English

Installation, Operation and Maintenance Manual

Heliomotion Solar Power Plant

HelioZenit

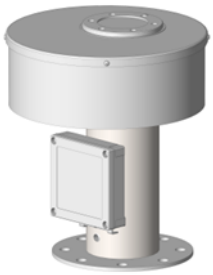
Revision 2, 2019

ABOUT THIS MANUAL

Congratulations on buying a Heliomotion product and on helping the environment by deciding to use renewable energy. This manual describes the installation, operation and maintenance of the Heliomotion Solar Power Plants and the Heliomotion Tracker. Please read this manual carefully before installation, then store in a safe place for future reference.

ABOUT THIS PRODUCT

The core of the Heliomotion power plant is the dual-axis tracker. The tracker is designed to be mounted with either photovoltaic or thermal solar collectors and can carry a panel area of up to 10 m².



Tracker

There are four standard applications for the tracker: PV-2M, PV-3M, PV-4M and PV-6M. These models use photovoltaic solar panels for power generation.

PV-2M **PV-3M** **PV-4M** **PV-6M**

INSTALLATION

The Heliomotion products are engineered to be easy to assemble and install. As such, the installation may be done by the customer or a handy layman, who has studied this manual, the quick assembly guide, and any other manuals provided for your specific solar system configuration. If you do not feel confident about doing the installation yourself, or if this is not legal in your country, we advise you contact a qualified renewable energy professional to perform the installation.

IMPORTANT: The electrical part of the installation must be carried out by a certified electrician. This requirement applies to the high voltage part of the system, including the solar panels and inverter along with their connections. It does not apply to turning on the tracker's power source, as this part of the system uses a low voltage.

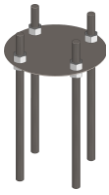
For step by step instructions on how to perform the installation please refer to the quick assembly guide for your Heliomotion product. What follows here is complementary information to that document.

Site selection

The solar power plant is typically installed free standing on the ground. The key to site selection is to choose a sunny location that has a clear view of the sun's path from sunrise to sunset, or as much of the path as possible, to provide the maximal amount of energy. In this way you will gain the most from your installation. The tracker rotates, therefore it should be situated away from obstructions and vegetation that may come in contact with it during this movement. The minimum clearance from the foundation column is 1 meter for a PV-2M, 1.5 meter for a PV-4M and 2 meter for a PV-6M.

Cement foundation

The foundation needs to take into account the soil and wind conditions, tower height, panel area and local building codes at your tower site. If you are unsure about these factors we recommend you employ a qualified professional to design the foundation for your solar installation. Provided your location has undisturbed soil (not sand), and the height of the extension column does not exceed the standard length for a free standing installation, here are our recommendations:



To withstand wind speeds of up to 30 m/s a free standing PV-2M installation should consist of at least 200 liters of concrete, filled in a square hole that is 0.6x0.6m wide and 0.7m deep. For a PV-4M the hole should be 0.7x0.7m wide and 0.8 meter deep to give room for 400 liters of concrete. The foundation for the PV-6M should be 0.8x0.8m wide and 1m deep and filled with 600 liters of concrete. If the soil is disturbed, or contains a high amount of sand, it is recommended to use 50% more concrete to compensate for uncertain soil conditions. Bear in mind that a smaller installation can easily be upgraded to a larger installation at a later time if the foundation is made large enough to support it.

If the casting is done in the bedrock four holes need to be drilled for the reinforcement bars (see picture above). The holes should be ⌀20 mm wide and 300 mm deep. Fill the holes half full with chemical anchor adhesive (~500ml) and then push the foundation piece into the holes.

It is preferable that the foundation is cast directly into the earth, without using forms, as this provides greater stability from the surrounding soil. Furthermore, it is recommended that the hole is dug by hand, using a shovel or auger, because undisturbed soil provides greater stability and is a much better conductor of electricity than backfilled soil. When casting cement the soil

must not be frozen and the air temperature should be above 4 °C for the first 7-day curing period. Be sure to wait at least 24 hours for the cement to cure before assembling the solar power plant.

Extension column
Typically, the tracker is installed on an included 1.5 meter extension column. It is recommended that the installation height does not exceed this length, in order to simplify assembly.

Wiring
An installation with a 1-phase grid-tied inverter mounted on the unit needs a cable with 3 cores. Other installations, such as battery systems and 3-phase grid-tied systems, require a cable with 5 cores. The cable needs to be shielded and suitable for underground use. Subject to local regulations, the cross sectional area of the wire is recommended to be 2.5 mm^2 for cable runs up to 40 meters. For distances up to 100 meters the wire area should be increased to 6 mm^2. Note that using a 5-core cable makes it easier to upgrade a 1-phase system into a 3-phase system in the future.

The cable size can be adjusted to keep transmission losses low between the power plant and the inverter/solar station. Correct sizing of wires is important for both safety and energy efficiency. Undersized wires cause high energy loss (voltage drop) to the system, and if substantially undersized may lead to electrical fire.

Transmission losses are proportional to the ampere (A) so to keep losses low the voltage (V) should be kept high. For a standard Heliomotion PV solar system, where all the panels are connected in series to increase the voltage, the current will be limited to 7.5 A with full sunshine. If the cross sectional area per copper wire is 2.5 mm^2, the losses in a 20 meter cable length will be about 2.7 volt (1.3% for a PV-6M). Doubling the cross-sectional area of the wire halves the losses, but increases the cost of the cable.

In a battery-tied PV system the voltage between the batteries and the inverter/charger is lower, so the distance between the units should be kept short and a thicker cable must to be used. We recommend at least 16mm^2 wires, which gives 0.9% (0.2 V) transmission losses with a load of 1000 watt (40 A) for a 24 volt battery system and a 2 meter cable.

Power options
The tracker can be powered from any constant 24 VDC power source – either from a 24 V battery bank or from the grid using a 24 VDC transformer. If the installation is for a 48-volt battery system the tracker can be powered from any 24 VDC point in the battery array, due to its low power consumption. The input voltage range is 24 VDC ± 20%.

Commissioning
Commissioning of a PV system, including connecting the electrical wires from the solar panels and switching on the DC breakers to the inverter or solar station, must be performed by a certified electrician.

OPERATION

The operation of your tracker is fully automatic and it will start tracking the sun as soon as you connect power to it. When powered on the tracker goes through the following steps:

1. The tracker waits until a GPS fix has been established to retrieve information needed to calculate the sun's current position: latitude, longitude, date and time. This information is recalibrated every morning.
2. The tracker rotates to face the sun's present position.
3. As the sun moves across the sky the tracker follows it, moving in intervals of 1.8 degrees every couple of minutes. After each movement the tracker positions itself 0.9 degrees ahead of the sun.
4. The tracker continues to follow the sun until sunset or until its evening position is reached, which is 90 degrees after the noon position.
5. After sunset the tracker returns to its noon position.
6. Before sunrise the tracker moves to sunrise position or to morning position, which is 90 degrees before the noon position.
7. The tracker awaits sunrise and then repeats the sequence from Step 4.

Safety and obstacle handling

It is important to keep the tracker's path clear of obstacles, such as vegetation and snow. If the tracker encounters an obstacle that prevents it from rotating the tracker will pause its normal operation for three hours before trying to rotate again. The motor power is set to only 5 Nm by default for safety reasons, allowing a person or obstacle to easily stop the rotation of the tracker without causing damage to the installation or injuries to any person. The default rotation speed is also set low (5 minutes for 180 degrees) for safety reasons. Parameters such as motor torque, motor speed and pause duration can be adjusted through the Heliocom tool.

Temperature alarm

The tracker has an optional temperature alarm for use with thermal collectors. The alarm is activated by connecting a PT-1000 temperature sensor to the connection circuit board of the tracker. By default, the alarm triggers at 95 ºC for thermal installations, causing the tracker to turn away from the sun (to morning or evening position). The tracker will remain turned away for at least 10 minutes and stay away until the collector has cooled off by 10 ºC. The trigger point for the alarm can be adjusted through the USB interface.

Internal clock

As a redundancy feature the tracker is equipped with an internal clock which has a backup battery (3V lithium cell). Should the GPS module or network fail the tracker can still keep operating for many years using this clock and the stored latitude/longitude settings. Note that the tracker operates on solar time, which is different from local time. The sun always reaches its highest elevation at 12:00 solar time.

MAINTENANCE

The Heliomotion Tracker has been designed to run for long periods without requiring any maintenance. There are no parts that require lubrication or scheduled maintenance procedures.

It is recommended that you visually inspect your system annually. This includes checking that all bolted joins are tight and making sure the panels are clean in order to maintain maximum power output.

Serviceable components
This product has been designed to allow worn out components to be replaced by the customer as needed. Through this process the lifetime of the system can be greatly extended. Contact us through www.heliomotion.com to order spare parts for self-replacement.

USB INTERFACE

For service purposes the tool Heliocom can be used to communicate with the tracker. The tool and its description can be downloaded from here:

- https://heliomotion.com/app/uploads/heliocom.zip
- https://heliomotion.com/app/uploads/heliocom-manual.pdf

A USB connector is found on the circuit board on the solar tracker. By connecting to this terminal with a laptop and a USB extension cable, Heliocom allows the following tasks to be performed:

1. Manual control of the tracker. Specifically, turning the tracker clockwise, counter-clockwise, stopping its movement, resuming its movement and resetting the unit.
2. Changing configurable settings, such as motor torque, rotation speed and movement interval.
3. Monitoring the tracker's operation.

LEDs
The circuit board has five LEDs that indicate the status of the tracker:

- (A) Green – Blinks to indicate that the tracker is powered and operational.
- (B) Yellow – Lit if the tracker has paused its operation due to being unable to rotate. Blinks to indicate movement so start or noon position.
- (C) Orange – Lit to indicate temperature alarm (for thermal installations). Blinks instead of green LED to indicate clock battery is depleted.
- (D) Blue – Lit during GPS synchronization, which occurs at startup and dawn.
- (E) Red – Lit to indicate satellites where not found during the latest GPS synchronization.

A second set of two LEDs appears near the bottom of the circuit board: red and orange. The orange led indicates that the motor is currently running. The red led is not used.

WORKING ENVIRONMENTS

The Heliomotion Tracker is designed to operate in most geographical areas and climate conditions. The standard (dual-axis) configuration can be deployed in locations situated between 20° and 90° on the northern or southern hemisphere.

Snowy regions
The foundation column length is chosen to prevent the tracker from getting stuck in the snow during winter. Should the snow depth surpass 0.5 meters the snow should be manually removed around the Heliomotion's path. Snow prevents light from getting through to the solar panels, but as soon as the sun hits the panels they are usually the first place to become snow free. Since the panels are at a steep angle in the tracker's morning and evening positions, most snow falls right off the unit and there is usually no need to remove the snow manually.

Dry regions
Solar arrays are typically self-cleaned by the rain and do not need additional cleaning. However, in dry climates it may be necessary to wash the panels every couple of months to prevent dust and sand from building up.

Windy regions
The tracker and solar panels are engineered to withstand high wind-loads and survive wind speeds up to 30 m/s. Should you expect wind speeds beyond 30 m/s, it is recommended that you use the provided extension rod to tilt the panels horizontally and turn off the tracker. This will protect the installation until the storm passes, as this is the position where the installation is best able to resist high wind loads.

TROUBLE SHOOTING

Tracker does not move and no motor sound is heard.	1. Check the light on the 24 VDC transformer to confirm power is supplied. If the light is blinking, or is dark despite being powered, then replace the defective transformer. 2. Check the status LEDs on the tracker's circuit board to ensure the board is working. If all LEDs are dark use a voltage meter to confirm that the circuit board is supplied with 24 VDC and that the polarity is correct. If 24 VDC is correctly supplied and no LEDs are lit then replace the circuit board. 3. Try restarting the tracker by toggling the power source off for 20 seconds. 4. Connect to the tracker with Heliocom to diagnose other potential issues.
Tracker does not move but motor sounds are heard.	1. Make sure nothing is blocking the path of the tracker or if so then remove the obstacle. 2. Restart the tracker and attempt to aid its movement by gently pushing it towards the sun. If this makes the tracker move the issue is friction related. 3. Inspect the tracker for possible sources of friction, such as excessive icing, snow loads or vegetation, and remove any such hindrances. 4. Use Heliocom to turn up the motor power until the tracker is able to overcome the friction. 5. If friction isn't the issue then pull down the tracker's drive cover and inspect the motor and external gearbox for damage. Replace any damaged gears or motor.
Tracker is significantly before or ahead of the sun.	1. Confirm that the tracker is properly aligned to true south (or north). 2. Connect to the tracker with HelioCom to make sure the displayed date and solar time is correct. The date and time settings are normally synchronized daily through the GPS network. 3. Use Heliocom to perform a manual GPS synchronization. If the synchronization fails then replace the GPS module.

TECHNICAL SPECIFICATIONS

Mechanical capabilities	
Number of turning axis	Dual-axis
Protection rating	IP65 (designed for outdoor installation)
Azimuth tracking	180°
Elevation angle	20-90°
Tracker specific properties	
Weight (ex. packaging)	24 kg
Dimensions	315x315x370 mm
Max panel area	10 m^2
Max panel weight	140 kg
Environmental data	
Ambient temperature	-25 °C to +55 °C
Height	0m to 2000m above mean sea level (AMSL)
Operating humidity	0% to 100% of relative humidity
Max safe wind speed	30 m/s
Electrical data	
Operational voltage	10-29 VDC
Motor current capacity	400-800 mA default, configurable up to 2000 mA
Power consumption	<0.3 watt while idle, 10-20 watt while moving
Energy consumption	<0.01 kWh/day
Backup battery	3V cell (CR2450FTH15-2)
Communication interface	USB
Positioning data	
Accuracy of tracking	±0.9°
Turning time interval	7 min (1.8°)

WARRANTY

Subject to the terms below, HelioZenit warrants its products against defects in material or workmanship under normal use consistent with product instructions for a period of three (3) years from original date of purchase. If warranted products contain defects covered under this warranty, HelioZenit's obligation shall be limited to, in HelioZenit's sole and absolute discretion, repairing or replacing the defective parts. Repaired or replaced parts are warranted for the remainder of the original warranty period. This limited warranty does not cover:

- Equipments, materials, or supplies not manufactured by HelioZenit.
- Products that has been modified or altered with non-original parts.
- Damage due to wind speeds over 30 m/s (67 MPH).
- Damage due to severe weather conditions, such as excessive wind, hail, ice, lightning strikes or other natural occurrences.
- Accidental or intentional damage.
- Damage due to improper installation.
- Misuse, abuse, or neglect.
- Products used for purposes other than their intended use.
- Trackers with more than the intended area of panels mounted on them.
- Damage due to improper packaging on return shipment.

Any and all labor charges for troubleshooting, removal or replacement of solar power plant or components of solar power plant are not covered by this warranty. Return shipping is to be pre-paid by the original purchaser.

For more information or technical support
www.heliomotion.com
info@heliomotion.com