Android device.

DataModule Registration – To set up a pump using PumpScanner, access to the DataModule is necessary. To gain access, the pump system with DataModule must be registered at LORENTZ partnerNET "Sites". After registering at "Sites", the "Licence List" must be updated within PumpScanner settings. For detailed information refer to partnerNET. You can register your pump system here:

http://www.lorentz.de/sites

4 Receipt,Storage and Handling

Table 1: Controller packing list

#	Item	QTY
1	PSk2 controller	1 unit
2	Key for front door	1 unit
3	Mini plug for accessories	3 pcs
4	Sun Switch module 1.5Wp	1 unit

Check on receipt that the packaging is undamaged and complete. If any abnormity is found, contact your distributor. Check you delivery according to the following table.

LORENTZ pumps are supplied from the factory in proper packing in which they should remain until they are to be installed at the site. Handle the pump with care and avoid unnecessary impacts and shocks.

CAUTION – Do not attempt to use the controller for any purpose other than LORENTZ PSk Pump Systems. Do not attempt to run the motor without the controller.

Prolonged intermediate storage in an environment of high humidity and fluctuating temperatures must be avoided. Moisture condensation may damage metal parts. Non-compliance will void any warranty. It is recommended storing the parts in a closed and dry room.

The motor, the pump end and controller can be stored (not used) in the range of –20 °C to +65 °C (–4 °F to +149 °F). The components should not be exposed to direct sunlight.

If the motor is stored for more than 3 months, the rotor must be turned by hand before use to ensure that the rotor is not stuck.

5 Operating Conditions

Table 2: Permitted ambient temperatures

Item	Max. temperature	
Controller	–30 °C to +50 °C	–22 °F to +122 °F
Pump unit (pump end + motor)	0 °C to +30 °C	+32 °F to +86 °F
Fluid temperature	0 °C to +30 °C	+32 °F to +86 °F

Humidity and air salinity – The pump system must not be stored or operated where the average day humidity is above 80 %. It should not be stored or operated within 1 km / 0.6 miles of coastal regions or in saline air (more than 2 µg/m³).

Altitude – The pump system must not be installed at altitudes above +3,000 m / +10,000 ft mean sea level (other altitudes on request).

Fluid – PSk2 submersible pumps can be used for drinking water supply, livestock watering and irrigation applications not containing solid or long fibred particles larger than sand grains, with a max. grain size of 2 mm. The max. permitted sand content is 500 ppm, a higher sand content will reduce the pump life considerably due to wear. The max. salt content is 300 – 500 ppm at max. 30 °C / 85 °F. Defects due to pumping other liquids are not covered by the warranty.

6 Safety Instruction and General Warnings

Safe operation of this product depends on its correct transportation, installation, operation and maintenance. Failure to follow these instructions can be dangerous and/or void the warranty.

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 cords 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!

- The manual contains basic instructions which must be observed during installation, operation and maintenance. Before installation and start-up, the manual should be carefully read 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 qualifications 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 operator. Should the available personnel be lacking the necessary qualification, they must be trained and instructed accordingly. If necessary, the operator may request the manufacturer/supplier to provide such training. Furthermore the operator/user must make sure that the personnel fully understand 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; danger to 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 eliminated by using good installation practices and working to local regulations (e.g. 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 assembly work is performed exclusively by authorized and qualified experts sufficiently informed through careful study 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 of or changes to 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 documentation** – DIN 4844 Part 1 Safety marking; Safety symbols W 8, Supplement 13; DIN 4844 Part 1 Safety marking; Safety symbols W 9, Supplement 14

- **Ensure all power sources are disconnected when working on the system. Follow all appropriate electrical codes. There are no user-serviceable parts inside the motor or the controller.**

Explanation of Warning Symbols

WARNING – Disregard might lead to injury or damage of the installation.

CAUTION – Recommended to avoid damage or premature ageing of the pump etc.

7 Product Description

7.1 General

LORENTZ PSk2 solar submersible pump systems are vertical multi stage pumps designed to efficiently deliver the highest volumes of water across a wide range of lifts. PSk2-C-SJ submersible pumps are typically used in irrigation projects and for wide area drinking water applications where they reliably meet the most demanding requirements, economically, without pollution and without a grid connection or diesel generator.

The system is composed of a PV generator array, a pump and a solar pump controller. Based on the design philosophy that it is more efficient to store water rather than electricity, there is no energy storing device such as sa storage battery in the system.

The PV generator, an aggregation of PV modules connected in series and in parallel, absorbs solar irradiation and converts it into electrical energy, providing power for the whole system. The pump controller controls and adjusts the system operation and converts the DC produced by the PV generator into AC to drive the pump, and adjusts the output frequency in real-time according to the variation of sunlight intensity to realize the maximum power point tracking (MPPT).

The PSk2 controller converts the DC power from the solar array to digitally created AC signal to run the motor. Due to the special nature of this PWM signal it cannot be measured with a multimeter. Motor speed (RPM) is proportional to the signal frequency. The frequency starts low (about 20 Hz), and increases gradually to a maximum about 60 Hz.

The PSk2 C-SJ pumps are centrifugal pumps, driven by a 3-phase water cooled AC motor.

Each system consists of a pump, pump motor and a controller, this modular concept keeps all electronics above ground, simplifying servicing and lowering cost of ownership.

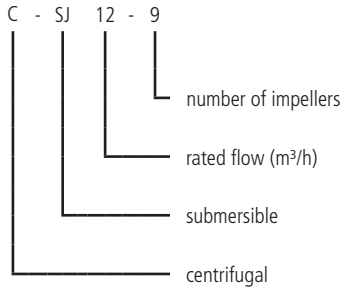
7.2 Features

LORENTZ PSk2-C-SJ series has the following features:

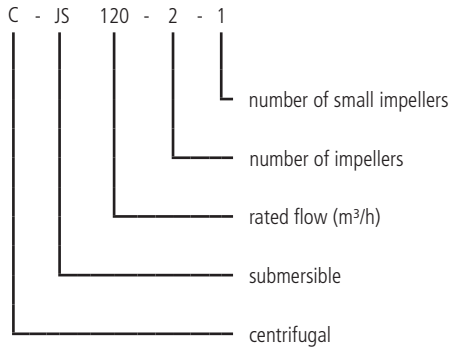
- Engineered in Germany using high quality non corrodible materials
- IP54 / NEMA 3A corrosion resistant housing
- 0 – 60Hz motor speed control
- Wide range of inputs to influence pump behaviour
- Integrated monitoring and management including onboard recording of 5 years performance data, smart device access via PumpScanner Android™ App and integration to LORENTZ pumpMANAGER remote management service
- Inbuilt irradiation measurement and pump control based on power available
- Integration with the LORENTZ SmartPSU for grid / generator connection and power blending

7.3 Naming

Pump model definition
for C-SJ8-44 to C-SJ75-4 pumps



for CS-SJ120-2-1 pumps



7.4 Technical data of controller

Table 3: Technical data of PSk2 controller

Model	Solar input power	Pump motor: rated power	Pump motor: rated voltage	Max. DC input voltage	MPP voltage	Output current	Output frequency
	[kWp]	[kW]	[V]	[V]	[V]	[A]	[Hz]
PS7k2	7	5.5	380–400	850	500–600	13	0 – 60
PS9k2	9	7.5	380–400	850	500–600	18	0 – 60
PS15k2	15	11.0	380–400	850	500–600	24	0 – 60
PS21k2	21	15.0	380–400	850	500–600	30	0 – 60
PS25k2	25	18.5	380–400	850	500–600	39	0 – 60
PS40k2	40	30	380–400	850	500–600	65	0 – 60

7.5 System layout

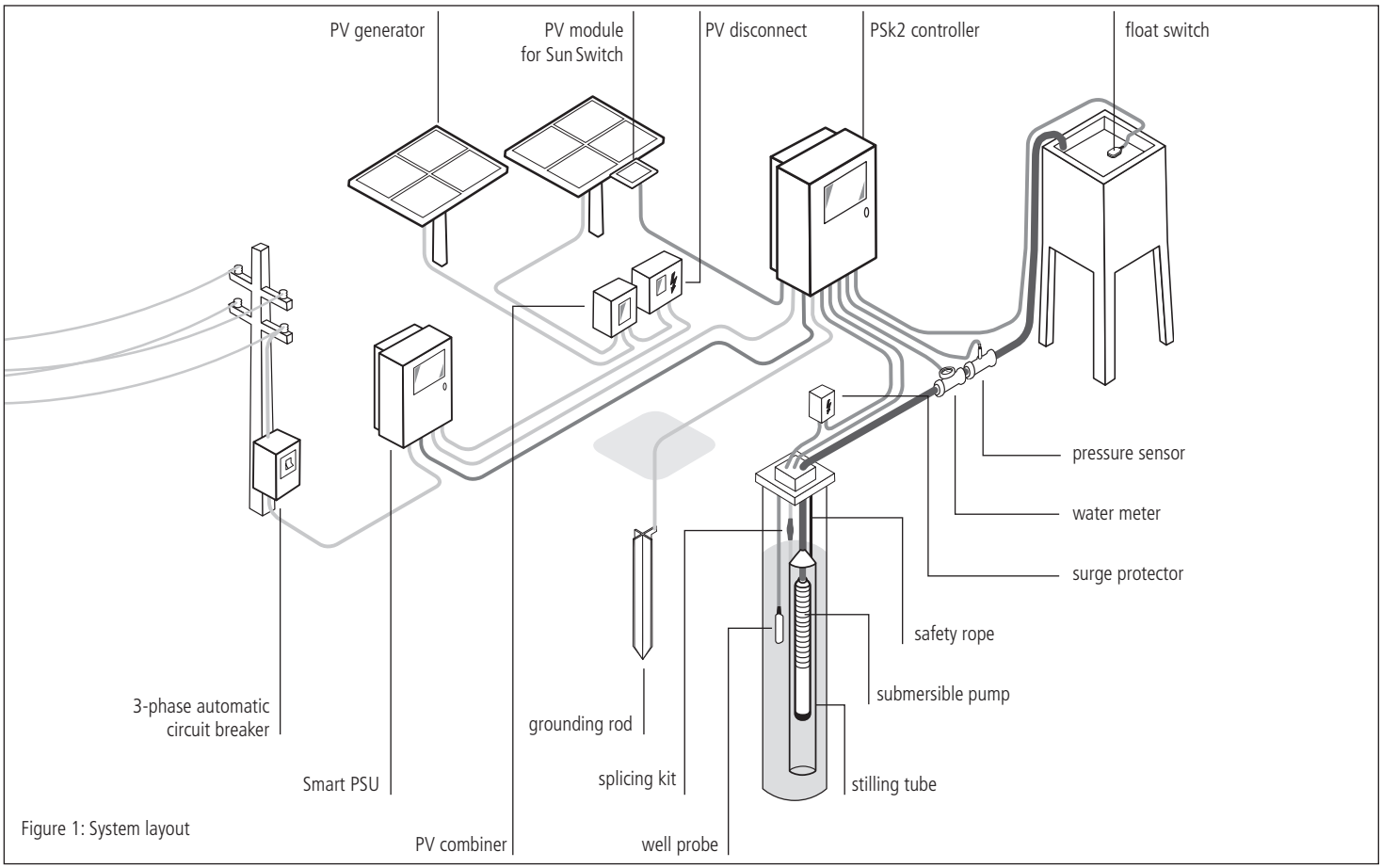


Figure 1: System layout

8 Controller Installation

8.1 General

The pump system must be equipped with a proper sized DC disconnect switch. The switch must be installed between the solar generator and controller. It must meet the following requirements:

- minimum 850 V DC
- continuous current rating according to maximum current of pump controller or higher
- the switch must be rated for DC current, **NOT AC**

A PV disconnect switch, matching all requirements above, can be purchased from LORENTZ.

NOTE – The use of a properly sized disconnect switch is an important safety measure and obligatory for a professional installation of a solar pump system.

Electrical conduit is recommended. We recommend the use of an electrical conduit (pipe) to protect outdoor wiring from the weather, from human activities and from chewing animals. If you do not use a conduit, use a strong, high-quality outdoor cable. Where cables enter the junction box, install sealed strain-relief cable glands.

WARNING – Do not dismantle the controller while still connected to the power supply! Before any installation, maintenance or inspection activities wait at least FIVE MINUTES after the power supply has been disconnected from the controller!

Treat the controller as industrial waste when processing the discarded controller. It is possible that some components could produce toxic and harmful gas.

8.2 Controller Placement

The controller must be protected from water, moisture and animals. Place the controller in a dry and sufficiently ventilated environment.

Place the controller close to the solar array, not the pump. This will reduce the risk of lightning damage. Explanation: The controller's input circuitry is more sensitive to surges than its output. It is safest to minimize the length of the input wiring.

Electronic devices are most reliable when they are protected from heat. Mount the controller where it is shaded from the midday sun. An ideal location is directly under the solar array, on the North side of the mounting structure. 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 function in the controller causing it to reduce the power consumption or turn it off.

Figure 2: Controller dimensions for installation

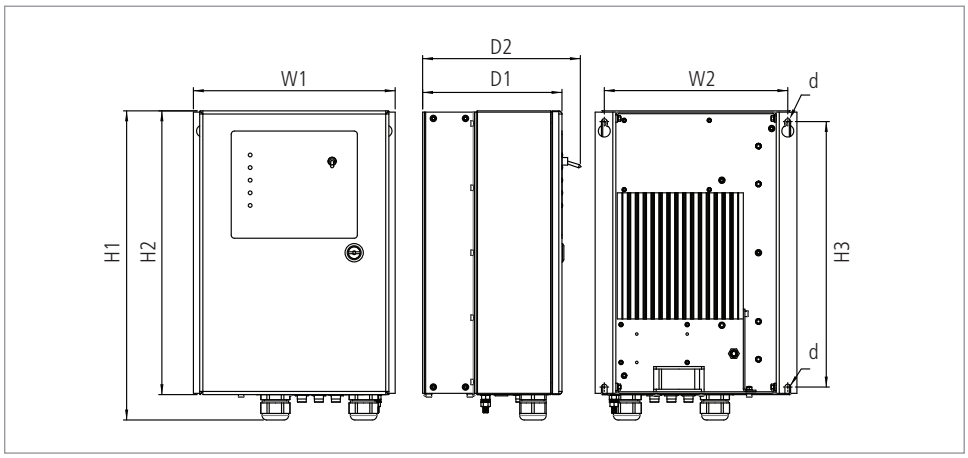


Table 4: Controller dimensions for installation

Model	Dimension [mm]							Weight [kg]
	W1	W2	H1	H2	H3	D1	D2	
all	320	290	500	450	425	220	250	17

8.3 Mounting, space and ventilation requirements

The PSk2 controller must be mounted to a solid wall or back-plate. Ensure that the mounting back-plate can support the weight of the controller. The user is responsible for correct and safe mounting.

First, mark all drill holes. Refer to "Table 4: Controller dimensions for installation" on page 9 and use the values W2, H3 and d. Fit all screws, leave about 10 mm / 0.4" space between the screw's head and the wall. Hang the controller on the wall. Finally, tighten all screws.

PSk2 controllers can be mounted side by side.

The controller must be mounted directly on a vertical, flat wall or equipped with a back plate. The controller must not be installed inside an additional enclosure, box or any other hollow space that could result in the controller not being efficiently cooled. Inefficient cooling will reduce the system performance and can damage the controller.

CAUTION – To ensure effective cooling, the controller must be installed vertically with at least 20 cm / 8" space above and below the casing.

CAUTION – The heat sink gets hot during operation. Do not touch it until it has cooled down to avoid the risk of burns.

CAUTION – Do not let any swarf (drilling chips) fall into the controller fins or fan during installation.

Figure 3: Minimum spacing for wall mounting

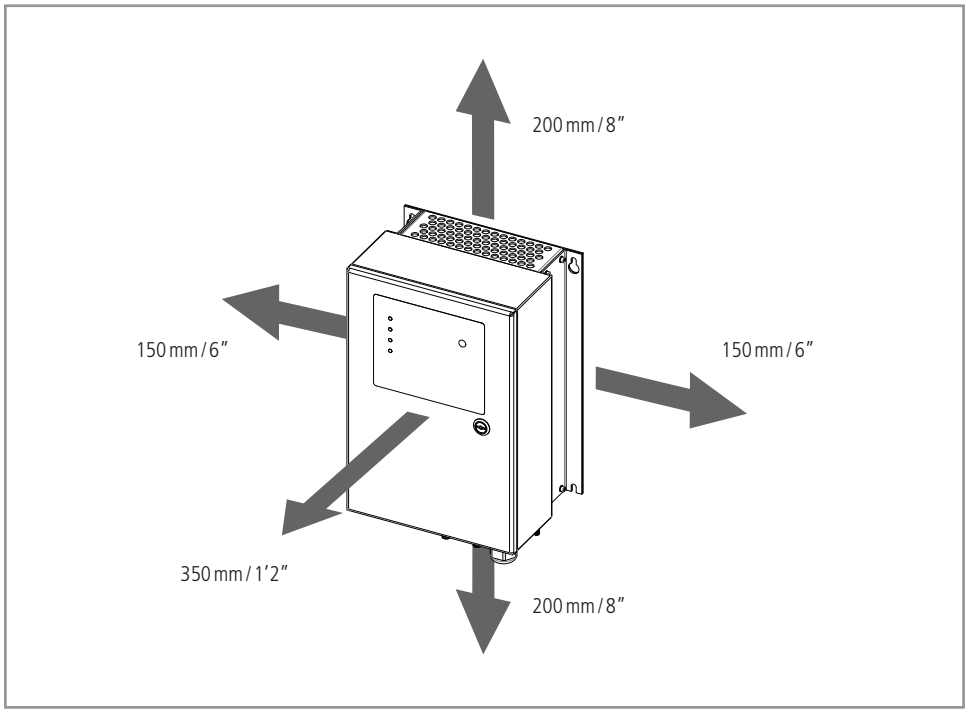


Figure 4: Correct controller mounting: direct to the wall

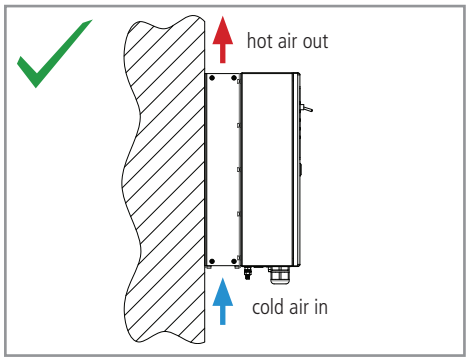


Figure 5: Correct controller mounting: with back cover

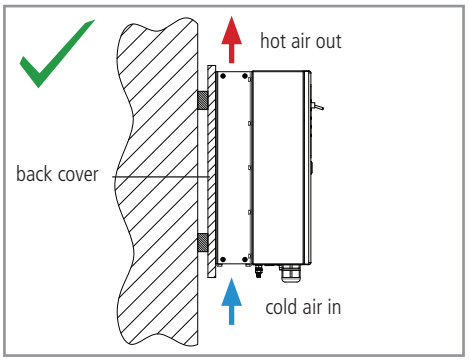
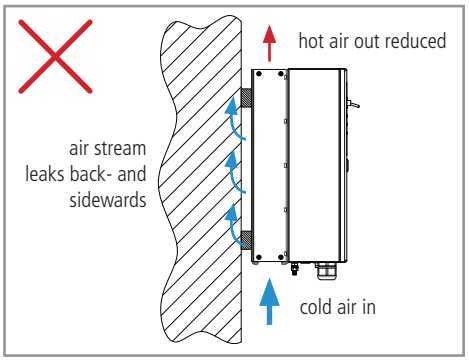


Figure 6: Wrong controller mounting: without back cover



8.4 Wiring

WARNING – The wiring has to be done by qualified service personnel only.

**WARNING –
BEWARE OF HIGH VOLTAGE!
ELECTRIC SHOCK HAZARD!**

Before starting to work on the electrical system make sure that all components are disconnected from the power source. Do not work on this equipment when power is connected or for five minutes after power disconnection. The controller needs time to discharge.

Only switch on the system when all work has been finished.

WARNING – All electrical connections should be performed by qualified experts only! Unqualified handling might lead to shock, burns, or death.

WARNING – The controller should only be connected to power after correct wiring or the controller might get damaged.

WARNING – Do not modify the connection while the system is connected to power to avoid electrocution.

WARNING – Do not install disconnect switches in the power wires between the motor and pump controller. Connecting the motor wires to a switched-on controller may cause irreparable damage. Such damage is excluded from the warranty.

WARNING – SOLAR-DIRECT systems only – Do not connect any electrical load to the solar array if it is not part of the LORENTZ pump controllers. 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.

WARNING – TEST THE VOLTAGE before connecting power to the controller. Voltage (open circuit) must not exceed 850 V DC. (Even in cloudy weather, the open circuit voltage will be near maximum.)

8.4.1 Terminal type PS7k2 – PS25k2

The terminal system used in PSk2 controllers is provided by Weidmüller. These terminals use tension clamp technology which allows for faster termination of system wiring and provides higher reliability as under or over clamping problems associated with screw terminals are reduced. A stainless steel spring is used to securely connect the wire to the current bar.

The cable entries are on the top of the terminal (either vertical or at 45°). This has the advantage that it is easier to see where the wires are inserted and so reduces wiring errors.

Cf. below "Figure 7: Weidmüller single and double stage terminals", these are examples of the Weidmüller terminal system, a ZDU 16 single-stage and ZDK 2.5 double-stage.

Strip the insulation from the end of the cable to be terminated. For a 16 mm² cable strip 10 mm / 0.4" of insulation, for 2.5 mm² clamps strip 5 mm / 0.2" of insulation.

To install the wires push a flat screw driver downward into the terminal block. Push the stripped cable into the terminal. When the screwdriver is removed a high contact force is supplied by the stainless steel clamp. Gently pull the cable to check it is secured, cf. below "Figure 8: Weidmüller clamp cable fixing".

8.4.2 Terminal type PS40k2

In PS40k2 controllers, Weidmüller screw type terminals for cables up to 35 mm² are used to connect the PV power connection (POWER IN+, POWER IN-), the pump motor wiring (Pump L1, Pump L2, Pump L3) and the protective earth connections. The cable entries are at the side of the terminal.

To install the wires push the stripped cable into the terminal and use a screwdriver to tighten the screw.

All other terminals use tension clamp technology; please refer to "8.4.1 Terminal type PS7k2 – PS25k2" for wiring instructions.

Figure 7: Weidmüller single and double stage terminals

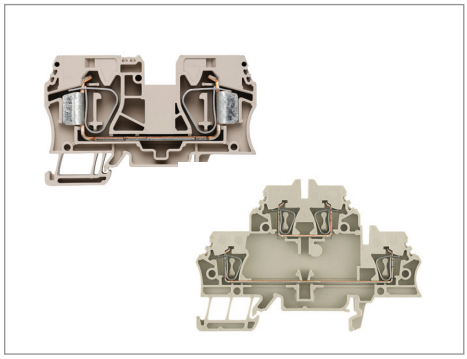
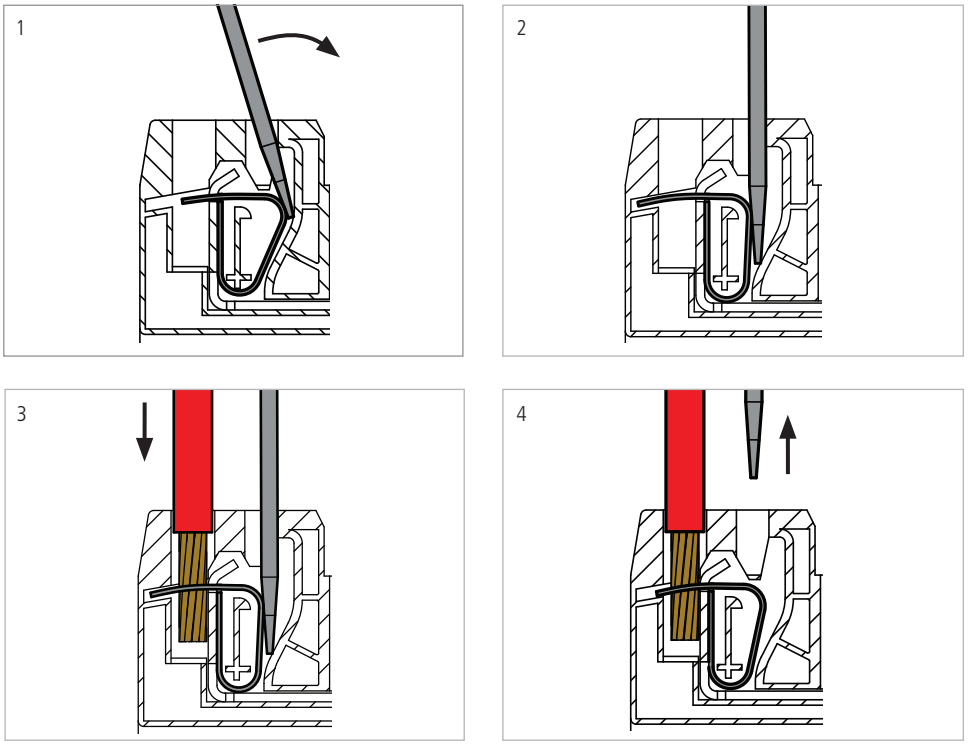


Figure 8: Weidmüller clamp cable fixing



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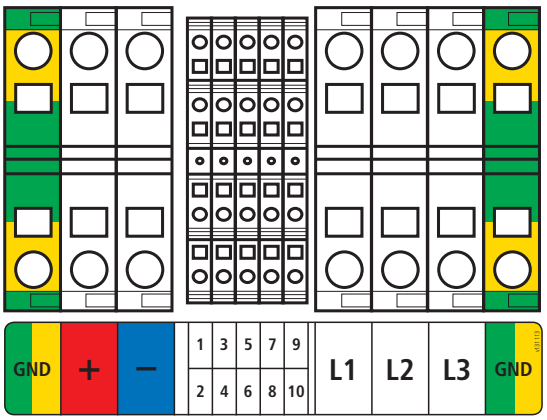
8.4.3 Terminal description

WARNING – Do not apply a short circuit or amp meter between + and – POWER IN when the controller is connected. A short circuit here will cause a strong electric discharge which could result in burns, injury or death.



Picture may differ to product

Figure 9: Terminal block, numbering

Table 5: Terminal explanation

Socket	Terminal	Connection	Function	Terminal clamping range
Ground	GND	connected to protective ground wire (PE)	grounding	14 AWG – 4 AWG 1.5–16 mm²
POWER IN	+	connect to positive terminal of PV module	the following conditions apply "Table 3: Technical data of PSk2 controller" on page 8	14 AWG – 4 AWG 1.5–16 mm²
	–	commect to negative terminal of PV module		
Water detection sensor	1	connection to NC	connect water detection sensor for surface pumps – for submersible pumps a jumper wire is needed between 1 + 2	26 AWG – 12 AWG 0.5–2.5 mm²
	2	connection to COM		
Pressure sensor	3	connect positive (+)	4 – 20 mA signal sensor supply voltage +24V load impedance 100 Ω	
	4	connect negative (–)		
Flow meter	5	connect to Signal	input impulse – reed switch; max. rating 1 kHz setting range: adjustable by PumpScanner application	
	6	connect to COM		
PSU control	7	connect positive (+)	Refer to the Smart PSU manual	
	8	connect negative (–)		
IN 24V	9	connect positive (+)	For service purpose – use only if instructed by the manufacturer	
	10	connect negative (–)		
AC output	L1	connect to the L1 phase of the motor	the following conditions apply "Table 3: Technical data of PSk2 controller" on page 8	14 AWG – 4 AWG 1.5–16 mm²
	L2	connect to the L2 phase of the motor		
	L3	connect to the L3 phase of the motor		
	GND	connect to protective motor ground wire (PE)		

8.4.4 Cable entries and external sockets

There are cable glands and plug sockets in the bottom of the controller. The sockets for the plug connections are pre-wired and pre-assembled in the controller housing. Three plugs are included in the delivery. The plugs are used to connect the pump accessories **low water sensor, remote float switch and solar panel for Sun Switch**. Accessories which use cable glands B1-B6 must be fixed tightly in the glands for strain relief and sealing.

Preparing plugs – Cut the wire of the plug in half and splice the cables of the corresponding pump accessory to it. Use a proper crimping tool and sleeves matching the cable size. If a plug socket isn't used set the mini plug into the socket of the controller housing without cutting the cable in half.

Exception for solar panel for SunSwitch – The plug of the solar panel for SunSwitch has a red (positive +) and a black (negative –) cable. Ensure you have the correct polarity. A voltage reversal will lead to damage of the controller. The Plug has a plastic pin that fits into a groove in the socket for the plug to ensure correct plug installation.

Spare mini plugs are available, please contact your supplier for further information. Check "Table 6: Mini plug sockets description" below for details of the plug connections.

CAUTION – Observe the polarity of the solar panel for Sun Switch before connecting it to its plug. Wrong polarity will lead to damage of the controller!

Figure 10: Bottom view of PSk2 controller: cable entries and external sockets

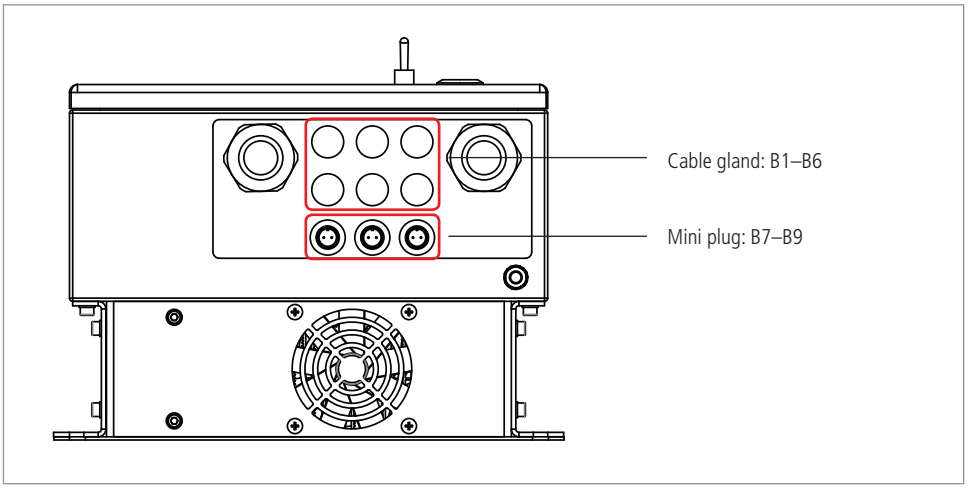
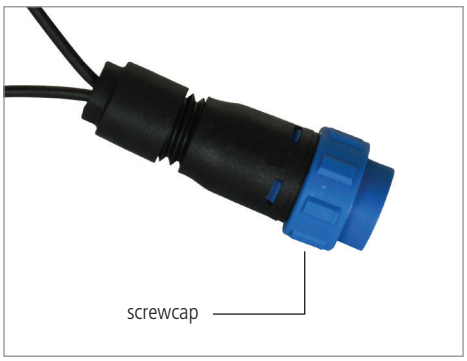


Table 6: Mini plug sockets description

Remote float switch	B7	connection to NC connection to COM	normally close (NC) is bypassed to COM
Low water sensor	B8	connection to NC connection to COM	normally close (NC) is bypassed to COM
Solar panel for Sun Switch	B9	connect positive (+) wire from Sun Switch panel to RED wire of the plug connect negative (–) wire from Sun Switch panel to BLACK wire of the plug	connected to solar panel for SunSwitch

Figure 11: Mini plug for pump accessories



8.4.5 Solar panel for Sun Switch

WARNING – To avoid multiple starts of the pump in twilight conditions, the SunSwitch must be installed and configured according to COMPASS data. Multiple starts due to an incorrectly configured SunSwitch can lead to increased wear and damage the pump. Such damage is excluded from the warranty.

The PSk2 controller is supplied with a special small 1.5 Wp PV module (pre-wired for crimping). This PV module is used to measure the solar irradiation and allows you to set irradiation dependent START / STOP values for the pump. These settings can only be done via LORENTZ Pump-Scanner. (Please check LORENTZ partnerNET and the "PS DataModule and PumpScanner" manual).

WARNING – Do NOT use any other PV module than the one supplied or the PSk2 controller may be damaged.

Mount the PV module with the same alignment as the solar array that powers the pump system. For example, if the solar array is tilted at an angle of 20°, the PV panel for the Sun Switch should be tiled exactly the same. You can ensure this by mounting the PV module on the frame of the PV module array.

The plug of the small solar panel for Sun Switch has a red (positive +) and a black (negative –) cable. Take care of correct polarity. The plug has a plastic pin that fits into a groove in the socket for the plug. This ensures correct plug installation.

WARNING – Voltage reversal of the Sun Switch panel will lead to damage of the controller.

If you need to switch external units ON/OFF, e.g. a genset, use external Sun Switch (see partnerNET under "Products" – "Manuals" – "Accessories").

8.5 Grounding

8.5.1 Why ground

Before starting to work on the electrical system make sure that all components are disconnected from the power source. Only switch on the system when you have finished all work.

Grounding is mandatory to protect the users from potentially fatal electric shocks. It also protects against electric charging or a short circuit inside the device. This is accomplished through clamping, bolting or other mechanical means to provide an effective grounding path to the earth to ensure safe operation at all time.

The grounding is also important to the system for lightning protection. In general it is meant for indirect lightning strikes and induced electrical potentials during operation of the pump system.

8.5.2 How to ground

A protective earth connection for the controller must be connected to the left GND terminal. The right GND terminal, next to the motor phases (L1, L2, L3), is for the protective earth wire of the motor.

8.5.3 Insufficient ground source

Where there is an inadequate ground source you can use a grounding rod. A grounding profile rod should be located about 4 – 5m (13 – 16 ft) from the controller. The cable must not carry any mechanical loads. The rod must be completely buried in the ground (0.5 m / 1.5 ft below ground level). You must refer to local standards and requirements. The grounding cable should be a copper cable with a cross section of not less than 16 mm² (AWG 6).

CAUTION – The wiring has to be done by qualified staff only. Make sure that the grounding cable has a reliable connection to the ground source.

CAUTION – The earth cable must be sufficient to carry the maximum supply fault current.

Figure 12: Protective earth connection

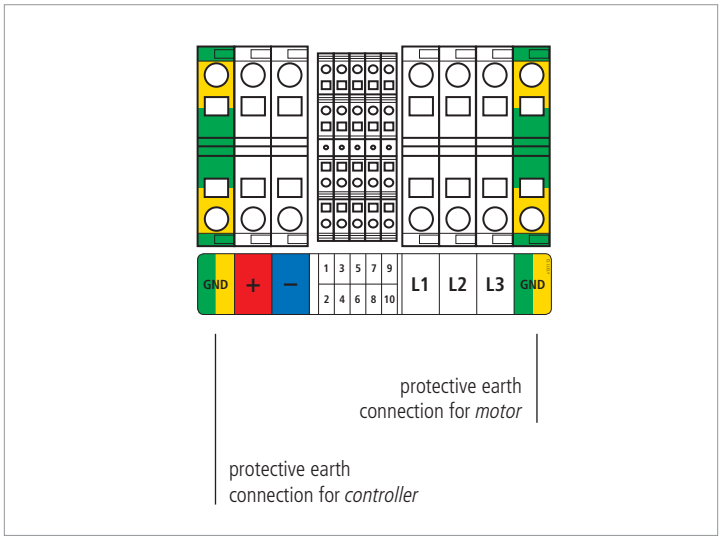


Figure 13: Controller grounding

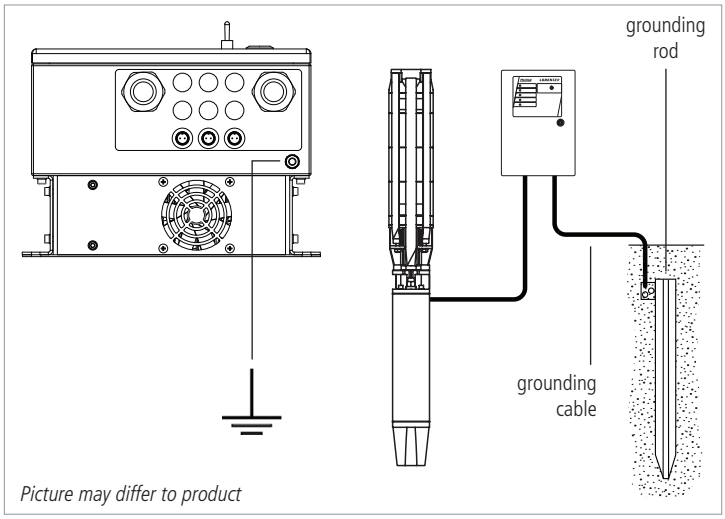


Figure 14: Grounding cable mounting at controller housing

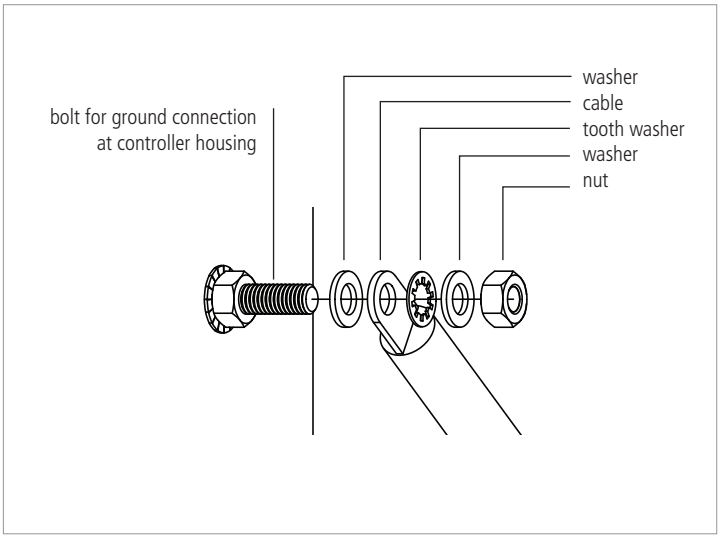
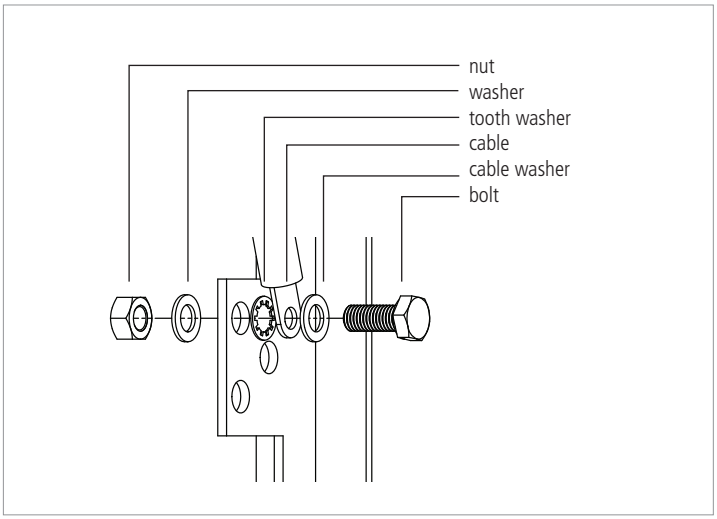


Figure 15: Grounding cable mounting at grounding profile rod



8.5.4 Operation with a Power Supply Unit (Smart-PSU)

WARNING – Where the PSk2 controller is used in combination with a Power Supply Unit (PSU), for example the LORENTZ SmartPSU, DO NOT implement positive or negative pole grounding. This would result in a connection betwenn the power line and earth causing a short circuit!

WARNING – Only connect the ground wire to the official grounding terminals that are described in this manual.

9 Pump Installation

The pump dimensions and part list are available in COMPASS.

9.1 Pipe sizing

LORENTZ pump systems are extremely efficient. It is important to keep this efficiency throughout the entire system. A main reason for loss of efficiency is pipe pressure loss caused by friction. Make sure that you have included the pipe pressure losses during the sizing process of your system.

CAUTION – Consult COMPASS or a pipe pressure sizing chart to determine the correct size. Oversize the pipe line to reduce the pressure drop.

HDPE-pipes – The use of correctly specified plastic pipes is possible.

If you are not sure about the strength of your pipes contact the pipe manufacturer.

CAUTION – When you use plastic pipes you must use a safety rope.

9.2 Motor water filling/refill

The submersible motor is factory-filled with water, but the motor filling must be checked before installation.

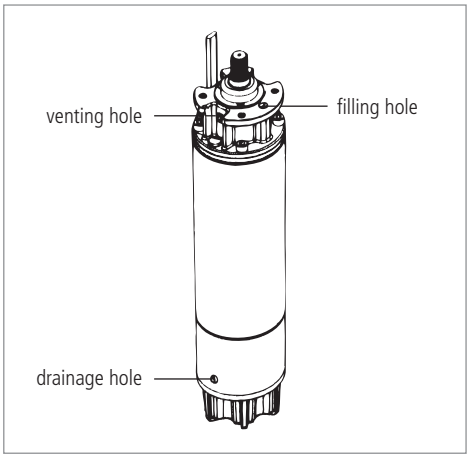
The motor must be filled in vertical position (coupling showing upwards, see figure below, "Figure 16: Filling, venting and drainage hole").

To fill the motor with water, remove the filling and venting screw. Fill clean drinking water in to the motor until the water flows out continuously without bubbles.

NOTE: Do not fill the motor using a high pressure source such as a tap or hose as this will cause unwanted bubble formation. This may cause unwanted bubble formation.

To refill the motor open the filling, venting and drainage screws to allow water to exit from the drainage hole. Refill the motor with clean drinking water as described above.

Figure 16: Filling, venting and drainage hole



9.3 Resistance measurement

We recommend checking the winding and insulation resistance before connecting the pump to the controller. For a submersible pump these measurements should be done BEFORE lowering the pump into the well.

WARNING – Before starting any work on the pump system, make sure that the electricity supply has been switched off and that it cannot be accidentally switched on!

To measure the winding and insulation resistance disconnect all motor leads from the controller. A good quality Multimeter is necessary to measure the phase-to-phase resistance with an accurancy to the first decimal place. ("0.1 Ohms"). It is also adviseable to consider the resistance of the multimeter leads when measuring very low values:

- Hold the tips of the multimeter together and note the value.
- Always substract this value from your motor resistance measurements!

Winding resistance

1. Set the multimeter to "resistance measurement" and select the lowest measuring range.
2. All PSk2 motors are 3-phase motors. Measure the resistance of phase-to-phase: L1-L2, L2-L3, L3-L1. Make sure there is good contact between the probes and the cable.
3. The deviation between the phases should be within 10 %. If the deviation is too high, the reason is likely a damaged submersible cable or a faulty cable splice.
4. The absolute value is made up of the resistance of the motor winding and the submersible cable. The resistance of the submersible cable depends on its length and size. For copper cable, the values of the table below, "Table 7: Motor cable resistance", can be used as a rough approximation.

Example:

- Motor:
  AC DRIVE SUB 6" 7.5 kW → 1.8 Ω
- Motor cable:
  150 m and 6 mm^2 → 0.25 Ω / 100 m

Calculation of expected phase-to-phase resistance:

= 1.8 Ω + 2 × 150 m × 0.25 Ω / 100 m
= 1.8 Ω + 2 × 0.375 Ω
= 1.8 Ω + 0.75 Ω
= 2.55 Ω
= ~ 2.6 Ω

The real measured values can be different, depending on the measurement equipment and materials that are used. This is just an approximation.

Insulation resistance

Use a Megohmmeter at 500 – 1,000 V.

Measure each phase to ground. Connect one test prod to the phase hold the other test prod to the pipe work, or if plastic pipes are used to the ground wire.

If the insulation resistance is below 0.5 MΩ ,the motor cable must be ckecked for damage.

Table 7: Motor cable resistance

Cable	Resistance
	[Ω / 100 m]
4 mm^2 / AWG 11	0.40
6 mm^2 / AWG 9	0.25
10 mm^2 / AWG 7	0.17
16 mm^2 / AWG 5	0.10

9.4 Assembly

WARNING – Before starting any work on the pump/motor, make sure that the electricity supply has been switched off and that it cannot be accidentally switched on!

CAUTION – Before starting the assembly, make sure that all parts are delivered and have not been damaged during transport.

9.4.1 Preparation of the installation

To lower the pumps into the borehole, a crane or hoist is required. You need also two clamps and ropes to lift the components.

All parts have to be strong enough to withstand the weight of the pump, the motor, the motor cable and the pipe system.

It is also helpful to lower a pump dummy into the borehole before you lower the pump to make sure that the hole is completely free and the pump can slide into the hole without collisions.

CAUTION – Pay attention to the label on the motor if the liquid in the motor need to be checked, filled up or if the motor needs to get completely refilled.

9.4.2 Installation

WARNING – Never stand under suspended loads.

CAUTION – Be careful not to bend the pump, take particular care with pumps with higher numbers of stages. Make sure that the pump never stands on the motor cable, that the cable does not get jammed or damaged by sharp ledges or that the cable is not pulled or jerked where it enters the motor.

To connect the pump end and the motor you have to set the motor with the clamps in the bore hole to fix it, cf. figure below, "Figure 17: Motor in borehole".

Make sure that the clamps rest on a sufficient stable support structure, for example the well casing. If the structure is not strong enough to carry the weight a support structure has to be built that is suitable for the installation process.

Screw the first piece of the pipe into the pump and install a second clamp at the pipe, cf. figure below "Figure 19: Installation depth of the first piece of pipe".

CAUTION – Make sure that the motor cable is outside the clamps, otherwise you will damage the cable.

Note: Do connect the clamp directly under the flange to leave some space for mounting the bolts.

If threaded joints are used instead of flanges they must fit together to ensure that they do not work loose when subjected to the torque reaction caused by the starting and stopping of the pump.

The thread on the first section of the riser pipe which is to be screwed into the pump should not be longer than the threads in the pipe, cf. figure below "Figure 19: Installation depth of the first piece of pipe".

Figure 17: Motor in borehole

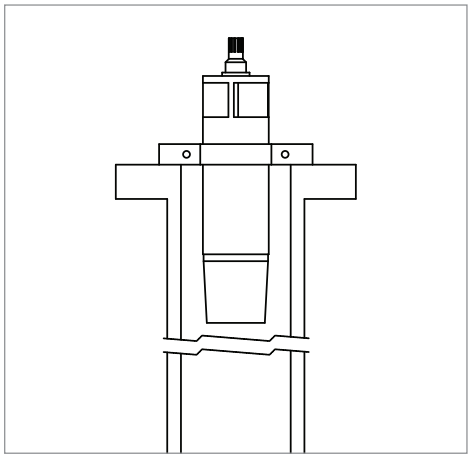


Figure 18: Preassembly of the pump

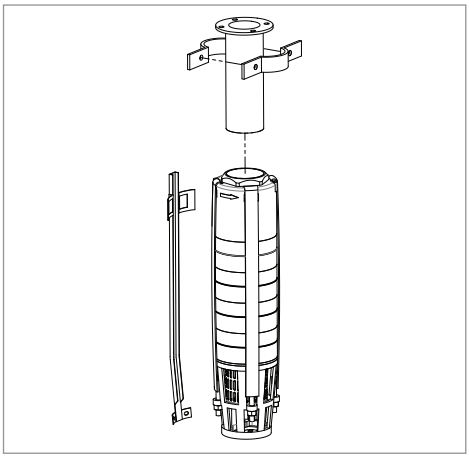
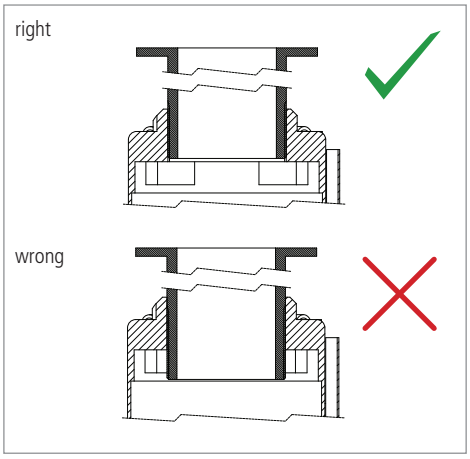


Figure 19: Installation depth of the first piece of pipe



CAUTION – When you fit the pipe into the pump hold the pump only at the top chamber!

Figure 20: How to hold the pump end

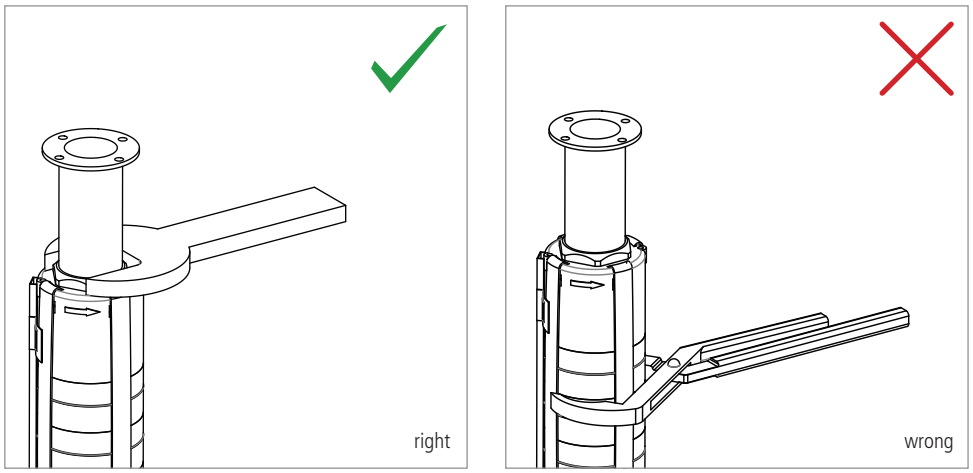
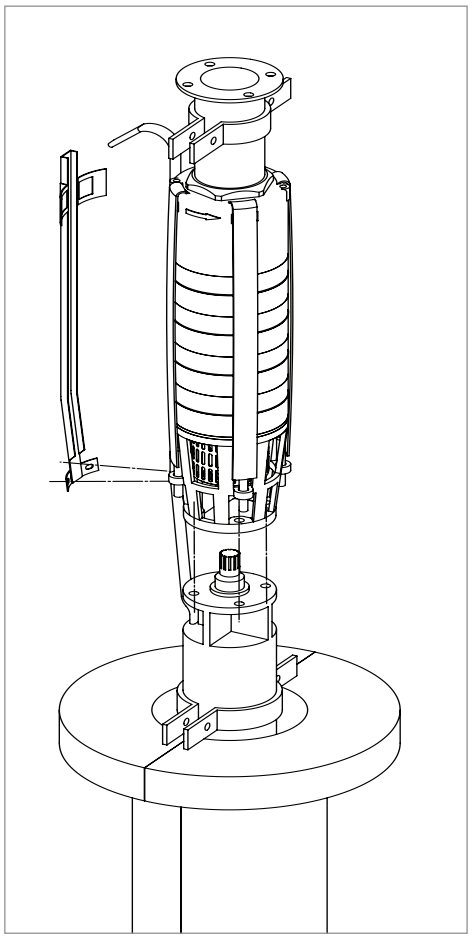


Figure 21: Connection pump end with motor



Lower the pump end carefully onto the motor and fix it with the supplied screws. It is very important to avoid heavy impact when the pump end is mounted onto the motor.

CAUTION – Impact between the pump end and motor can damage the pump system.

CAUTION – The NEMA coupling of the motor and the pump end must be CLEAN when the pump end is mounted onto the motor.

For correct connection pay attention to the following table with tightening torques. The screws must be tightened diagonally.

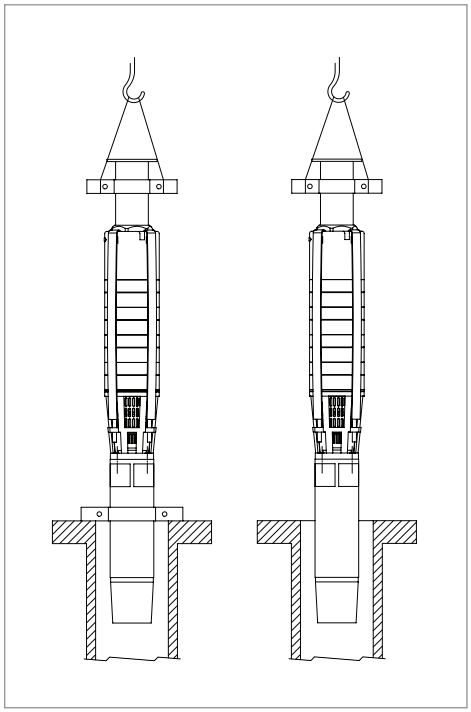
Table 8: Tightening torques for pump/motor connection

Pump / Motor	Torque [Nm]	Torque [lb × ft]
M8	18	13
M12	70	52
M16	150	110

When pump end and motor are assembled lift the pump unit a little and remove the lower clamp on the motor. Now lower the pump carefully downwards into the bore hole until the upper pipe clamp is resting properly on the support structure. Be careful not to allow the pump to hit the side of the well or this may cause damage.

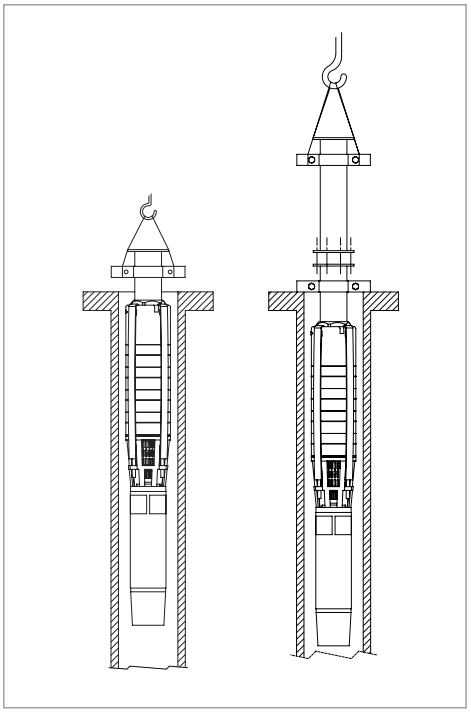
WARNING – Always take suitable security precautions (like a strong safety rope) to safeguard the pump against slipping into the well during installation!

Figure 22: Dismantling the lower clamp



Now the next piece of clamped pipe can be mounted onto the flange/connector of the previous one. Only use suitable bolts and sealing material.

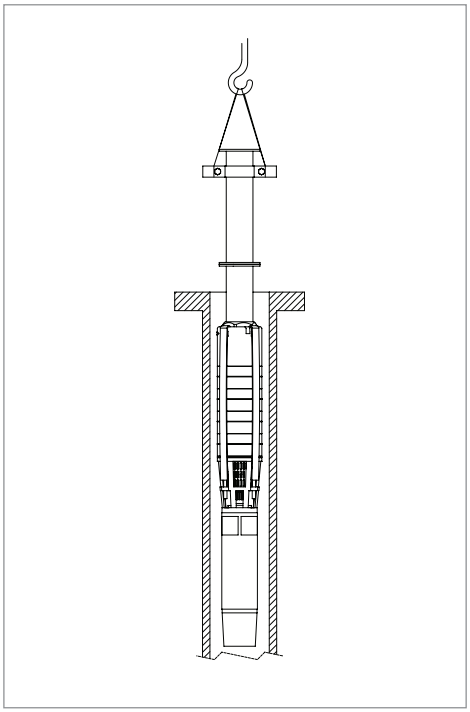
Figure 23: Connecting the next piece of pipe



After connecting the two pipes lift the whole pump system again to dismantle the lower clamp above the pump end. This procedure has to be followed for every piece to pipe until the pump has reached the desired installation depth.

WARNING – If the pump is not lifted before the clamp is being dismantled the pump will sag. This could cause serious injuries to the worker and damages to the pump system.

Figure 24: Dismantling the lower clamp



During the process of lowering the pump into the well the motor cable has to be fixed properly to the pipe, see "Figure 25: Fixing of the motor cable at a joint (top) and a strait pipe (right)" below. Where a plastic pipe is used, the longitudinal stretch of the pipe under load has to be considered by leaving a sufficient gap between the pipe and the cable! The cable sould be fixed with water-resistant tape. It is a good installation practice to form a loop with the motor cable near the pump and repeat it about every 40 m / 130 ft along the riser pipe. This will keep any tensile forces away from the motor cable.

To extend the motor cable pay attention to "9.4.5 Cable splicing" on page 24.

Round off the edges of a flange to prevent damage to the cable. Do not fix the cable tightly. Leave space for the pipes to expand. The cable needs to get fixed every 3 m.

NOTE: Measuring and noting down the distances between the fixing will help to lower the pump to the right depth.

Note: Pay attention to "9.5 Installation depth" on page 25

Figure 25: Fixing of the motor cable at a joint (top) and a strait pipe (right)

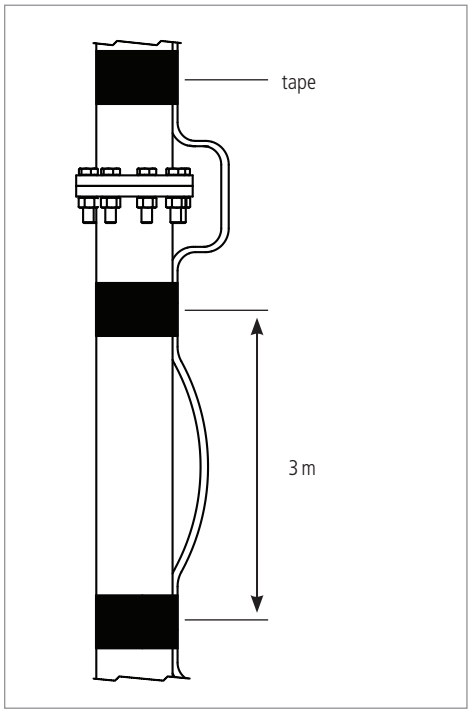
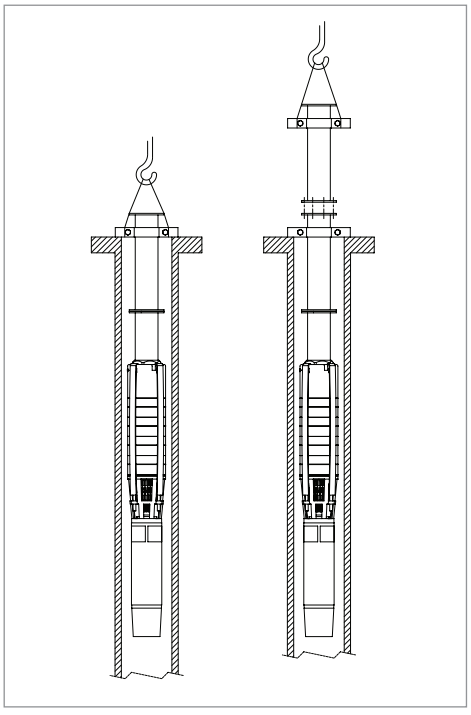


Figure 26: Connecting the next piece of pipe



9.4.3 Pipes with thread

If you use pipes with a thread instead of a flange the installation is basically the same.

The threads have to be sealed with hemp- or teflon tape. Make sure that the threads cannot work loose over time.

9.4.4 Removal

If you have to remove the pump system it is the same principle as the installation in the other direction. When removing the pump the pipes will be full of water and will be heavier.

Note: When you lift the pump system out of the well the pipes are full of water. This causes additional weight.

In the table below you can see the additional weight of the water per meter pipe length.

Table 9: Additional weight per meter pipe length

Pipe diameter	Additional weight	
[in]	[kg/m]	[lb/ft]
2	2.0	14.5
2.5	3.2	23.1
3	4.6	33.3
4	8.2	59.3
5	12.7	91.9
6	18.4	133.1

9.4.5 Cable splicing

To connect the motor cable with a cable extension you should connect the cable ends with a splicing kit.

It is very important that the cable joints are fully sealed otherwise moisture could cause a short circuit and this will damage the pump system.

For more information about connecting cable ends with a splicing kit see the "submersible cable splicing" manual in the package of the splicing kit.

9.5 Installation depth

WARNING – The pump must be submerged completely. Never let the pump run dry. Always use a dry-running protection to make sure that the pump cannot not run dry. LORENTZ prescribes a dry run protection for every submersible pump system.

Make sure that the pump unit is suspended properly and is not in contact with sand and mud from the well bottom.

It is recommended to install the pump above the filter zone (= water entry zone) of the well to keep the sand content in the water low and ensure proper cooling of the motor, cf. figure below "Figure 27: Installation depth".

CAUTION – If the pump does not hang above the filter zone a flow sleeve is necessary.

9.6 Additional features

9.6.1 Loss insurance

We recommend the use of a safety rope as a loss insurance. If the pipe breaks because of start-up torques of the motor, too much weight, pipe corrosion or wrong installation a safety rope can prevent the total loss of the pump system and damage to the well.

Choose a saftely rope that can handle the the weight of the whole installation and the water inside the pipes. The rope material must be water-resistant.

9.6.2 Plastic pipes

When the pipes are strong enough the use of plastic pipes is possible. If you are not sure about the strength of your pipes contact the pipe manufacturer.

CAUTION - You have to check if the pipes are strong enough to hold the whole weight of the pump, the motor, the pipe system and the water in the pipes.

CAUTION - When you use plastic pipes you should use a safety rope.

9.6.3 Flow sleeve

All LORENTZ PSk2 submersible pumps are designed for the use of water with a temperature between 0°C and 30°C.

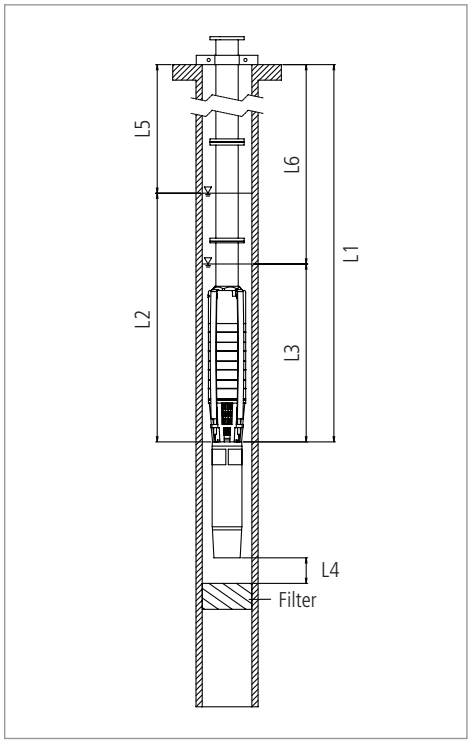
The minimum liquid velocity past the motor is 0.16 m/s.

CAUTION – Where the stated liquid velocity cannot be achieved, a flow sleeve must be installed.

The maximum recommended sand content, before any significant detrimental effects occur, can be found in chapter "5 Operating Conditions" on page 5.

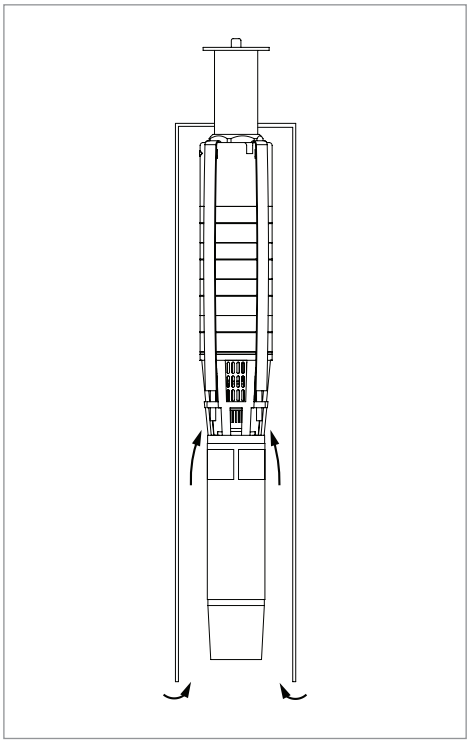
A higher content will cause excessive wear within the pump and reduce the pump's life span considerably. Any pump that is blocked by sand will not be covered by warranty.

Figure 27: Installation depth



L1: Installation depth
L2: Max immersion depth = 70m
L3: Min immersion depth = 1m
L4: Distance to filter
L5: Depth to highest water level
L6: Depth to lowest water level

Figure 28: Operation of a flow sleeve



9.7 Dry running protection

The well probe, cf. "Figure 29: Well probe", contains a mechanical float with a magnet inside. When the probe is submerged, the float rises, and the magnet actuates a switch. The switch closes (makes contact) to indicate the presence of water. If the water level drops below the probe, the float drops, and the switch opens (breaks contact): The controller will stop the pump. When the water level recovers and switch closes again, the controller will delay the restart for 15 minutes. This gives time for the water level to recover. To force a quick restart, turn the controller off, then on again. The switch is sealed, so the contacts never touch the water.

Fixing – The probe is packed with two cable ties. For a pump that is to be installed in a vertical position, clamp it to the pipe just above the pump outlet, as shown below "Figure 30: Well probe fixing". Splice the two probe wires using the splice kit components that are packed with the probe. The assembly procedure is the same as the main pump splice.

Wiring to the controller – The dry run protection must be connected to the controller via plug at slot B8, cf. "8.4.4 Cable entries and external sockets" on page 14.

Potential problems with the low-water probe in surface water – The probe has a moving float. It is highly resistant to deposits and debris. However, it may stick under some extreme conditions, especially from algae or water creatures (snails, etc.) that may be present in surface water.

Possible solutions are:

- Hang the probe independently of the pump and pipe (clamped to a weight, but not to the drop pipe). This way, it can be pulled up for inspection or cleaning without the need to pull up the pump. (This may not be feasible if the well casing is smaller than 6 in)
- Pull the probe out periodically (with the pump, if necessary) for testing and inspection. The pump should stop at the moment the probe leaves the water.
- Wrap the probe in a protective screen (fiberglass window screen, for example). Substitute a different type of float switch. You can use any switch that makes contact on rise (normally open).
- Use an encapsulated switch instead of the well probe if there is enough space for it to operate propery, for example the LORENTZ float switch.

CAUTION – Running completely dry will damage the pump and void the warranty. The purpose of the probe system is to sense the loss of water and turn the pump off before it can run dry.

CAUTION – The low-water probe must be positioned vertically, within 10°. If the pump is NOT to be installed vertically, find an alternative way to mount or suspend the probe, so that it is higher than the pump, and in a vertical position.

Figure 29: Well probe

9.7.1 Water detection sensor

CAUTION – For submersible pumps a jumper cable between the terminals 1 and 2 has to be installed.

The terminals 1 and 2 inside the PSk2 controller are for connecting the LORENTZ water detection sensor, cf. chapter "8.4.3 Terminal description" on page 13.

This sensor is ONLY installed with surface pumps . For operation with submersible pumps the terminals 1 and 2 need to be bypassed with a jumper cable. If the jumper is not in place the controller will show "Source Low" and the pump will not run.

Figure 30: Well probe fixing

9.8 Water meter installation

For information on the water meter installation, please refer to the manufactures manual. Pay attention to the installation position, flow direction and the calming section.

Basic rule: The water meter should have 10 nominal diameters of straight pipe ahead of the meter and 5 nominal straight pipe diameters after to ensure proper flow through the meter.

9.9 Automatic control for full-tank shutoff

We recommend the use of a float switch or other means to prevent overflow of your tank. This will stop the pump when the tank is full, then reset when the level drops. This conserves ground water, prevents overflow, and eliminates unnecessary pump wear. PSk controllers allow the use of small diameter signal cable to a remote float switch, even if the tank is a long distance away.

Float switch requirements:

(1) A switch must be used, not wet electrodes.
(2) The preferred system requires a float switch to OPEN contact on rise to turn the pump OFF. This is called "normally closed" (N.C.).

Float switch cable requirements:

(3) Two wires are needed.
(4) Minimum wire size 1 mm² [AWG 18]. This is good for a distance as far as 600 m [2,000'].
(5) The cable must be suitable for its environment.
(6) If it must run a long distance, use twisted-pair shielded cable to reduce the chance of damage from lightning-induced surges.

Grounding shielded float switch cable – If you use shielded cable, connect the shield to ground AT THE CONTROLLER ONLY. DO NOT ground the shield at the float switch. This will reduce surges induced by nearby lightning.

Operation of the float switch system – When the water level is high, the float switch will stop the pump. The TANK-FULL indicator on the controller will light up. When the water level drops, the float switch will signal the controller. The indicator light will go out, and the pump will restart if sufficient power is available.

Wiring to the controller – The float switch must be connected to the controller via plug at slot B7, cf. chapter "8.4.4 Cable entries and external sockets" on page 14.

Manual remote control switch – The float switch circuit can be used with a manual switch to turn the pump on and off from a distance. Use any simple on/off switch available from an electronic supply, electrical supply, or hardware store (it only carries low voltage, very low current).

Figure 31: Water meter installation

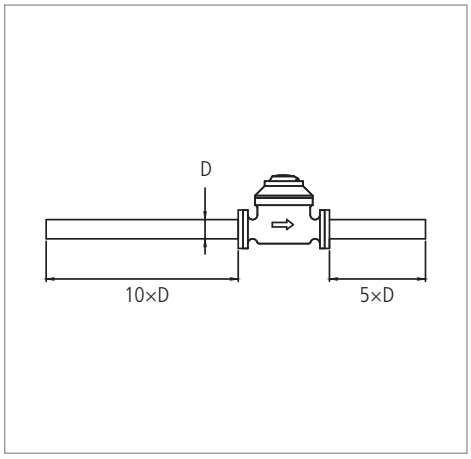
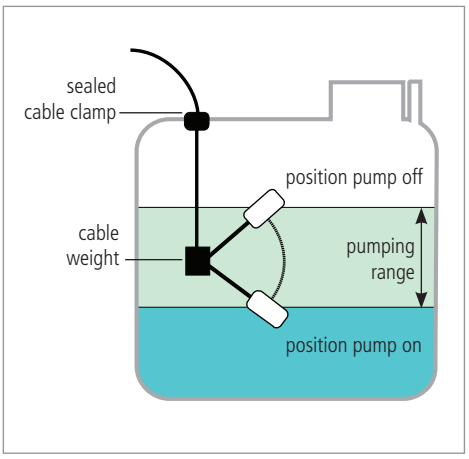


Figure 32: Float switch scheme



9.10 Checking correct rotational direction

The submersible pump must be submerged in water before checking the correct rotational direction. The correct rotation direction for submersible pumps is counter-clockwise, viewed from the top. It is also labeled with an arrow on the pump end.

Check the rotational direction as follows:

1. Connect the pump to the controller and power supply.
2. Start the pump and check the delivered flow rate.
3. Stop the pump, disconnect the power supply and change two of the three phase leads (e.g. red and yellow).
4. Start the pump again and check the delivered flow.
5. Stop the pump, disconnect the power supply and compare the flow rates from point 2 and 4. The wiring with the better flow rate has the right rotational direction.

10 Operation of the Controller

10.1 LED status

	System status of controller	green light	Power is present, controller is switched on
		no light	System turned off or powerless
	Running and shutdown indicator light for pump	green light	Pump is running Sequence of flashing indicates pump speed
		red light	Pump is off due to overload
	Low water source indicator (submersible pumps) Dry run protection (surface pumps)	red light	Water source is low (submersible pumps) Air in suction pipe (surface pumps)
		no light	Level of water source is normal
	Tank full, solar irradiation below threshold or timer pump stop	red light	Tank full, pump stopped
		flashing red light	Solar irradiation below trigger point Pump stop due to PumpScanner timer settings
	Communication link	blue light	Bluetooth™ connection established
		no light	No Bluetooth™ connection present

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:

	Hz
1 flash	> 25
2 flashes	> 30
3 flashes	> 35
4 flashes	> 40
5 flashes	> 45

If the **PUMP is OVERLOADED**, green changes into red.

- **SOURCE LOW (red)** – The water source has dropped below the level of the low-water probe or the water sensor has detected air in the suction pipe. After the water level recovers or the suction pipe has been re-filled with water, the pump will restart after a delay of 15 minutes.
- **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.)
- **TANK FULL (flashing red)** – The pump is turned off because the solar irradiation is below the trigger point setting or the pump has been stopped due to the timer setting that was set with the PumpSanner application. The pump will start working when the set conditions are met.
- **LOCAL COMMUNICATION (blue)** – The controller is connected to the PumpScanner application.

10.2 Parameter setting

Every PSk2 controller is equipped with a PS DataModule.

It is required to make an initial general configuration of the DataModule inside the PSk2 controller for every PSk2 installation.

You will need to register the pumpsystem and then update your "License List" in PumpScanner to connect to the Datamodule with your Android device.

The registering must be done online at "Sites" in LORENTZ PartnerNET..

CAUTION – Make always sure that the latest version of Pumpscanner is installed on your device. Make sure that the PSk2 DataModule is equipped with the latest Firmware version. It can be checked and updated using Pumpscanner as well.

For detailed instructions how to install and use Pumpscanner on an Android OS based device read the "PS Datamodule and PumpScanner" manual. It is available in LORENTZ partnerNET.

NOTE: The maximum operating frequency has to be set correctly in order not to overload the motor or the controller Please refer to your COMPASS sizing report to determine the maximum operating frequency This value can be found in the data table "system characteristic" under "Pump system" in row "Frequency" Please take the value from the right column named "Max /STC".

Check whether the latest version of PumpScanner is installed on your android device. Make sure you have registered the pump system at Sites in partnerNET and updated your "license List" in PumpScanner settings afterwards. Check the PumpScanner manual for help.

1. Make sure that the physical installation is completed and that all connections have been double checked for correct connection.
2. Connect the power to the PSk2 controller but the ON/OFF toggle switch of the PSk2 controller is in position OFF. The pump must not run at this point.
3. Connect to the pump controller using Pumpscanner as per the PumpScanner manual.
4. Check the PSk2 controller Firmware version as per the PumpScanner manual and update it if asked by Pumpscanner to do so.
5. Click on "Pump profile" in PumpScanner to access the parameter settings for the PSk2 controller. Do not forget to scroll to the bottom and **SAVE the changes** before leaving the "pump profile" menu.

Controller and pump unit – Use the pull down menu to select the correct controller and the correct pump unit, cf. "Figure 33: Sun Switch function in PumpScanner" below.

Cable length and cable size – Enter here the length and size of the installed motor cable to allow PumpScanner to calculate the correct cable losses for the pump system.

SunSwitch – The Sun Switch is used to stop the pump if the solar power is insufficient. In weak sun conditions the pump may spin without lifting water all the way to the outlet.

WARNING – If the pump spins without lifting water there is a chance of pump damage caused by the water overheating.

The limiting value for the Sun Switch must be set in the pump profile using the PumpScanner application.

The shutdown threshold must be set manually. Check at what irradiation the pump starts to deliver water. Set the value in PumpScanner under Pump profile (cf. "Figure 33: Sun Switch function in PumpScanner" on page 30), and round it up to the next tens. *Example: The actual irradiation, when the system starts to deliver water, is 247 W/m². Set the left array to 250 W/m².*

Restart – Once the pump got shuts down because of low irradiation it will turn on again when the irradiation is 10 % above the shutdown value.

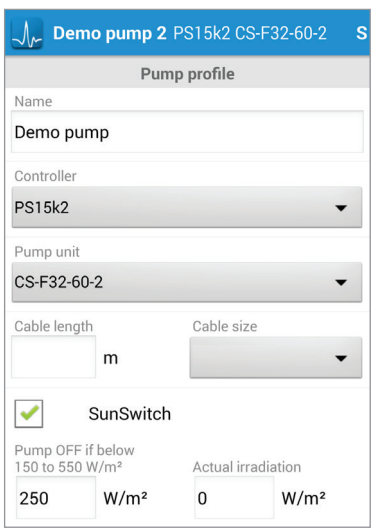
Flow meter and pressure Sensor – If any Water Meter or Pressure Sensor is connected to the PSk2 controller enter here the characteristics of the sensors as described.

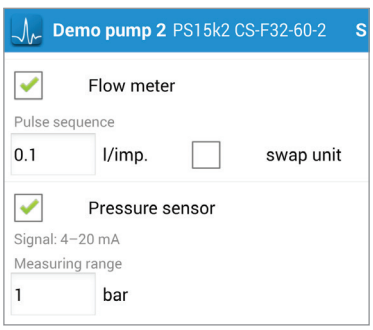
The remaining options are explained in the PumpScanner manual.

Always click the **SAVE Button** on the bottom of the pump profile menu to keep the changes.

The pump profile configuration is done and the pump can be switched ON.

Figure 33: Sun Switch function in PumpScanner





NOTE: These are only examples, please adjust the settings according to your installed system.

11 Trouble Shooting

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 secure 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 240 seconds.

When solar power is insufficient – When solar power on the array is present, but too weak for the pump to run, it will attempt to start about every 240 seconds. During each attempt, you will see the PUMP ON light come on.

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 the pump stopped due to insufficient sunshine – 240 seconds;
(2) After full-tank float switch resets – 2 to 3 seconds;
(3) After low-water probe regains contact with water in the source – 15 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;

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 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). 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.

Pump attempts to start every 240 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-PowerPack) system should start if there is enough sun to cast a slight shadow.
(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 vibrates, but does not turn, it may be getting power on only two of the three motor wires. This might 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.

12 Service and Maintenance of the Controller

Routine inspection and maintenance – To make the controller run stably, a periodic inspection must be performed every year.

Requirement of inspection and maintenance:

(1) The inspection must be performed by professional technical personnel.
(2) If necessary, cut off the power supply of the controller first.
(3) Avoid leaving any metal components in the controller, or else they might cause damage to the equipment.
(4) An electric insulation test has been made on the controller before it has left factory. A further test is not necessary.
(5) Do not use the megohmmeter to test the control circuit.
(6) When conducting any insulation test on the motor, you must dismantle the connection between motor and controller.

Main points for inspection and maintenance
– Please use the controller under the environmental conditions of this manual. Inspect and maintain as per the following table.

Table 10: Inspection overview

Inspect frequency regular	Inspection item	Inspection content	Judgment standard
✔	running environment	1. temperature, humidity 2. dust, gas	1. temperature <50°C 2. humidity <90%, no dew condensation, no peculiar smell, flammable, explosive gas
✔	cooling system	1. installation environtment 2. radiator	1. excellent ventilation in installation environment 2. radiator air duct not blocked
✔	controller body	1. vibration, temperature rise 2. noise 3. lead, terminal	1. stable vibration, normal temperature of the shell 2. no abnormal noise and peculiar smell 3. fastening screws not loose
✔	motor	1. vibration, temperature rise 2. noise	1. steady running and normal temperature 2. no abnormal and uneven noise
✔	input and output parameter	1. input voltage 2. output current	1. input voltage in the specified scope 2. output current under the rated value

13 Appendix

13.1 Calculating the discharge rate from the water-jet

The following table and calculation is used to determine the discharge rate of a pump system with a given pipe diameter by measuring the water-jet with a simple tool (angle bracket).

CAUTION – Keep in mind that this method is just an approximation and does not replace professional flow sensors.

13.1.1 How to measure the discharge rate

1. Start the pump system.
2. Wait until the pump gives continuous discharge.
3. Use an angle bracket, best with a scale on both legs.
4. Put the angle bracket straight onto the pipe like shown in "Figure 34: Reading off the discharge rate according to the pipe diameter" on page 33.
5. Read off the discharge rate according to the pipe diameter
6. Note the value "a". Make sure b, i.e. the other leg, is adjusted to 4" at the water-jet surface.

NOTE – The pipe´s wall thickness is ignored. The measure result depends on the measuring precision.

13.1.2 How to calculate the discharge rate

The following examples show how the discharge rate has been calculated for table X

Formulas needed:

$$Q = v \cdot A \qquad \text{B.1}$$

$$v = \frac{a}{\sqrt{2 \cdot \frac{b}{g}}} \qquad \text{B.2}$$

$$A = \frac{\pi d^2}{4} \qquad \text{B.3}$$

Constraints:

Q = Flow rate
v = velocity field
A = pipe cross-sectional vector area
a = value for discharge length of water-jet
b = value for drawdown of water-jet
g = earth's gravity, by definition, 9.81 m/s² / 32.17 ft/s²
d = pipe diameter

13.1.3 Calculation example 1

This example is done in the US system.

a: 15"
b: 5"
d: 2"

Calculation:

Using formula B.2:

$$v = \frac{a}{\sqrt{2 \cdot \frac{b}{g}}} = \frac{15\ in}{\sqrt{2 \cdot \frac{5\ in}{32.17\ \frac{ft}{s^2}}}} = 93.22 \frac{in}{s}$$

Using formula B.3:

$$A = \frac{\pi d^2}{4} = \frac{\pi (2in)^2}{4} = 3.14\ in^2$$

With conversion 1 in³/s ≈ 0.2598 GPM (US) as well as v and A inserted into formula B.1 follows:

$$Q = 93.2 \frac{in}{s} \cdot 3.142\ in^2 = 292.8\ \frac{in^3}{s}$$

$$= 292.8 \frac{in^3}{s} \cdot 0.2598 \frac{GPM}{\frac{in^3}{s}} = 76.05\ GPM$$

With the given values the approximated discharge rate of the pump system is about 76 *GPM*.

13.1.4 Calculation example 2

This example is done in the metric system.

a: 30 *cm* = 0.3 *m*
b: 15 *cm* = 0.15 *m*
d: 3" = 7.62 *cm* = 0.0762 *m* (1" = 2.54 *cm*)

Calculation:

Using formula B.2:

$$v = \frac{a}{\sqrt{2 \cdot \frac{b}{g}}} = \frac{0.3\ m}{\sqrt{2 \cdot \frac{0.15\ m}{9.81\ \frac{m}{s^2}}}} = 1.72 \frac{m}{s}$$

Using formula B.3:

$$A = \frac{\pi d^2}{4} = \frac{\pi (0.0762\ m)^2}{4} = 0.00456\ m^2$$

With v and A inserted into formula B.1 follows:

$$Q = 1.72 \frac{m}{s} \cdot 0.00456\ m^2 = 0.00782\ \frac{m^3}{s}$$

$$= 28.2 \frac{m^3}{h} \approx 28 \frac{m^3}{h}$$

With the given values the approximated discharge rate of the pump system is about 28 *m³/h*.

Figure 34: Reading off the discharge rate according to the pipe diameter

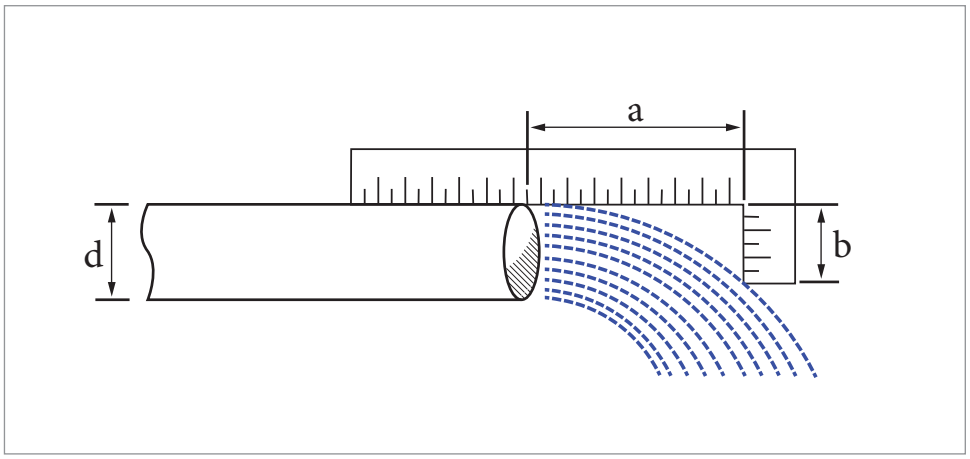


Table 11: Discharge rate for nominal pipe diameter

a		1"		1 1/4"		1 1/2"		2"		2 1/2"		3"		4"		5"		6"	
inch	cm	GPM	m³/h	GPM	m³/h	GPM	m³/h	GPM	m³/h	GPM	m³/h	GPM	m³/h	GPM	m³/h	GPM	m³/h	GPM	m³/h
4	10	6	1	10	2	13	3	22	5	31	7	49	11	84	19				
5	13	7	2	12	3	17	4	28	6	39	9	61	14	104	24	163	37		
6	15	8	2	15	3	20	5	33	7	47	11	73	17	125	28	195	44	285	65
7	18	10	2	17	4	23	5	39	9	55	12	85	19	146	33	228	52	334	76
8	20	11	3	20	5	27	6	44	10	63	14	98	22	166	38	260	59	380	86
9	23	13	3	22	5	32	7	50	11	70	16	110	25	187	42	293	67	430	98
10	25	14	3	25	6	33	8	56	13	78	18	122	28	208	47	326	74	476	108
11	28	16	4	27	6	37	8	61	14	86	20	134	30	229	52	360	82	525	119
12	30	17	4	29	7	40	9	66	15	94	21	146	33	250	57	390	89	570	129
13	33	19	4	32	7	43	10	72	16	102	23	158	36	270	61	425	96	620	141
14	36	20	5	34	8	47	11	77	17	109	25	170	39	292	66	456	104	670	152
15	38	21	5	36	8	50	11	83	19	117	27	183	42	312	71	490	111	710	161
16	41	23	5	39	9	53	12	88	20	125	28	196	44	334	76	520	118	760	173
17	43			42	10	57	13	93	21	133	30	207	47	355	81	550	125	810	184
18	46					60	14	99	22	144	33	220	50	375	85	590	134	860	195
19	48							110	25	148	34	232	53	395	90	620	141	910	207
20	51									156	35	244	55	415	94	650	148	950	216
21	53											256	58	435	99	685	155	1,000	227
22	56													460	104	720	163	1,050	238
23	58															750	170	1,100	250
24	61																	1,140	259

13.2 System Report

Purchase

Date of Purchase: DD . MM . YYYY

Dealer (full contact details):

Installation

Date of installation: DD . MM . YYYY

Installer (full contact details):

System

Pump system: PS [ ] k2 C-SJ [ ] - [ ] - [ ]

Controller serial number:

Motor serial number:

Pump end serial number:

Remote switch installed? ☐ yes

Low water sensor? ☐ yes

SunSwitch installed? ☐ yes

Pressure sensor installed? ☐ yes

Other accessories:

PV generator

PV module brand:

PV module model:

Number of panels: [ ] series

[ ] parallel

Total wattage of PV generator: [ ] W

Total Vmp: [ ] V DC

Total Voc: [ ] V DC

Well situation

Well depth: [ ] ☐ m ☐ ft

Pump installation depth: [ ] ☐ m ☐ ft

Total dynamic head TDH (static head + pressure losses): [ ] ☐ m ☐ ft

Drawdown level: [ ] ☐ m ☐ ft

Riser/outlet pipe

Size: [ ] ☐ mm ☐ inch

Type:

Length: [ ] ☐ m ☐ ft

Additional pipe (to tank)

Size: [ ] ☐ mm ☐ inch

Type:

Length: [ ] ☐ m ☐ ft

Pump cable

Wire size: [ ] ☐ mm² ☐ AWG

Length (controller to pump): [ ] ☐ m ☐ ft

Max. RPM control

Factory setting is max. ☐ yes

If setting was reduced, enter setting here: [ ] Hz

Please note: It is good practice to make detailed photographic record of every installation for proper documentation.