FLOCEA

DIRECT-CURRENT SOLAR PUMPS

USER MANUAL

Solar controller low voltage

For DC solar pumps from 24 V to 110 V

Installation • Connection • Operation • Troubleshooting

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Use with DC pumps from 24 V to 110 V

Choosing the solar panels

01 Basics of solar panel connection

Solar panels fall into three families: monocrystalline silicon cells, polycrystalline silicon cells and thin-film cells. Monocrystalline offers the best efficiency but is also the most expensive; thin film is the cheapest. As a rule of thumb, a solar panel produces about 150 W per square metre.

The open-circuit voltage (Voc) stated on the panel is the maximum electromotive force before a load is applied. This voltage drops in operation: it is then called the operating voltage (Vmp). Common open-circuit voltages are 21 V, 36 V, 44 V, etc. They vary with panel area and temperature: the lower the temperature, the higher the voltage. The other key value is power, which is proportional to the panel area. If the voltage is too low, several panels must be connected in series: the total voltage is then the sum of the voltages of each panel.

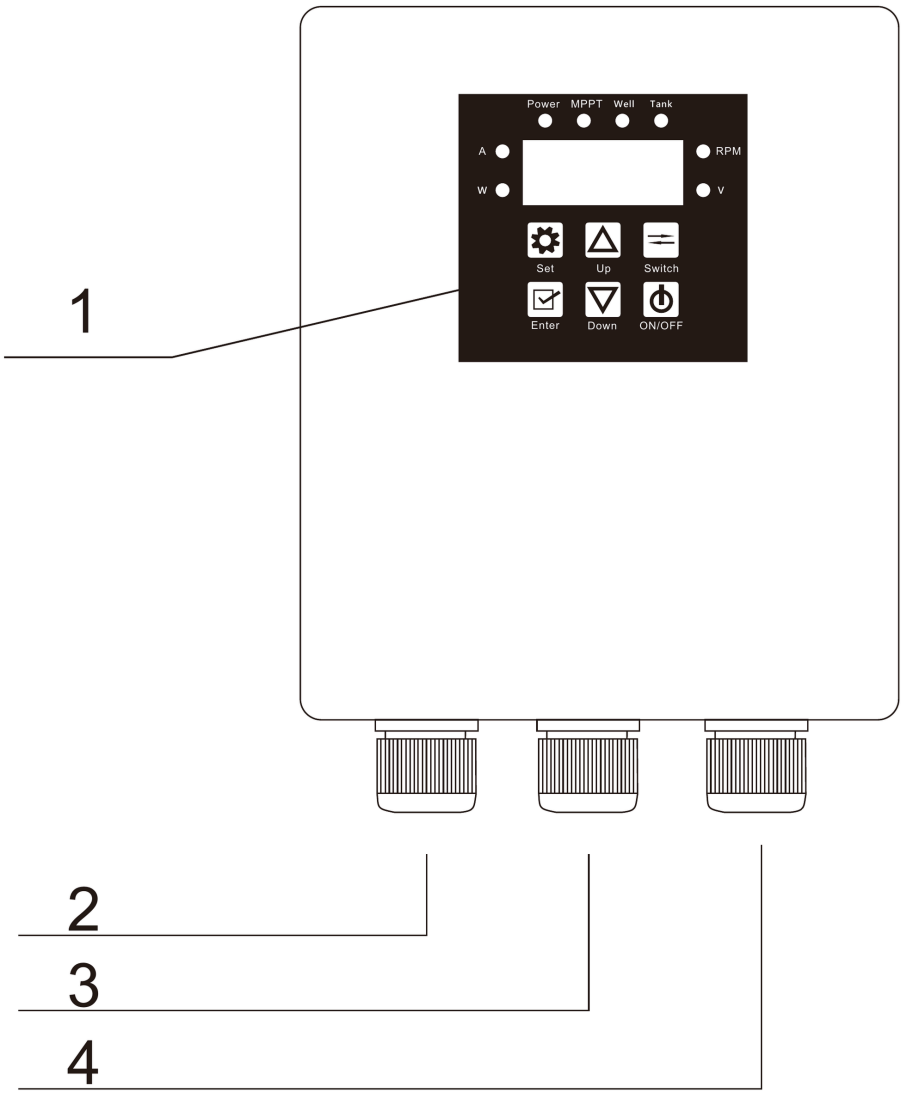
The operating voltage of the panels is chosen according to the operating voltage of the controller; the open-circuit voltage of the solar array must then be checked. Once the voltage is validated, choose the solar power according to the power of the pump.

POWER SIZING

The power of a solar pump is an absorbed power, and the real efficiency of the panels is generally below 70%. To guarantee 4 hours of rated operation per day, the panel power must be equal to **the absorbed power of the pump multiplied by 1.5** : this is the minimum power.

Below this value, the pump can still run normally but will not reach its rated flow or head. If conditions allow, it is better to install more panels: the pump will run longer at its rated flow and head.

Connection diagram



1	Control panel
2	DC power cable inlet
3	Water level sensor cable inlet
4	Pump power cable inlet

Recommended solar panels

For DC solar pumps from 24 V to 110 V — DC-type control box. Number of panels to provide according to panel power.

Pump model	Solar panel parameters				Control box parameters	
	375 W Vmp 34.20 V Voc 41.50 V	400 W Vmp 38.6 V Voc 46.4 V	450 W Vmp 41 V Voc 49 V	545 W Vmp 41.80 V Voc 49.75 V	Optimal operating voltage	Open-circuit voltage
120W-24V 180W-24V 210W-24V 210W-36V	1	1	1	1	30–48 V	< 60 V
280W-24V 300W-24V	1	1	1	1	30–48 V	< 60 V
400W-48V	2 in series	2 in series	2 in series	2 in series	60–90 V	< 110 V
500W-48V 550W-48V	2 in series	2 in series	2 in series	2 in series	60–90 V	< 110 V
600W-48V	2 in series	2 in series	2 in series	2 in series	60–90 V	< 110 V
600W-72V	3 in series	3 in series	3 in series	2 or 3 in series	90–120 V	< 170 V
750W-72V	3 in series	3 in series	3 in series	3 in series	90–120 V	< 170 V
900W-72V	3 in series	3 in series	3 in series	3 in series	90–120 V	< 170 V
1100W-110V	4 in series	4 in series	4 in series	3 in series	110–150 V	< 220 V
1200W-110V 1300W-110V	8 in total: 2 strings of 4 in series, connected in parallel	4 in series	4 in series	4 in series	110–150 V	< 220 V
1500W-110V	8 in total: 2 strings of 4 in series, connected in parallel	8 in total: 2 strings of 4 in series, connected in parallel	8 in total: 2 strings of 4 in series, connected in parallel	4 in series	110–150 V	< 220 V

Vmp: panel operating voltage • Voc: panel open-circuit voltage.

ADVICE

In series, voltages add up and the current stays the same; in parallel, the voltage stays the same and the currents add up.

Before switching on, always measure the open-circuit voltage of the panels with a meter, or calculate it using the rules for series and parallel connection. The open-circuit voltage of the solar array must be lower than the maximum input voltage of the controller, otherwise the controller will suffer irreversible damage.

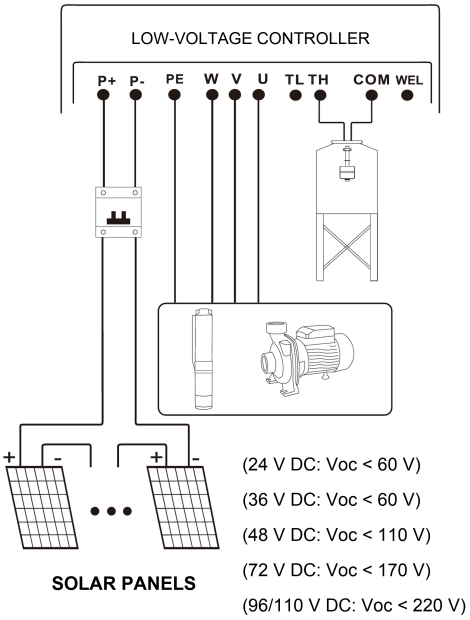
System wiring

Connect the pump and the panels to the control box as shown in the diagram below. Connect the pump to the controller, making sure the wires do not touch each other. During the system test, if the wiring is reversed the pump will run backwards: simply swap two wires to restore the correct direction of rotation.

When connecting to a battery, observe the polarity: plus to plus, minus to minus. Charge controllers usually have the following connections, marked in words or with symbols: Battery, Panel and Load. The PV solar input of the pump controller is connected to the “Load” terminals of the charge controller. For safety, we recommend a charge controller able to supply at least 1.5 times the power required by the pump (selection method described above).

CAUTION

If you connect a battery, never reverse or short-circuit the terminals. Remove any metal bracelet or watch before starting. Photovoltaic panels connected together can also produce a lot of energy: be just as careful. Covering the panels with a dark cloth is a good precaution to reduce their output.



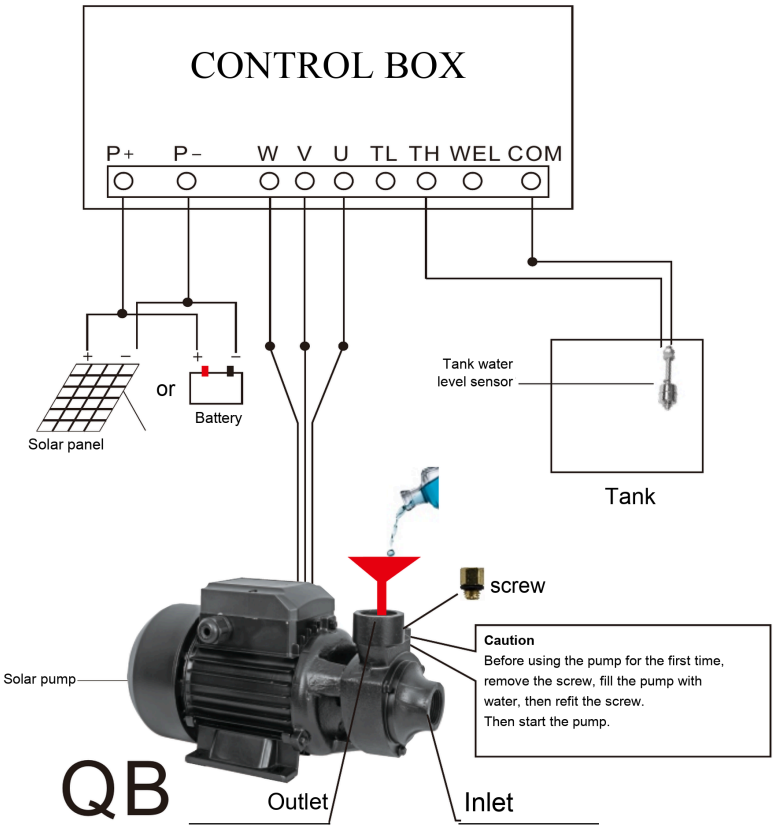
INTERNAL WIRING DIAGRAM

IMPORTANT

- **Tip 1:** do not reverse the positive and negative of the power supply, otherwise the system will not work.
- **Tip 2:** before starting the wiring, the control box switch must be in the **OFF position**.

Wiring with a surface pump

The wiring instructions on the previous page also apply to this set-up (supply from a solar panel or from a battery).



INTERNAL WIRING DIAGRAM

IMPORTANT

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Environment and electrical specifications

Controller / pump matching

Controller model	Compatible pump	Max. input current (A)	Max. open-circuit voltage (V)	MPPT voltage range (V)	Operating temp. (°C)
HD-24	Rated 24 V pump	18	< 60	30–48	–15 to 60
HD-36	Rated 36 V pump	18	< 60	30–48	–15 to 60
HD-48	Rated 48 V pump	18	< 110	60–90	–15 to 60
HD-72	Rated 72 V pump	18	< 170	90–120	–15 to 60
HD-110	Rated 110 V pump	18	< 220	110–150	–15 to 60

The controller will be destroyed if the open-circuit voltage exceeds the specified value.

WARNING

The controller must only be used with the recommended solar pumps. Do not use it with other pumps: we accept no liability for any problem resulting from such use.

For optimal performance and a long service life, protect the controller from impacts, vibration, sunlight, salt mist, oil mist, etc. Because of line losses, use a cable as short as possible. With a longer cable, the cross-section of the cable between the controller and the solar panels must be greater than 4 mm² (do not use single-core solid cable). Between the controller and the pump, the cross-section must be at least 2 mm² up to 30 m, and at least 4 mm² beyond 30 m.

Cables — length according to cross-section

Power (W)	2 mm²	2.5 mm²	4 mm²
300W-24V, 210W-36V, 120W-24V	30	50	100
400W-48V, 600W-48V, 750W-48V	30	50	100
750W-72V	70	100	150
1100W-72V	—	100	150
750W-96V, 1100W-110V	—	150	200
1300W-110V, 1500W-110V	—	150	200
750W-96V, 1100W-150V, 1500W-180V, 2200W-280V, 3000W-300V	—	150	200

Values in metres of cable.

Control panel

01 Indicator lights

Indicator	Meaning
V — voltage	Voltage display indicator.
RPM — speed	Speed display indicator (rpm).
A — current	Current display indicator.
W — power	Power display indicator.
Tank — tank full	On when the tank is full.
Well — well dry	On when there is no more water in the well.
MPPT	Flashes during operation on solar power.
Power — run	Flashes when stopped; steady on during operation.

02 Key functions

Key	Function
Set	Setting of manufacturer parameters, not accessible to the user.
Enter	Setting of manufacturer parameters, not accessible to the user.
Up	Speed adjustment key: each press increases the speed by one step. In the event of a fault: hides / shows the fault code.
Down	Speed adjustment key: each press decreases the speed by one step.
Switch	During operation, scrolls the display: voltage (V) → speed (RPM) → current (A) → power (W).
ON/OFF	During operation: stops the pump. When stopped: starts the pump.

Test run

Before testing the pump, the control box switch must be in the off position. The pump must be permanently submerged and must have been conditioned beforehand (left in the water) for at least 15 minutes. The water lubricates the pump: if it has not been properly conditioned, the bearings will not be sufficiently lubricated.

Never try to run the pump out of the water, even for a moment: this would cause irreversible damage. Use a large container so that the pump does not empty it within a few seconds.

1. Attach a strong rope or a stainless steel cable to the top of the pump, in the fixing hole. The rope or cable must be longer than the depth at which you want to install the pump. It is used to lower and raise the pump. **Never use the power cable for this.**
2. **Precautions**
   - Always keep the pump submerged during operation.
   - Take care when wiring.
   - Remove the pump if it is not used for a long time, then wipe the screw and the pump body with vegetable oil.
   - Make sure there is enough water around the pump while pumping. Do not run it without water.
   - Install the photovoltaic panels in full sun, facing due north (southern hemisphere) or due south (northern hemisphere). If the panel tilt is fixed, an angle equal to the latitude of the site is a good compromise.
   - Never run the pump out of the water, even briefly: this voids the warranty.
   - Do not use the pump in dirty water: premature wear is not covered by the warranty.
   - Do not dismantle the pump or the control box.

Operating modes

01 Starting the pump

1) Start at power-up

Each time the power is switched on, the system starts by default and the pump runs immediately, without checking the tank level (unless a stop condition is present).

2) Start with the key

When stopped, press

to start the pump, without checking the tank level (unless a stop condition is present).

3) Start on low-water signal

If the system is powered but the pump is stopped, and the low-water contact closes, the pump starts immediately (signal terminal TL of the main board is connected to terminal COM).

02 Stopping the pump

1) Float switch mode

During operation, when the “tank full” contact closes, the pump stops immediately (signal terminal TH of the main board is connected to terminal COM and the Tank indicator lights up).

During operation, when the low-water contact closes, the pump stops immediately (signal terminal WEL of the main board is connected to terminal COM and the Tank indicator lights up).

2) Stop on dry running

If the pump runs for some time with a power below the set-point power for the current speed, and this lasts 20 s, the pump stops immediately and displays fault P48. The fault clears after 30 minutes.

3) Stop with the key

During operation, press

to stop the pump.

03 Pump operation

At each start, the controller spends 10 seconds identifying the power supply mode, DC (battery) or PV (solar), then switches to the corresponding mode. The set speed is not taken into account during this identification.

1) DC mode (battery)

In DC mode (battery), the pump speed can be adjusted from 1000 to 4000 rpm. The default speed is 4000 rpm. It is adjusted with the

and

keys: each press increases (or decreases) the speed by one step.

While the pump is running, the DC (battery) supply voltage gradually drops. To prevent excessive discharge, the pump stops when the voltage falls below the corresponding protection voltage.

Model	Protection voltage (V)
HD 24	20
HD 36	20
HD 48	40
HD 72	60
HD 110	80

2) PV mode (solar)

In PV mode, the speed is set as in DC mode and the maximum speed limit (4000 rpm) applies. The pump speed also depends on the available solar power, thanks to maximum power point tracking (MPPT): when sunlight increases, the power supplied by the panels increases and so does the pump speed, and vice versa.

In PV mode, the MPPT indicator flashes. Fast flashing means the operating point is close to the maximum power point. Slow flashing, or no flashing, means the controller is still searching for the maximum power point.

If the solar power is insufficient, the pump speed gradually decreases; when it drops to 600 rpm, the pump stops and fault P46 is displayed after 3 seconds.

When the solar power is too low for the system to start or run, the output voltage of the panels drops quickly.

When the voltage falls to the minimum system voltage for 10 s, fault “PL” is displayed. The controller tries to restart 5 times in a row; if fault “PL” persists, it remains in this state for 30 minutes, then tries to start again.

04 Reverse polarity protection

If the positive and negative of the power supply are reversed, the controller sounds a continuous alarm.

05 Dry-run protection

When the pump has emptied the well, the system automatically detects the lack of water and stops the pump according to the defined program. Dry-run protection is active in all modes: manual mode, float mode and solar mode. The pump goes on standby for 30 minutes, then restarts (if the start conditions are met). It checks again for water: if there is none, it stops automatically; if water is present, it keeps running. This cycle repeats.

Care and maintenance

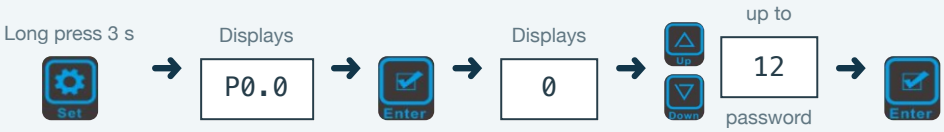
1. After 3000 hours of operation, replace the wear parts (bearings, seal rings, mechanical seal); otherwise, much more serious damage may occur.
2. If the pump is not used for a long period, clean it and store it in a dry, ventilated place, in good storage conditions.

Fault codes and troubleshooting

Code	Fault	Causes and solutions	Reset
P0	**Hardware overcurrent**	• Incompatible motor model: use a compatible pump. • Short circuit between phases U, V, W: redo the wiring to ensure U, V, W are connected correctly.	Automatic reset after 30 s
P43	**Phase protection**	• Phase U, V or W open: redo the wiring to ensure reliable contact.	Automatic reset after 30 s
P46	**Locked-rotor protection**	• Incompatible motor model: use a compatible pump. • Pump cable extension too long: shorten it. • Power too low: increase the supply power. • Pump bearing seized: clean the bearings.	Automatic reset after 30 s
P49	**Software overcurrent**	• Pump bearing seized: clean the bearings. • Short circuit between phases U, V, W: redo the wiring to ensure U, V, W are connected correctly.	Automatic reset after 30 s
P50	**Undervoltage protection**	• Input voltage too low: size the power supply according to the electrical specifications.	Immediate reset as soon as the voltage returns to normal
P51	**Overvoltage protection**	• Input voltage too high: size the power supply according to the electrical specifications.	Immediate reset as soon as the voltage returns to normal
P48	**Dry-run protection**	• Air has not been completely expelled from the pump: switch off, switch on again and restart the pump after 30 seconds to purge it. • No more water in the reservoir: wait for the water to return, the pump will restart.	Automatic reset after 30 minutes or by switching off and on again
P60	**Overheating protection**	• The temperature of the controller's microcontroller (MCU) exceeds 90 °C.	Automatic reset when the temperature returns to normal
E8	**Current measurement fault**	• Switch off and restart after 30 seconds.	Switch off and on again
PL	**Insufficient power**	• No sun: wait for the sun to return for the restart. • Unsuitable solar panels: refer to the recommendations for correct matching.	First 5 times, reset after 30 s; then after 30 minutes

Controller system settings

ACCESSING THE SETTINGS MENU



Press and hold Set for 3 s to enter the settings menu; press and hold Set again for 3 s to save and exit.

Code	Parameter	Initial value	Setting range
P0.0	Password	0	12: authorises changes • 21: restores factory settings
P0.1	Pump type	1	1: OPEN (enabled) • 0: CLOSE (no dry-run protection)
P0.2	Power supply mode	0	0: automatic detection • 1: DC mode • 2: solar mode
P0.3	Voltage protection reset value		24 V = 2 · 48 V = 4 · 72 V = 6 · 96/110 V = 8
P0.4	Undervoltage protection threshold		24 V = 20 · 48 V = 40 · 72 V = 60 · 96/110 V = 80
P0.5	Dry-run power threshold 1 corresponding speed 2000 rpm		24 V = 35 · 48 V = 70 · 72 V = 80 · 96/110 V = 80
P0.6	Dry-run power threshold 2 corresponding speed 3000 rpm		24 V = 60 · 48 V = 120 · 72 V = 155 · 96/110 V = 180
P0.7	Dry-run power threshold 3 corresponding speed 4000 rpm		24 V = 95 · 48 V = 200 · 72 V = 280 · 96/110 V = 360
P0.8	Dry-run power threshold 4 corresponding speed 5000 rpm		24 V = 140 · 48 V = 300 · 72 V = 400 · 96/110 V = 500
P0.9	Default operating speed	4000	1000 to 5000
P1.0	Run/stop state memory	1	0: stopped by default • 1: started by default • 2: resumes the last command
P1.1	DC power limit		24 V : 500 W · 48 V : 1000 W · 72 V : 1200 W · 110 V : 1550 W
P1.2	Motor direction of rotation	0	0: normal direction • 1: reverse direction
P1.3	Motor model	Depends on the pump model	24 V: 2C24 and 3C24 • 48 V: 2C48 and 4C48 Function reserved for 24 V / 48 V control boxes