English

Installation, Operation and Maintenance Manual

Heliomotion Solar Power Plant

HelioZenit

Revision 3, 2017

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

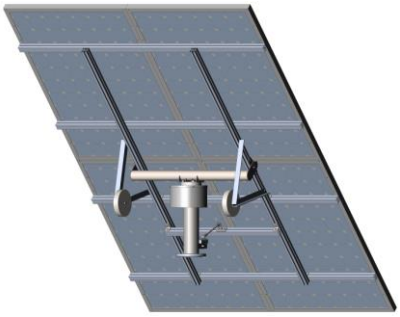
The core of the Heliomotion Solar Power Plant is the dual-axis tracker. The tracker is designed to be mounted with either photovoltaic or thermal solar collectors. The tracker comes in two models: Tracker S and Tracker XL. Tracker S is engineered for up to 4 m² of panel area and Tracker XL for up to 8 m².

Tracker S

Tracker XL

There are four standard applications for the trackers: PV-650, PV-1300, TC-1000 and TC-2000. PV models have photovoltaic panels and TC models use thermal collectors for heating tap water. Tracker S is used with PV-650 and TC-1000. Tracker XL is used with the larger models PV-1300 and TC-2000.

PV-650



PV-1300

TC-1000

TC-2000

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: An electrical solar system must be approved by a certified electrician prior to turning it on. 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 lower voltage.

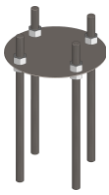
For step by step instructions on how to perform the installation please refer to the quick assembly guide for your Heliomotion product. What follows here is complementary information to that document.

Site selection

Your solar power plant may either be placed free standing on the ground or next to a wall with a wall support. 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, so that the energy generated from the sun is maximized. In this way you will gain the most from your installation. The tracker moves, therefore it should be situated away from obstructions and vegetation that may come in contact with it during this movement.

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 1.2 meters for a free standing installation, here are our recommendations:



To withstand wind speeds of up to 30 m/s a free standing PV-2 installation (<4m^2 panel area) should consist of at least 100 liters of concrete. If wind speeds can reach upwards of 40 m/s at your location this volume needs to be increased to 200 liters. For a PV-4 installation (<8m^2 panel area) these volumes of concrete need to be doubled. If the soil is disturbed, or contains a high amount of sand, it is recommended to use twice as much concrete to compensate for uncertain soil conditions. 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 250 mm deep.

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 7 days for the cement to cure before assembling the remainder of the solar power plant.

Extension column

Typically, the tracker is installed on an included 1.2 meter extension column. It is recommended that the installation height does not exceed this length, in order to simplify assembly.

Wiring

For a PV-650 or PV-1300 solar power plant a 4x2.5 mm² cable can be used, provided the panels are connected in series and the distance to the power plant does not exceed 100 meters. TC models can use a wire size of 4x1mm² for a distance up to 20 meters.

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 PV-650 or PV-1300 solar system, where all the panels are connected in series to increase the voltage, the current will be limited to 6 A with full sunshine. If the cross sectional area per copper wire is 2.5 mm², the losses in a 20 meter cable length (with wires going both ways) will be up to 1.4% (1.5 V). 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 16mm² 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.

Breakers

DC breakers provide a means of safely disconnecting electrical devices in the installation. Sunny Boy inverters have a built-in breaker and therefore do not require an external breaker. MPPSolar stations need external DC breakers for both the solar panels and the batteries.

Breaker sizes should be larger than the maximum current and voltage that it will flow through them. The breaker for the solar panels need to be able to handle 15 A 250 V for a PV-650 installation, and 30 A 500 V for a PV-1300 installation. The breaker for the battery's positive terminal must be able to handle 100 A 48 V. A TC-1200 installation does not need any breakers.

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 power adapter. If the installation is for a 48-volt battery system, a 48/24 voltage converter should be used. 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. Tracker S turns to its initial position, which is noon position. Tracker XL does not perform this step.
2. Once initial position is reached the tracker pauses 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.
3. The tracker rotates to face the sun's present position.
4. 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.
5. The tracker continues to follow the sun until sunset or until its evening position is reached, which is 90 degrees after the noon position.
6. After sunset the tracker returns to its noon position.
7. Before sunrise the tracker moves to sunrise position or to morning position, which is 90 degrees before the noon position.
8. The tracker awaits sunrise and then repeats the sequence from Step 4.

Handling of obstacles
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 moving to its noon position it will pause its normal operations for three hours and then try again.

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 (see assembly guide for TC model). By default, the alarm triggers at 95 ºC, 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.

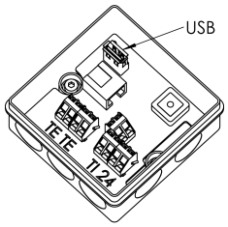
MAINTENANCE

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. Spare parts for self-replacement can be ordered through www.heliomotion.com.

USB INTERFACE



A USB connector can be found on the connection circuit board of the tracker, located in the junction box on top of the balk. By connecting to this terminal with a laptop and a USB extension cable, after downloading the communication program HelioCom from the website, this interface 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. Updating the tracker's firmware. The latest version of the firmware can be downloaded through program.
3. Changing configurable settings. These include the time, date, latitude and longitude settings which are normally automatically configured with information from the GPS network.
4. Monitoring the tracker's operations.

The USB feature was introduced with version 80-7011r02 of the connection circuit board and version 80-7001-r00 of the main control circuit. The latest version of these circuits can be ordered separately from the website.

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 25° and 90° on the northern or southern hemisphere. A single axis configuration is also available for use within the equatorial region, between latitude -25° to 25°.

Snowy regions
In climates with snow the foundation column should be 1.2 meter above ground level to prevent the tracker from getting stuck in the snow during winter. 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 winds of 25-30 m/s, it is recommended that you stop the tracker in the noon position until the storm passes, as this is the position where the tracker and panels are best able to resist high wind loads. If wind speeds are expected to go beyond 30 m/s, it is recommended that you remove the panels, in order to protect the installation.

TROUBLE SHOOTING

Tracker does not move and no motor sound is heard.	1. Check the green light on the 24 VDC power adapter to confirm it is supplying power. If the light is blinking, or is dark despite being plugged in, then replace the defective Power Adapter. 2. Use a voltage meter on the connection circuit board to confirm that the tracker is supplied with 24 VDC and that the polarity is correct. 3. Check the green light on the tracker's connection circuit board to ensure the main circuit board has power. If this light is dark despite 24 VDC being supplied there is a short circuit on one of the circuit boards. To determine which one, unplug the RJ45 network cable on the connection circuit board and restart the tracker. If the tracker moves then replace the Connection Circuit Board. If the tracker does not move then replace the Main Circuit Board. 4. Restart the tracker by switching its power off for 10 seconds and then back on. If this works a firmware update can resolve the issue permanently. 5. Connect to the tracker with HelioCom to diagnose the issue. If no connection can be made then pull down the tracker's drive cover to visually inspect the main circuit board for damage, for instance in the form of burn marks due to lightning damage. If none of the board's three status LEDs are active or blinking you will need to replace the Main Circuit Board.
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 to the noon position. If this makes the tracker move the issue is friction related and you can move on to the next troubleshooting item. 3. Pull down the tracker's drive cover and remove the motor from the worm gear. Confirm that the motor axis is moving following a tracker restart. If the axis is not moving, or if the motor sounds damaged, then it is worn out and you need to replace the Stepping Motor.
Tracker is struggling to move.	1. Inspect the tracker for possible sources of friction, such as excessive icing, snow loads or vegetation, and remove any such hindrances. 2. Turn up the motor effect. To do so first pull down the cover hood on the tracker to access its main circuit board. On the board (or on the side of it in earlier models) there is a potentiometer. Turn it clockwise (using a small screwdriver) to increase the power to the motor, until the tracker is able to overcome the friction. 3. Examine the three white plastic bushings for wear. They are located below the fork and on the sides of the fork. Replace any worn out bushings.
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 Connection Circuit Board (or adjust the time manually).
Tracker is not moving symmetrically to both extreme positions.	1. Remove any obstacles blocking the path of the tracker in either its morning or evening position.

TECHNICAL SPECIFICATIONS

Mechanical capabilities		
Number of turning axis	Dual-axis	
Protection rating	IP65 (designed for outdoor installation)	
Azimuth tracking	180°	
Elevation angle	15-90°	
Tracker specific properties	**Tracker S**	**Tracker L**
Weight (ex. packaging)	16 kg	17 kg
Dimensions	260x260x940 mm	280x280x680 mm
Max panel area	4 m^2	8 m^2
Max panel weight	90 kg	180 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	25 m/s	
Survival wind speed	30 m/s	
Electrical data		
Operational voltage	24 VDC ± 20%	
Motor current capacity	1000 mA default	
Power consumption	<1 watt while idle, 25 watt while moving	
Energy consumption	0.05 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 five (5) 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 30m/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