Troubleshooting Manual

Trina Tracker

1.Introdution

The purpose of this manual is to provide detailed explanations of all the devices involved in the operation of the TrinaTracker solar tracker control system so that it is possible to address any problems that may arise. It also serves to guide the operator in identifying and viewing variables, modifying parameters and helping them understand how a tracker will behave as these values vary.

This manual covers and describes the SP1000 and Vanguard 450-2P models and each section includes details of the unique features of each particular tracker.
The information contained in this manual is complemented by other manuals, such as the “Assembly Manual” and the “Maintenance Manual”.

- Assembly Manual Vanguard 450-2P
- Assembly Manual SP1000
- Maintenance Manual

2. SP1000

The main function of the control system is to rotate rows of photovoltaic panels so that they remain perpendicular to the position of the sun as it follows its trajectory throughout the day.

This is the basic premise of a solar tracker although there are conditions that modify it, as will be explained in more detail in this manual.

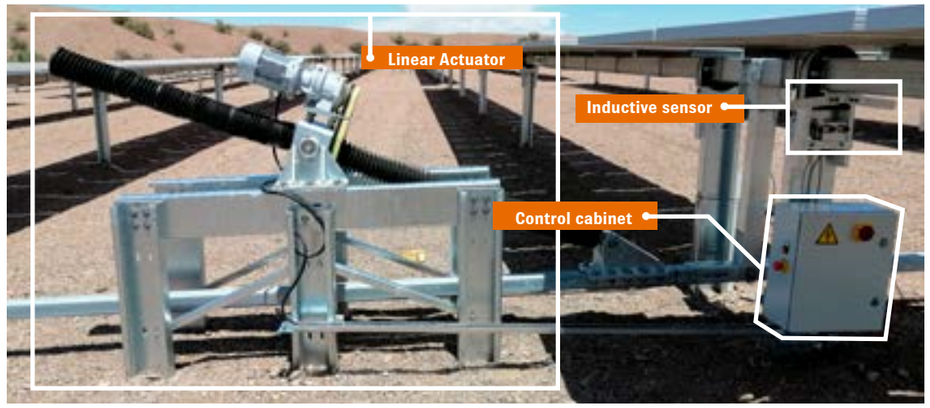
2.1 Elements of the SP1000 tracker control system

The tracker control system comprises:

- The control cabinet
- The inclinometer
- Inductive sensor

It also comprises the Handy, an auxiliary element that will be explained in detail in this manual.

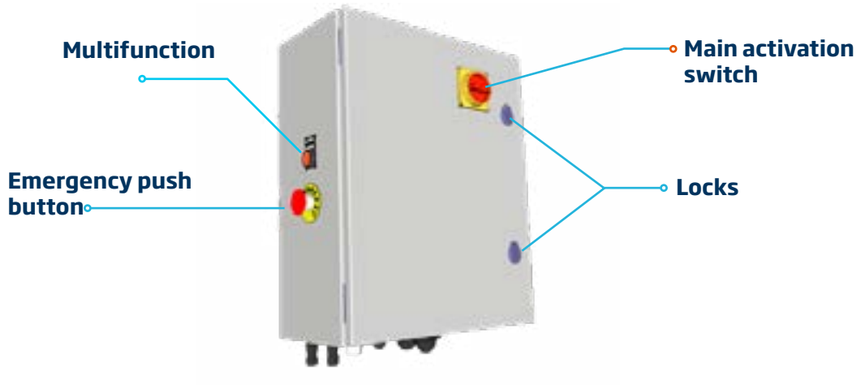
In a solar tracker assembly, the control system is identified as follows:



Note: The location of the indicated elements may vary according to the design of the tracker, but their functionality within the assembly does not change.

Components mounted on the controller exterior

Depending on the design of the tracker, there are two types of enclosure for the solar tracker control system: one made from laminated steel sheet with textured powder coating and another made with fibreglass reinforced polyester. Both types are machined to allow cables to enter and exit and they also have several elements incorporated on the exterior:

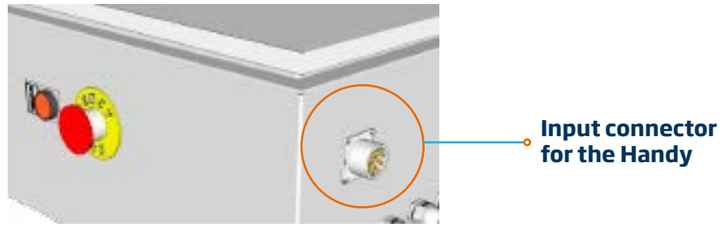


The Handy is the portable console that is used to control and configure the tracker.

NB Handy Model

NQ Handy Model

It connects via the connector located at the bottom of the enclosure and is used to access the internal configuration of the tracker, view and modify parameters or switch between



Manual and Automatic modes

Connector for the Handy

1. The Handy is connected via a pin circular connector.

2. Unscrew the protective cap on the controller connector.

Male connector

Female connector

3. The male connector is on the Handy and the female is on the bottom of the controller.

4. To connect the terminal line up the pins and so that they can be connected.

5. Push the connector of the Handy so that it fits correctly with the connector on the cabinet. Then screw on the collar of the Handy connector until it is tight to prevent the Handy from being disconnected.

2.2 Types of alarms on the SP1000

This section will analyse the different alarms that may appear on a tracker, the reasons why they appear and the possible solutions to restore the tracker to normal operation. In some cases the tracker is capable of continuing to track normally even though the alarm is active and will only need to be reset. In other cases a series of checks will need to be carried out to establish the cause of the alarm and how to solve the problem.

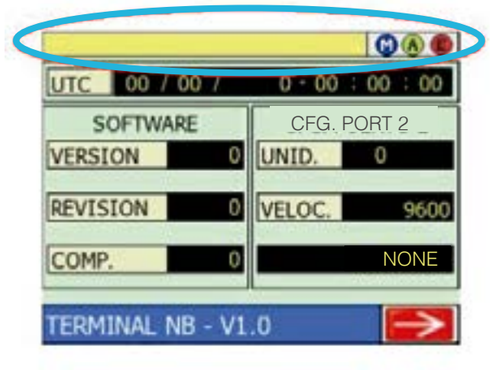
The following table summarises how the tracker behaves in the event of each possible alarm.

HANDY ALARM MESSAGE	TRACKER LAMP	TRAKS?	RESET REQUIRED?	OPERATOR REQUIRED?
00-EMERGENCY	ON	NO	YES	YES
01-INVERTER NOT OK	BLINKING		YES	YES
02-PLC BATTERY LOW	BLINKING	NO		YES (1)
03-TRACKER DOES NOT REACH THE DEFENSIVE POSITION				
04-SELF-SOLVING TRACKING ERROR	OFF	NO		
05-NON-RECOVERABLE TRACKING ERROR				
06-ANEMOMETER FAULT	BLINKING	NO (DEFENSIVE		YES
07-ANEMOMETER MALFUNCTIONING	BLINKING	NO (DEFENSIVE	YES	YES
08-EAST SOFTWARE LIMIT	OFF	ONLY TO THE WEST		
09- WEST SOFTWARE LIMIT	OFF	ONLY TO THE EAST		
10- EAST HARDWARE LIMIT REACHED	OFF	ONLY TO THE WEST		
11- WEST HARDWARE LIMIT REACHED	OFF	ONLY TO THE EAST		
12- EAST HARDWARE LIMIT OPERATING FAULT				
13- WEST HARDWARE LIMIT OPERATING FAULT				
14- MOTOR TURNING IN WRONG DIRECTION				
15- INCLINOMETER DISCONNECTED OR BROKEN				
16- LOW WIND	BLINKING	LIMITED 30°		
17- MEDIUM WIND	BLINKING	LIMITED 15° (DEFENSIVE		
18- HIGH WIND	BLINKING	NO (DEFENSIVE		
19-CLEANING MODE	BLINKING	NO (DEFENSIVE		
20-DEFENCE	BLINKING	NO (DEFENSIVE		
21-LATENCY	BLINKING	NO		

(1) A maintenance operator is required to change the battery.
(2) Check if there are any other accompanying alarms. The tracker could be in manual and require an operator to put it back into automatic mode.
(3) As per factory settings.

Each alarm that appears in the tracker influences both the status of the push button lamp and the status of the system. The tracker alarms have different degrees of severity: some imply that they are not tracking, that a reset is required to restore the tracker to its normal status or even that the presence of an operator is required to verify that the tracker has not been damaged.

For a detailed view of the alarms that can be activated in a tracker, connect the Handy console: the alarms will appear in the margin at the top of the screen:



Top bar. Alarms and status lamps.

Main body. Information regarding variables and modification of parameters.

Bottom bar, screen information. Terminal model (NB / NQ) and software version of the Handy terminal.

The last alarm that appeared in the tracker is displayed in the top bar. If the tracker has no alarms, this bar will be empty. The tracker status is also indicated by the lamps that appear on the right.

A — Tracker in automatic mode.

M — Tracker in manual mode.

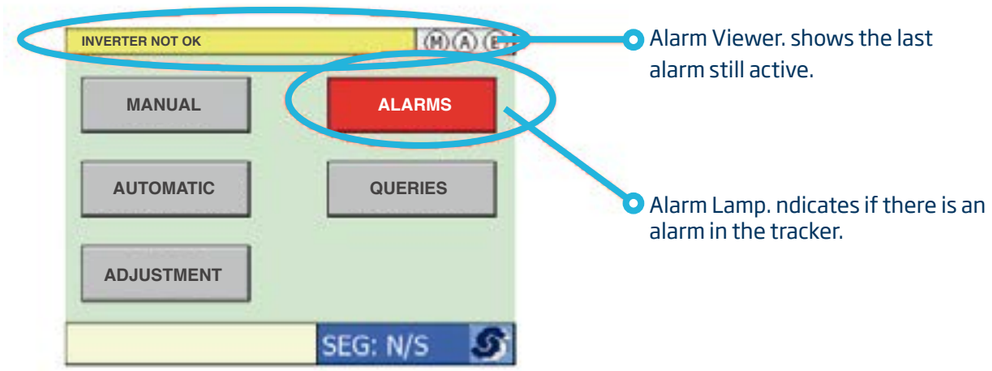
E — Tracker in emergency mode.

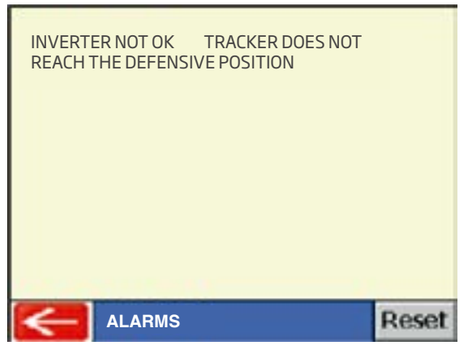
Only one of the three lamps can be on since no more than one status can occur at any one time.

Viewing the alarms

The tracker alarms can be viewed and managed from the Handy. Firstly, if an alarm exists, the alarm lamp on the initial screen turns red and blinks.

The last alarm that occurred in the tracker appears in the bar at the top of the screen. Keep in mind that the alarm that appears in the top bar is the last (but perhaps not the only) alarm. The alarm query screen can be accessed by clicking on the alarm display located at the top of the screen or on the flashing alarm lamp:





Press the "Reset" button to clear the alarms. It must be pressed in order to clear the alarms that require "reset". See section 3.3 of this manual for a detailed description of the tracker alarms.

Note: The tracker DOES NOT CHANGE STATUS while the Alarms are being queried.

2.3 Causes and solutions for alarms

The alarms that are possible in the tracker are as follows:

00-Tracker in emergency mode

Description

The tracker is in Emergency Mode because the emergency push button in the cabinet has been pressed or the tracker has not been reset.

Solutions

1. Make sure the emergency push button has been reset. If it hasn't, reset it.
2. If the emergency push button has been reset but the "reset" button is constantly on, this means that the tracker has not been reset. Push the "reset" button. The lamp will go off and the tracker will return to the mode it was in prior to the push button being activated.

01-Inverter not ok

Description

The inverter is not working properly.

Probable causes

1. The inverter does not have a power supply.
2. There is an alarm in the inverter.

Solutions

1. Press the "reset" button. If there is an alarm in the inverter, it will reset and continue normal operation.
2. Make sure that the inverter circuit breaker is not turned off.

02-Low PLC battery

Description

The PLC battery voltage is lower than recommended. This alarm is important since a battery failure can affect not only the normal behaviour of the PLC, but also corrupt the memory and render it completely useless. When this alarm appears, the PLC battery must be replaced urgently in order to avoid further damage.

Solutions

Replace the PLC Battery as soon as possible.

03-Tracker does not reach the defensive position

Description

The tracker has received an external order to move to defensive position, but, after a period estimated to be long enough to perform the operation, the system detects that the tracker is still not in the defensive position.

Probable causes

1. The tracker has received the order but instead of being in automatic mode, it is in a priority state and cannot execute the order.
2. The tracker is stopped or cannot move due to mechanical problems.

Solutions

1. Check that the tracker is not in emergency mode. If it is, reset the tracker (See step 1 in the ANNEX), first making sure that doing so will not jeopardise its operation or the safety of any other operators.
2. Check that the tracker is in automatic mode. If not, reselect automatic mode.
3. Check that there are no physical or mechanical problems preventing the motor from moving. To do this, wait a few seconds until the tracker moves on its own or move it manually (see item 2 for how to move a tracker manually).
4. Check the Alarms screen: this alarm usually occurs along with others that can provide more information on the status of the tracker (Inverter not OK, Tracking Error, etc.)

04-Self-solving tracking error

Description

The tracker control system performs tracking checks. If, the system detects that the tracker is not in the desired position after the supervision interval, it assumes that a tracking error has occurred and activates the corresponding alarm.

Probable Causes

1. The tracker may have encountered a physical or mechanical problem that is preventing it from moving.
2. An alarm is preventing the frequency inverter from working or it is disconnected.
3. The tracker turning motor has a mechanical problem that is preventing it from moving.

Solutions

The alarm is "reset" automatically when normal tracking status is re-established before the number of allowable retries have been exhausted. However, if this error appears frequently in the tracker, it is worth trying to find out the cause. For example, if the error is caused by a physical or mechanical impairment, a follow-up maintenance check is recommended to avoid any other faults. It is also advisable to periodically check the motor and ensure that the inverter has power and does not have any alarms.

05-Non-recoverable tracking error

Description

A Tracking Error has occurred in the tracker and the control system has exhausted the number of recovery retries.

Probable causes

1. The tracker may have encountered a physical or mechanical problem that is preventing it from moving.
2. The inverter does not have any power or is not working normally. In this case this alarm is accompanied by the "INVERTER NOT OK" alarm.
3. The tracker turning motor has a mechanical problem that is preventing it from moving.

Solutions

1. Press the "reset" button to allow the system to try to solve the problem on its own.
2. If this doesn't work, check that the tracker is able to move to the East and West correctly and that there is nothing impeding it (see items 5.2 and 5.3 for how to move a tracker in manual or automatic mode).
3. Check that there is power to the inverter and there are no alarms preventing it from working.
4. Check that there are no physical or mechanical impediments that are preventing the tracker from performing the movement.
5. Check that there are no physical or mechanical impediments that are preventing the motor from performing the movement.
6. Check the alarms and events screen. A tracking error can hide other types of errors. (See item 7 in the annex).

06-Anemometer fault

Description

Anemometer not connected to the control system.

Probable causes

1. This alarm only appears on control systems with the wind master function or trackers that have an anemometer connected.

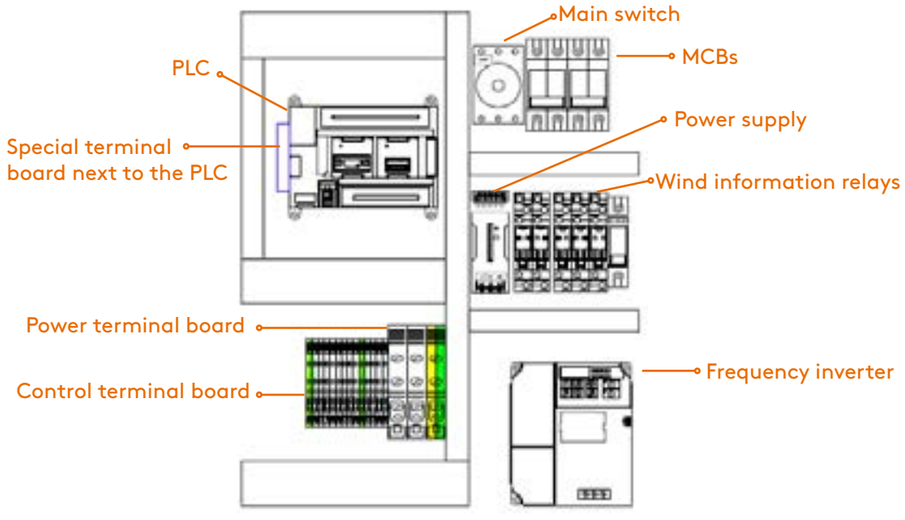
2. The anemometer has suffered a fault or has been disconnected from the control system.

Solutions

1. Press the "reset" button and check to see if the error disappears.

2. If the alarm persists, visually inspect that there is an anemometer and that it is correctly connected to the control system, or to the extension hose if it is incorporated within the cabinet.

3. If an anemometer exists and is connected correctly, check that it is properly connected inside the terminal block.



07-Anemometer malfunctioning

Description

The anemometer has not sent any movement pulses to the control system for a set time limit.

This alarm only appears on control systems with the wind master function or trackers that have an anemometer connected.

When the anemometer turns, it produces a series of pulses at the PLC input that allow the wind velocity to be calculated digitally and modified in relation to the trackers' behaviour. If the tracker control system does not receive any pulses in a pre-set time, usually 24 hours, it deduces that a fault has occurred with the anemometer and, in the absence of information, assumes the worst case: a High Wind situation that has not been detected due to a fault, causing it to immediately move to the defensive position.

Although not impossible, it is assumed that it is very unlikely that a perfectly functioning anemometer installed at height would not produce any pulses whatsoever during one whole day. As such, when this occurs, the system assumes that the anemometer is not working correctly.

Solutions

1. Press the "reset" button and check to see if the error disappears.

2. If the alarm persists, visually inspect that there is an anemometer and that the reason it is not moving is genuinely due to a lack of wind.

3. If this is not the case and the anemometer is moving, then it should be producing pulses. In this case, check that the pulses are being correctly sent to the control system. Look on the Handy (Automatic mode screen) to see if the wind velocity is being received.

4. If the anemometer is moving but the wind velocity is not being received, replace the anemometer.

This alarm will disappear as soon as the control system starts to receive new pulses.

08-East software limit

Description

The tracker has reached its East software limit of travel. This warning appears when the programmed inclination limit is reached. In normal tracking the East software limit coincides with the East hardware limit.

The East software limit cannot be passed when the tracker is in automatic mode but can if the tracker is moved manually, in which case it can be inclined until the East hardware limit is reached.

The tracker reaches the East limit of travel daily and this is part of its normal working. As such, it is not considered to be an alarm, rather simply a warning.

The East Software Limit can be seen on the Handy: see section "Software limit settings" in item 4 of the Annex.

09- West software limit

Description

The tracker has reached its West software limit of travel. This warning appears when the programmed inclination limit is reached. In normal tracking the West software limit coincides with the West hardware limit.

The West software limit cannot be passed when the tracker is in automatic mode but can if the tracker is moved manually, in which case it can be inclined until the West hardware limit is reached.

The tracker reaches the West limit of travel daily and this is part of its normal working. As such, it is not considered to be an alarm, rather simply a warning.

The West Software Limit can be seen on the Handy: see section "Software limit settings" in item 4 of the Annex.

10- East hardware limit reached

Description

The tracker has reached its East hardware limit of travel. This warning appears when the tracker is detected by the East limit of travel inductive sensor. For reasons of mechanical safety the control system does not allow the tracker to be inclined at an angle greater than the limit defined by the inductive sensors.

11- West hardware limit reached

Description

The tracker has reached its East hardware limit of travel. This warning appears when the tracker is detected by the West limit of travel inductive sensor For reasons of mechanical safety the control system does not allow the tracker to be inclined at an angle greater than the limit defined by the inductive sensors.

12- East hardware limit operating fault

Description

The East travel limit sensor has been activated despite the tracker not having reached that position.

Supposing the usual East limit for a tracker to be -45° and the tolerance of the system to be 10°, the inductive sensor can detect the tracker and activate the East limit alarm at angles over -35°. If the limit alarm is activated when the tracker is inclined at an angle greater than -35°, the inductive sensor is considered to be in fault and the "EAST HARDWARE LIMIT OPERATING FAULT" alarm is activated.

Probable causes

1. The East inductive sensor is damaged or disconnected.
2. The metal paddle intended to detect the East limit sensor is incorrectly calibrated with respect to the range of movement of the tracker.
3. The inclinometer is incorrectly attached to the structure and does not reflect the actual inclination of the tracker.
4. The inclinometer is incorrectly calibrated and does not reflect the actual inclination of the tracker.

Solutions

1. Press the "reset" button and check to see if the error disappears.
2. Check that the hose is correctly attached to the connector on the East inductive sensor.
3. Use the Handy to check that the angle of inclination of the tracker registered by the system coincides with the actual angle by using a digital level. If it does not, the system may need an adjustment to the offset or the inclinometer.
4. Check that the LEDs of the East inductive sensor light up. If they do, pass a piece of metal close to the inductive sensor to see if it detects it: the LEDs should turn off.
5. If it is not detected, disconnect the cable connecting it to the East inductive sensor, connect a new inductive sensor and perform a new check. If the LEDs do turn off in this case, replace the faulty inductive sensor with the new one inside the tracker structure.

Inductive sensor LEDs.
Turn off when metal is detected.

6. Manually move the tracker in both directions to check that both limits are working and correctly set (see item 2 to find out how to move a tracker in manual mode).

13- West hardware limit operating fault

Description

The West travel limit sensor has been activated despite the tracker not having reached that position.

Supposing the usual West limit for a tracker to be 45° and the tolerance of the system to be 10°, the inductive sensor can detect the tracker and activate the West limit alarm at angles over 35°. If the West limit alarm is activated when the tracker is inclined at an angle less than 35°, the inductive sensor is considered to be in fault and the "WEST HARDWARE LIMIT OPERATING FAULT" alarm is activated.

Probable causes

1. The West inductive sensor is damaged or disconnected.
2. The metal paddle intended to detect the West limit sensor is incorrectly calibrated with respect to the range of movement of the tracker.
3. The inclinometer is incorrectly attached to the structure and does not reflect the actual inclination of the tracker.
4. The inclinometer is incorrectly calibrated and does not reflect the actual inclination of the tracker.

Solutions

1. Press the "reset" button and check to see if the error disappears.
2. Check that the hose is correctly attached to the connector on the West inductive sensor.
3. Use the Handy to check that the angle of inclination of the tracker registered by the system coincides with the actual angle by using a digital level. If it does not, the system may need an adjustment to the offset or the inclinometer.
4. Check that the LEDs on the West inductive sensor light up. If they do, pass a piece of metal close to the inductive sensor to see if it detects it: the LEDs should turn off.

Inductive sensor LEDs.
Turn off when metal is detected.

5. If it is not detected, disconnect the cable connecting it to the West inductive sensor,connect a new inductive sensor and perform a new check. If the LEDs do turn off in this case, replace the faulty inductive sensor with the new one inside the tracker structure.
6. Manually move the tracker in both directions to check that both limits are working and correctly set (see item 5.2 to find out how to move a tracker in manual mode).

14- Motor turning in wrong direction

Description

The controller detects that the tracker is moving in the wrong direction.

Probable causes

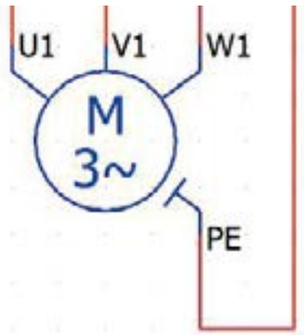
1. Two of the phases of the turning motor have been incorrectly connected.
2. The inclinometer has been incorrectly installed.

Solutions

1. Press the "Reset" button to check to see if the system recovers.
2. Check the behaviour of the tracker by moving it manually with the Handy. If, when you try to move the tracker to the East or West it moves in the opposite direction, the problem could be that two phases have been connected incorrectly. In this case it is possible to alter the direction of turning in two different ways:

   a. Using the Handy terminal. See item 5 "Axis settings" to find out how to invert the direction of turning using the software.

   b. Swapping over the phases of the motor. Inspect the motor connection box to check that the three phases are connected correctly. If they are not, reconnect them correctly according to the tags on each of the terminals:



Warning: Ensure this is done when the power to the controller has been disconnected.

Note: Once the phases have been changed or the direction of turning inverted using the software, the correct direction of turning can be checked by moving the tracker manually. The tracker inclination angle should increase when the tracker is moved to the West and decrease when it is moved to the East. See item 2 in the ANNEX for how to move a tracker in manual or automatic mode.

3. If, when you try to move the tracker to the East or West it moves in the correct direction but the alarm persists, it is possible that the inclinometer is loose and has not been installed correctly.

   Check that the inclinometer has been installed in the correct position and location, with the connector at the bottom. Check that it is securely fixed and does not vibrate or shake.

15- Inclinometer disconnected or broken

Description

The tracker inclinometer is connected incorrectly, disconnected from the controller or broken.

Probable causes

1. The WINC hose of the controller is not properly connected to the inclinometer or is loose.
2. The inclinometer is broken.

Solutions

1. Press the Reset button and check to see if the system recovers.
2. If it does not, check if the inclinometer hose is disconnected; if so, connect it again, making sure to firmly tighten the connector.
3. If the hose is connected, check that it is correctly connected. If it is not, disconnect the hose and reconnect it correctly, making sure that it is firmly tightened to the inclinometer connector.
4. Once the hose is properly connected, make sure the inclinometer works. To do this, visually check that the POWER LED is on:

5. If the POWER LED on the inclinometer turns on correctly, check that it is measuring the inclination correctly. To do this, in manual mode move the tracker (see item 2 in the ANNEX) both east and west. If the inclinometer is working correctly, a coherent value should be displayed in the "Tracker Inclination" field on the screen. The user should appreciate that this inclination value ought to increase when the tracker moves to the west and decrease when it moves to the east. A digital level can be used to verify the operation.
6. If the POWER LED does not come on, replace the Inclinometer with one that works correctly. Note: An offset adjustment is necessary after replacing an inclinometer. See item 7 of the ANNEX to find out how to perform this operation.
7. Once the inclinometer is correctly connected and operational, press the "reset" button to clear the alarm.

If point 2 above is true and the inclinometer is broken, it can be replaced as follows:

1. Move the tracker to the defensive position.
2. Disconnect the electrical connections.
3. Connect the new inclinometer in the same way as the old one.
4. Configure the new inclinometer according to item 7 of this manual.

16- Low wind

Description

The controller receives a low wind signal from a basic station, from an anemometer or via hardware or software wind signals.

The control system considers a low wind situation to be part of the tracker's normal operation; the wind alarms automatically disappear when the wind situation or the simulation cease or the system detects a different wind situation.

To find out more about the operation of the tracker in a low wind situation.

17-Medium wind

Description

The controller receives a medium wind signal from a basic station, from an anemometer or via hardware or software wind signals.

The control system considers a medium wind situation to be part of the tracker's normal operation; the wind alarm automatically disappears when the medium wind situation or the simulation cease or the system detects a different wind situation.

To find out more about the operation of the tracker in a wind situation.

18-High wind

Description

The controller receives a high wind signal from a basic station, from an anemometer or via hardware or software wind signals.

The control system considers a high wind situation to be a state of high priority for the tracker, causing it to immediately move to the defensive position to avoid any physical or mechanical damage resulting from the force of the wind. Wind alarms automatically disappear when the wind situation or simulation cease or the system detects a different wind situation.

To find out more about the operation of the tracker in a wind situation.

19-Cleaning mode

Description

The tracker has received an external order to move to the Cleaning position. This alarm appears in two situations: when a wind order from a Basic Station arrives at the tracker or when a Cleaning situation is simulated in Automatic Mode.

The control system considers the Cleaning situation to be part of the tracker's normal operation and the cleaning alarm disappears automatically when the cleaning order is performed or the simulation ceases.

To find out more about the operation of the tracker in cleaning mode.

20-Defence

Description

The tracker has received an external order to move to the Defensive position. This alarm appears in two situations: when an order to move to defensive position from a Basic Station arrives at the tracker or when a Cleaning situation is simulated in Automatic Mode.

The control system considers the defensive situation to be part of the tracker's normal operation and the defence alarm disappears automatically when the order is performed or the simulation ceases.

Note: Although the tracker also moves to the Defensive position in the High Wind and Latency Failure situations, these have their respective alarms and, therefore, the alarm that indicates the tracker is in the defensive position does not appear.

21-Latency

Description

The Latency fault appears when communication between the tracker and the basic station is interrupted. The controller detects this communication fault and acts by immediately moving the tracker to the defensive position.

Probable causes

1. A fault has occurred in the communication wiring.
2. A fault has occurred in the communication card.(See item 6 "PLC/ Communication ports").
3. A fault or disconnection has occurred in the Basic station.

Solutions

1. Check the communication wiring in the branch where the tracker is located.
2. Check that the communication card works correctly.
3. Verify that the basic station has power and that there are no problems.

22-Anemometer fault

Description

An Anemometer fault appears when the NCU main screen is operated: when the alarm screen is accessed, it appears as ANEMOMETER FAULT.

Probable causes

1. A fault has occurred in the wiring from the anemometer along the mast to the connection terminal.
2. A component has broken.

Solutions

1. Check by disconnecting the connections at the top of the mast and connecting a new anemometer if the turn count registers on the NCU screen. If wind information is obtained with the new anemometer, then the anemometer has a problem.
2. If it still does not register any velocity after the previous step, check the existing wiring and connections.

To change a broken anemometer.

1. Disconnect the communication cables from the anemometer (right side of the NCU terminal block).
2. Remove the anemometer post from the driver.
3. Carefully lower the post with the tensioners (this operation is dangerous)
4. Remove the second section (disconnect the cables from the junction box if there is one).
5. Remove the damaged anemometer and cable.
6. Mount a new anemometer and connect it to the junction box if there is one (if there is not, the cable should pass through the post to the NCU).
7. Mount the second section on the post.
8. Mount the post on the driver.
9. Tighten the tensioners that hold the anemometer post.
10. Connect the anemometer wires to the terminal block.

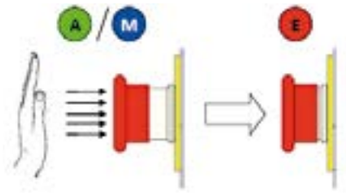
ANNEX

Item 1: Emergency mode

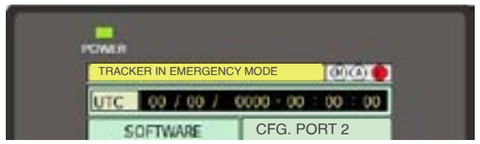
The tracker remains stationary in this mode. What is more, it is a state of high priority. When emergency status is activated in the tracker, it does not accept orders or changes in status, either in remote mode or via the Handy. It is, therefore, a safe way to manipulate the tracker.

Activating emergency mode:

The control system has an emergency push button on the outside of the enclosure, on the left side. To put the tracker in emergency mode, simply press this push button: emergency status will be activated by the system regardless of what mode of operation it was previously in.

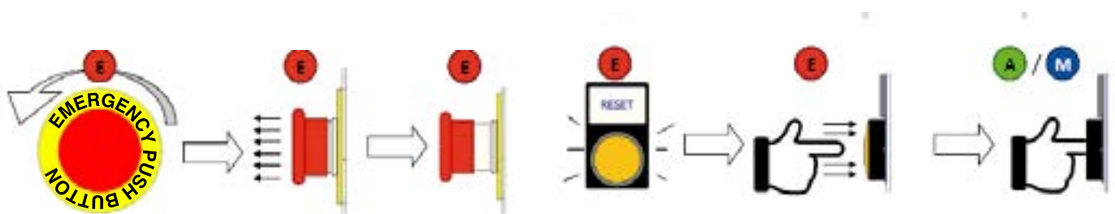


If the Handy is connected, the red Emergency Mode lamp will light up in the bar at the top of the screen. The words “Tracker in Emergency”.



Deactivating emergency mode:

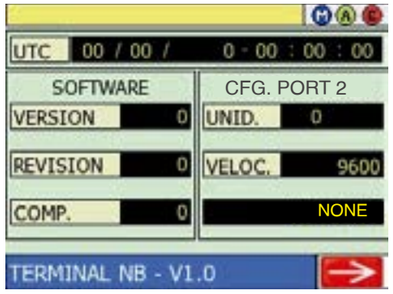
To leave emergency mode, the push button must be unlocked by turning it gently to the left, and the tracker reset by pressing the multifunction button once only. The lamp will go out and the tracker will return to the status it was in before entering into emergency mode:



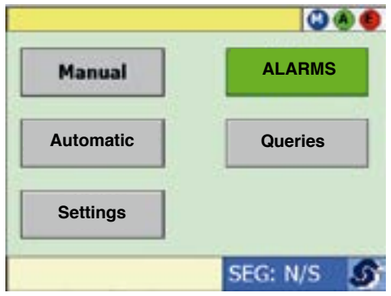
Item 2: Manual mode

Connect the Handy to the controller as explained in section 3.1.

The following startup screen will be displayed in the configuration terminal.



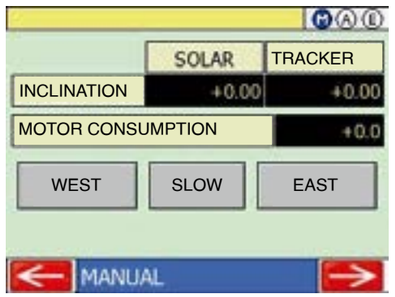
After 5 seconds, or when is pressed, it goes to the main screen of the tracker.



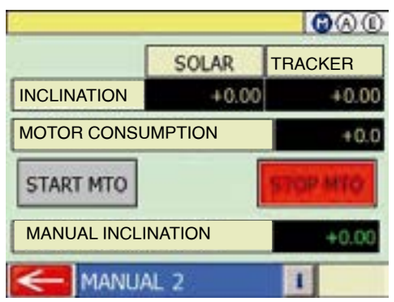
The tracker enters Manual Mode whenthe Manual button is pressed.

The Handy has two screens in this modeof operation.

Press → to go to the next screen.



Press ← to go to previous screen.



The following information can be displayed on both screens:

VARIABLE	UNITS	DESCRIPTION
SOLAR INCLINATION		Theoretical inclination of the tracker if it remains completelyperpendicular to the sun during its entire trajectory throughout the day. During the normal tracking state this coincides with the value in the "Tracker Inclination" table; the difference being that the solar inclination varies continuously and the tracker inclination varies in steps of movement.
TRACKER INCLINATION	**º**	Shows the true inclination of the tracker measured by the inclinometer. A negative value indicates that the tracker is tilted to the East, while a positive value indicates that it is tilted to the West.
MOTOR CURRENT	**A**	Shows the current in the motor in each moment.

There are two ways to manually move a tracker:

1. Go to the first screen in Manual Mode.
2. Press the middle button to toggle the moving speed from between "FAST" and "SLOW"
3. Press "EAST" or "WEAST" to start moving in the desired direction. It will continue to move for as long as the button is pressed or until it reaches its hardware limit of travel.

Note: For NQ terminal models the F1 or F3 buttons can be pressed on the Handy to move the tracker to the east or west respectively.

Moving the tracker this way is imprecise and of little use if you want it to reach a exact inclination. The tracker inclination can be seen on the display in real time.

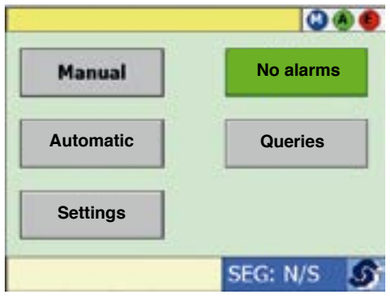
Shows the tracker inclination at each moment

Item 3: Mutomatic mode

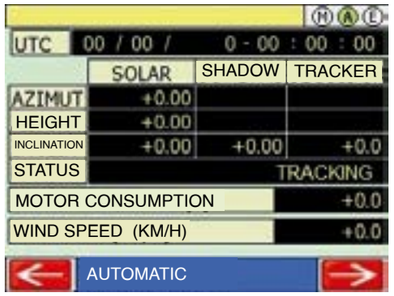
Automatic mode is the tracker's natural operating status. In this state, the tracker tracks and manages all of the implemented functions in order to operate the tracker remotely.

When the Handy is connected to the electrical cabinet of the tracker control system, the start screen is displayed on the configuration terminal.

After 5 seconds, or when ➔ is pressed,it goes to the main screen of the tracker.



The tracker enters automatic Mode when the automatic button is pressed.



Item 4: Modifying software limit

A tracker's range of motion is limited by two limits of travel, one to the east and one to the west. These hardware limits are complemented by two other software limits, which provide extra protection against movement outside the range.

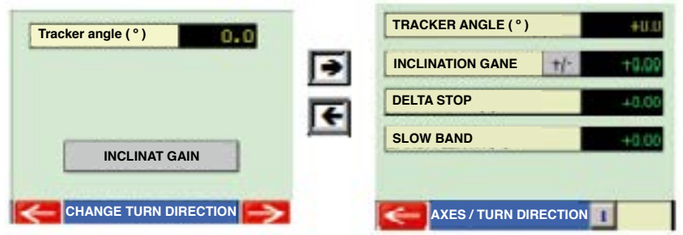
Follow the path: Settings > Axes to access the Software Limit adjustment screen:

PARAMETER	UNITS	DESCRIPTION	FACTORY SETTING
EAST LIMIT	º	East software limit. The tracker activates the "EAST SOFTWARE LIMIT REACHED" alarm and does not allow any further movement to the east when the inclination reaches this value.	-45
WEST LIMIT	º	West software limit. The tracker activates the "WEST SOFTWARE LIMIT REACHED" alarm and does not allow any further movement to the west when the inclination reaches this value.	45

Note: When the tracker is moved in manual mode, the software limits are cancelled and the tracker only stops when it reaches the hardware limits of travel, i.e. the inductive sensors.

Item 5: Axis settings

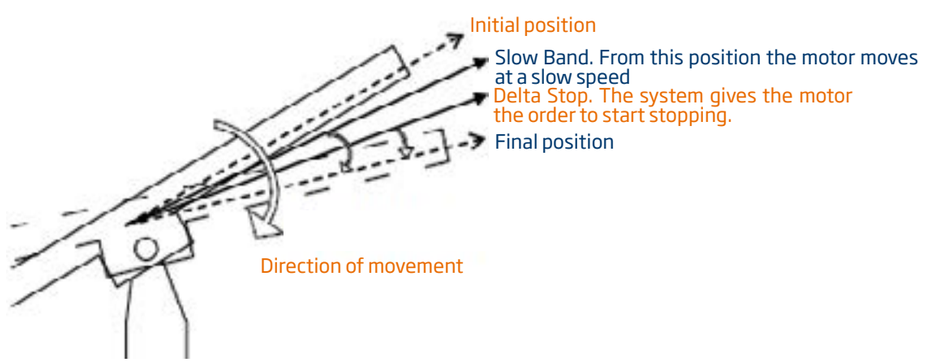
Follow the path: Settings > Axes > → > → > Password, to access the axes configuration screens:



When the "CHANGE TURN DIRECTION" button is pressed, the direction of turning of the motor is reversed via software.

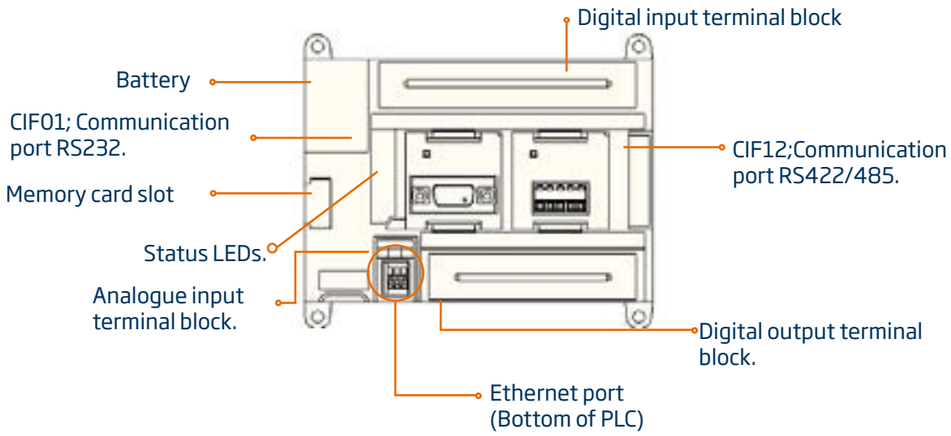
PARAMETER	UNITS	DESCRIPTION	FACTORY SETTING
INCLINATION GANE	º	When an inclinometer is turned from left to right, it generates an analogue signal. The inclination gain is the relationship between the variation of that analogue signal and the range of travel of the inclinometer, in degrees. This value is set in the factory and modifying it would cause a measurement error in the tracker inclination angle. The gain sign alternates depending on if the inclinometer is located facing North or South.	-163.0
DELTA STOP	º	Indicates the angle, in degrees, necessary to anticipate the motor stop order with respect to the desired position. This minimises the positioning error. This value is set in the factory: we do not recommend modifying it.	0.1
SLOW BAND	º	Indicates the angle with respect to the desired position, in degrees, at which the motor moves at a slow speed. This makes it easier for the system to move the tracker to the exact position desired. Using the previous example, a slow band value of 4º would mean that, if the tracker is to move to 30º, when it reaches 26º or 34º, depending on the direction of travel, the system would order it to move slowly.	4.0

The image below illustrates the above concepts:



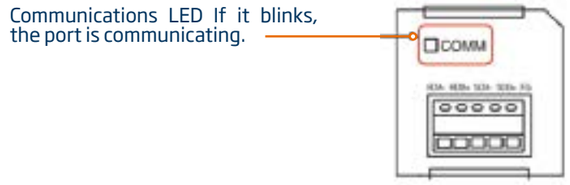
Item 6: PLC/communication ports

The PLC is the main element of the control system: it executes the entire program, interprets the signals received and controls the rest of the actuators.



LED	STATUS	INDICATIVE
POWER (GREEN)	Illuminated	PLC has power
	Off	PLC does not have power
RUN (GREEN)	Illuminated	The PLC is running a program
	Off	The program has been interrupted by a runtime error
ERR/ALM (RED)	Illuminated	Execution or hardware error. Operations are interrupted and all outputs are turned off in the PLC.
	Blinking	Non-fatal execution error. The PLC continues operating.
	Off	Off Operating normally.
IHN (YELLOW)	Illuminated	All outputs are off. The PLC is not sending any communications.
	Off	Operating normally.
LNK/ACT (YELLOW)	Illuminated	A valid Ethernet communications link has been detected
	Blinking	Communications in progress via the Ethernet port.
	Off	There is no communication via Ethernet or the cable is disconnected at either/both ends.
BCKUP (YELLOW)	Illuminated	A new memory program is being loaded into the PLC.
	Off	No memory program is being loaded.

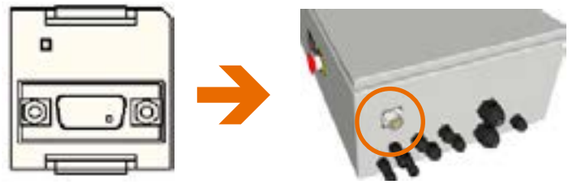
Communication port RS485:



Front

Communication Port RS232:

This port is wired directly to the Handy connector located at the bottom of the cabinet.



Power supply

The power supply converts the input voltage, which can be from 110 to 480VAC depending on the model, into an output voltage of 24VDC that supplies all the controller elements, except the frequency inverter. The power supply models may vary depending on the control system model:

24VDC supply
(cage clamp connection)

24VDC supply
(screw connection)

Frequency inverter

The frequency inverter is the element that controls the rotational velocity of the AC motor by modifying the supply frequency. There is a control panel on the front where the operating variables can be seen and the drive configuration parameters modified.

Circuit breakers

MCBs are protective devices that can interrupt the electrical current in the circuit when it exceeds a maximum value or when a short circuit occurs.

Depending on the solar tracker controller model it may have one MCB to protect all the elements of the system or two different MCBs: one to protect the frequency inverter and another to protect the power supply and, as a result, the rest of the elements of the system:

6Q2 Frequency inverter MCB.

24VDC Power Supply MCB.

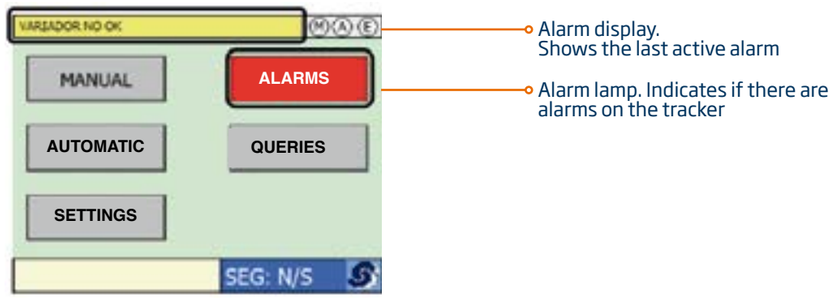
7Q3 For controller models with only one switch, the MCB will have a greater capacity in order to protect all the elements of the system.

Wind Input Relays

The relay is an electromagnetic device that functions as a switch controlled by an electrical circuit. The two relays in the control system serve as input bits that provide the PLC with information regarding the four possible Wind conditions: No wind, low wind, medium wind and high wind.

Item 6: Viewing alarms

The tracker alarms can be viewed and managed from the Handy. Firstly, if an alarm exists, the alarm lamp on the initial screen turns red and blinks.



The last alarm that occurred in the tracker appears in the bar at the top of the screen. Keep in mind that the alarm that appears in the top bar is the last (but perhaps not the only) alarm. The alarm query screen can be accessed by clicking on the alarm display located at the top of the screen or on the flashing alarm lamp:

Press the “Reset” button to clear the alarms. It must be pressed in order to clear the alarms that require a reset. See item 8 for a detailed description of the tracker alarms.

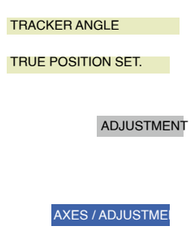
Note: The tracker DOES NOT CHANGE STATUS while the Alarms are being queried.

Item 7: OFFSET adjustment of the inclinometer

The inclinometer is a transducer that generates an analogue output according to the inclination angle at which it is set within an established inclination range. The offset adjustment of an inclinometer is performed during the tracker start-up procedure to provide a reference point. It involved a precise measurement of inclination that the system memorises and uses to calculate the position of the tracker within the established range.

To perform the offset adjustment, follow these steps:

1. Follow the path: Settings > Axes. > →to access the inclination offset adjustment screen



2. Place a digital level on the panel.

3. Move the tracker manually until it is completely horizontal (the digital level will read 0° ± 0.5°).

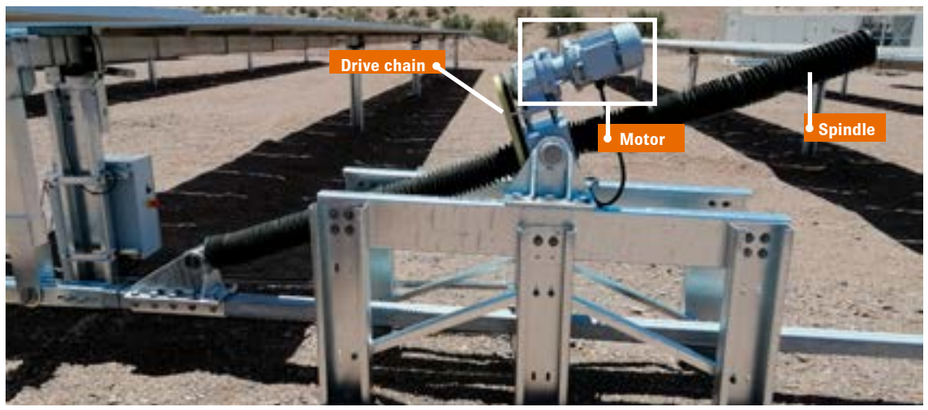
4. Enter the value indicated by the digital level in the field “True Position (°)”.

5. Then use the buttons to adjust the measurement of the analogue signal to the true reading.

6. Check that the value entered in the field “Tracker Angle (°)” matches the adjustment angle entered in “True Position (°)”.

2.4 Mechanical problems in the SP1000

Linear actuator for the SP1000.



Note: The location of the indicated elements may vary according to the design of the tracker, but their functionality within the assembly does not change.

PROBLEM	PROBABLE CAUSES	INSPECTION / SOLUTION
00-THE MOTOR DOES NOT START.	I. The motor does not have a power supply.	1. Check the voltage at the motor input (see the specification plate on the motor). 2. Supply the motor.
	II. The supply cable or the connectors are broken.	1. Check the cable and the connections. 2. Fix the cable and the connections.
	III. The motor MCB in the solar tracker control box has tripped.	1. Check the motor MCB. 2. Adjust protection settings.
	IV. Motor MCB is broken.	1. Check the external condition of the motor for dents / deformations / cracks / breakages / loose or lost components / lubricant leakages that could be the source of the motor fault. 2. Check the power cable, the condition of the connectors and the tightening torque. If it is poorly sealed, water can enter the engine and cause a fault. 3. Disconnect the motor and remove it from the Actuator (1). 4. Connect the motor to a supply and check it separately from the Actuator by comparing it with a new one. 5. Install it in a nearby tracker, supply power and check that it works. 6. If the problem persists, replace the motor.

PROBLEM	PROBABLE CAUSES	INSPECTION / SOLUTION
01-THE ACTUATOR VIBRTES EXCESSIVELY OR MAKES AN UNUSUAL SOUND COMPARED TO SIMILAR ACTUATORS IN THE SOLAR PLANT.	I. Vibration in the area of the motor / motor reducer →Fault with the motor / motor reducer.	1. Check the external condition of the motor / motor reducer for dents / deformations / cracks /breakages / loose or lost components that could be the cause of motor / motor reducer fault. 2. Disconnect the motor and remove the motor / motor reducer from the Actuator (1). 3. Supply the motor and check the motor / motor reducer separately from the Actuator by comparing it with a new one. 4. Install it in a nearby tracker, supply power and check that it works. 5. Replace the motor / motor reducer (Consult TrinaTracker).
	II. Vibration in the area of the worm wheel reducer / spindle →Mechanical fault in the Actuator.	1. Check the external condition of the actuator for dents / deformations / cracks / breakages / loose or lost components / lubricant leakages that could be the source of the motor fault. 2. Re-lubricate the spindle as explained in "Spindle lubrication" in the "Maintenance operations" section and complete one run. If the malfunction continues, repeat theoperation a second (even a third) time. 3. Secure the tracker, disconnect the motor and remove the tracker Actuator. 4. Supply the motor and check the actuator separately from the tracker (compare it with a new one). 5. Replace the Actuator (Consult TrinaTracker).
	III. Unusual sound in the drive chain.	1. Open the cover 2. Check the chain tension. 3. If it is not fully tense, tension until achieving the optimal condition (Contact TrinaTracker)
02-SEVERE LOSS OF VELOCITY OF ROD MOVEMENT.	I. Solar tracker overload.	1. Check the current at the motor input (see the specification plate on the motor). 2. Revise the load on the tracker.
	II.Voltage drops.	1. Check the voltage at the motor input. 2. Provide a better power supply
03-ROD MOVES IN THE WRONG DIRECTION.	I. The motor is connected incorrectly.	DC motor: Swap the phases. AC motor: Swap two phases.
04-THE MOTOR ROTATES, BUT THE ROD DOES NOT MOVE.	I. The worm wheel is completely worn.	1. Replace the Actuator (Consult TrinaTracker).
05-ROD MOVES IN THE WRONG DIRECTION.	I. The actuator.	1. Review Actuator consumption. 2. Check the status of the actuator dimensions, which are defined in the drawings and/or in the assembly manual. Loose or lost components / lubricant leakages that could be the source of the motor fault. 3. Check for possible interference between the lever and the pulling axis, as well as the condition of the bronze bushings. 4. An important factor to check, since it causes the actuator to stop, is to verify the maximum and minimum travel of the actuator. If it exceeds the design distance, the spindle can become stuck with the worm wheel.

2.5 Maintenance tips for the SP1000

MAINTENANCE TABLE		SP1000 TRACKER				CLIENT	
Date: _____ Signature of person responsible:	Estimated time	Frequency	Registration Tracker (1)	Registration Tracker (2)	Registration Tracker (3)	Registration Tracker (4)	Registration Tracker (5)
Position and action EAST zenith sensor	3′	Annually					
Position and action WEST zenith sensor	3′	Annually					
Sun perpendicularity setting check	5′	Annually					
Inclinometer vs Handy check	2′	Annually					
Anemometer signal check	2′	Monthly					
Fastener tightening torque (unions, posts, clamps, etc.)	10′	Annually					
Fastener tightening torque (throw profiles, actuator, etc.)	15′	Annually					
Check correct condition of fasteners	10′	Every two years					
Check distance from the ground to the throwing axis (5 cm in defence)	2′	Monthly					
Check post heads are within tolerances	3′	Annually					
Check operation of the actuator reducer (excess consumption or oil leaks)	5′	Every two years					
Grease drive chain actuator	10′	Every two years					
Grease actuator spindle	10′	Every two years					
Check/change oil level of actuator reducer	10′	Every ten years					
Inspect galvanization or appearance of rust	10′	Annually					
PLC battery replacement (handy alarm)	2′	Every six years					
Plastic bearing component inspection	20′	Annually					
Backtracking check	5′	Annually					
Alarm operation check	5′	Annually					
Electrical panel connections and Basic Stations check	3′	Annually					
Control software checks and updates (if necessary)	10′	Annually					

Lubricating drive chain and spindle FUCHS Gleitmo 805K.

PROPERTY	TEST/METHOD.	VALUE
COLOUR		Beige
BASE OIL		Synthetic
SOLID LUBRICANTS		White, surface reagents
NLGI CONSISTENCY	DIN 51 818	2
TEMPERATURE RANGE		-45 to 110°C
CORROSION PROTECTION100% RELATIVE HUMIDITY 30°C AHT	DIN EN ISO 6270-2	>30 CYCLES
WATER RESISTANCE	DIN 51 802	0/90
EMCOR (DISTILLED H20)	DIN 51 350	0/0
WELDING LOAD (FOUR-BALL TEST)	DIN 51 350	3600/3800
TIMKEN MATERIAL LOAD TEST	ASTM D 2509	55LBS
GRIPPING LOAD (ALMEM-WIELAND)		>18KN

Lubricating the reducer BP Energol SG-XP 220

Test	Method	Units	68	100	150	220	320
AGMA No			2EP	3EP	4EP	5EP	6EP
Density @ 15°C	ISO 12185 / ASTM D4052	g/ml	0.88	0.89	0.89	0.89	0.9
K.V. @ 40°C	ISO 3104 / ASTM D445	mm2/s	68	100	150	220	320
K.V. @ 100°C	ISO 3104 / ASTM D445	mm2/s	8.53	11.1	14.5	18.7	24
Viscosity Index	ISO 2909 / ASTM 2270	-	> 95	> 95	> 95	>95	> 95
Pour Point	ISO 3016 / ASTM D97	°C	-21	-21	-18	-18	-15
Flash Point, PMC	ISO 2719 / ASTM D93	°C	220	220	220	226	226
Foam Seq I	ISO 6247 / ASTM D892	ml/ml's	10/0	10/0	10/0	10/0	10/0
Copper Corrosion (3 hrs @ 100°C)	ISO 2160 / ASTM D130	-	1b	1b	1b	1b	1b
Rust Test (24 hrs Synthetic sea water)	ISO / 7120 / ASTM D665B	-	Pass	Pass	Pass	Pass	Pass
Timken OK Load	ASTM D2782 / IP 240	lbs	-	-	-	70	70
FZG fail stage (A8.3/90)	ISO 14635-1 / DIN 51354	-	> 12	> 12	> 12	> 12	> 12
FZG Micropitting							
Fail Stage	FVA Proj No. 54	-	-	-	>10	>10	>10
GFT Class	FVA Proj No. 54	-	-	-	High	High	High

3 Vanguard 450-2P

3.1 Elements of the Vanguard 450-2P tracker control system

The TCUs are mounted on the Tracker to control inclination and provide the power to move the motor when required. They can be powered by batteries or connected to the mains, depending on the model. Self-powered trackers require a separate solar panel to charge the battery.

Table 2 shows the different TCU models available, classified by communication and power supply.

Communication \ Power supply	Self Powered	Single Line
Zigbee	x	x
RS485		x

Table 2.- TCU models

Self-powered model

Normal model

Each TCU has a front panel with LEDs for alarms, mode and battery status (only self-powered models).
The alarm LED lights up if there are alarms active in the TCU.
The mode LED identifies the main mode of operation:

- LED off: operating mode off
- Double blink: manual mode selected from the PC software.
- Fast blink: manual mode selected from the front panel.
- Slow blink: automatic mode.

The panel also includes buttons for operating the controller. In the most recent versions the keyboard locks when not used for one minute. Press and hold the Mode button for half a second to unlock it. The alarm and mode LEDs will flash when unlocked. Once unlocked, the buttons have the following functions:

- Battery status (only on self-powered models). The battery status LED lights up according to the status of the charge. If the panel voltage is less than 10 V, the LED flashes when the button is pressed.
- Mode Changes the main operation mode.
- Sleep on/off. Pressing this button for 10 seconds turns off the TCU. Pressing this button again for 2 seconds turns on the TCU.
- East West. Moves the tracker if the TCU is in Manual mode. They are also used to configure the direction of movement.
- Zero. Used to self-calibrate all mechanical offsets during the commissioning phase without the need for additional manual operation.

3.2 Types of alarms on the Vanguard 450-2P

If a TCU detects certain anomalous situations, it also activates alarms that may affect the operation.

3.3 Causes and solutions for alarms

00-Emergency stop

Description

The emergency button is pressed

Solutions

1. Deactivate the alarm: the emergency stop button must be reset and the TCU must be in off mode or a "Clear Blockages" performed from the PC software.

01-Time not set

Description

The date and time of the TCU has not been set-up. The TCU will remain in night mode with the starting angle set as the destination position until the time is set.

Possible Causes

TCU not configured

Solutions

1. Press "Change Hour"

2. Press “Time/Date”

3. Press “Send”.

02-Inclinometer

Description

This alarm indicates that the inclinometer does not work properly. If the tracker is active, it is possible to move it in Manual mode, but not in Automatic mode.

Probable causes

PCB probably damaged.

Solutions

Restart the TCU by removing the fuse and disconnecting the panel cables.
To reconnect:Connect the panel cables

1. Turn on the TCU
2. Connect the panel cables.

03-Out of range

Description

This alarm indicates that the Tracker is more than five degrees outside the limits of movement. If this happens, the TCU will stop any automatic movements. The tracker can only be moved using the West/East movements when in Manual mode selected from the front panel.

Probable causes

The Tracker is outside its mechanical limits.

Solutions

Use an external TCU to move the Tracker within the tolerance values.

04-Not-enough batt

Description

This alarm can only be activated in the “Endurance Power” mode. It indicates that the remaining battery charge is not sufficient to safely reach the target position. This means that if the battery continues to lose charge, it will not be possible to reach the target position and then return to the safe position and keep the charge above 40%. If there are no more active alarms related to the battery, the tracker will not move to a safe position, but remain stationary.

05-Limited batt

Description

It indicates that the remaining battery charge is not sufficient to safely maintain the true position. This means that if the battery continues to lose charge, it will not be possible to return to the safe position and keep the charge above 25%. At this point, the Tracker will move to a safe position (only if not controlled manually) to ensure a minimum charge of 25%.

06- Low battery alarm

Description

This alarm is activated in Zen power mode. It indicates that the remaining battery charge is below 30%.

07- Critical batt

Description

This alarm is activated in the “Ultra Sleep” power mode. It indicates that the remaining battery charge is below 20%.

Probable causes

The TCU battery is not recharging.

Solutions

Leave the TCU in manual mode for 30 minutes so it can charge.
If this doesn’t work:

Restart the TCU by removing the fuse and disconnecting the panel cables.

To reconnect:

1. Connect the fuse.
2. Turn on the TCU
3. Connect the panel cables.

08- System monitor

Description

This alarm encompasses different types of alarms. If this alarm is activated, you should contact P4Q Electronics.

Probable causes

PCB probably damaged.

Solutions

Restart the TCU by removing the fuse and disconnecting the panel cables.
To reconnect:

1. Connect the fuse.
2. Turn on the TCU
3. Connect the panel cables.

09- Zigbee alarm

Description

Indicates that communication with the Zigbee antenna has failed.

Probable causes

PCB probably damaged.

Solutions

Restart the TCU by removing the fuse and disconnecting the panel cables.

To reconnect:

1. Connect the fuse.
2. Turn on the TCU
3. Connect the panel cables.

10-Test build

Description

Indicates that the current software version corresponds to a trial version of the software.

Probable causes

TCU not configured.

Solutions

Contact TrinaTracker.

11-Alarm com lost

Description

Activated when the TCU does not detect any communication during the time specified in the PC software. If this occurs, the Tracker will move to the safe position 1.

Probable causes

- Damaged antenna (ZigBee)
- Malfunctioning terminal connection (RS-485)

Solutions

- Check antenna (ZigBee)
- Check terminals (RS-485)

12-Low temp alarm

Description

This alarm is activated when the temperature drops below the threshold specified for that TCU. When this alarm is activated, the Tracker moves to a safe position.

13-Software limit current

Description

This alarm indicates that the value for current measured by the TCU is greater than can be supported, or close to the maximum value.

Probable causes

Collapse of the tracker, Revires, Actuator.

**It is important to know at what time and in what position the blockage occurs, and if it is repetitive.

Solutions

Increase overcurrent stop time.

14-Low speed

Description

This alarm indicates that the speed at which the motor is designed to move is not adequate.

Probable causes

Check the structure to look for collapses, revires.

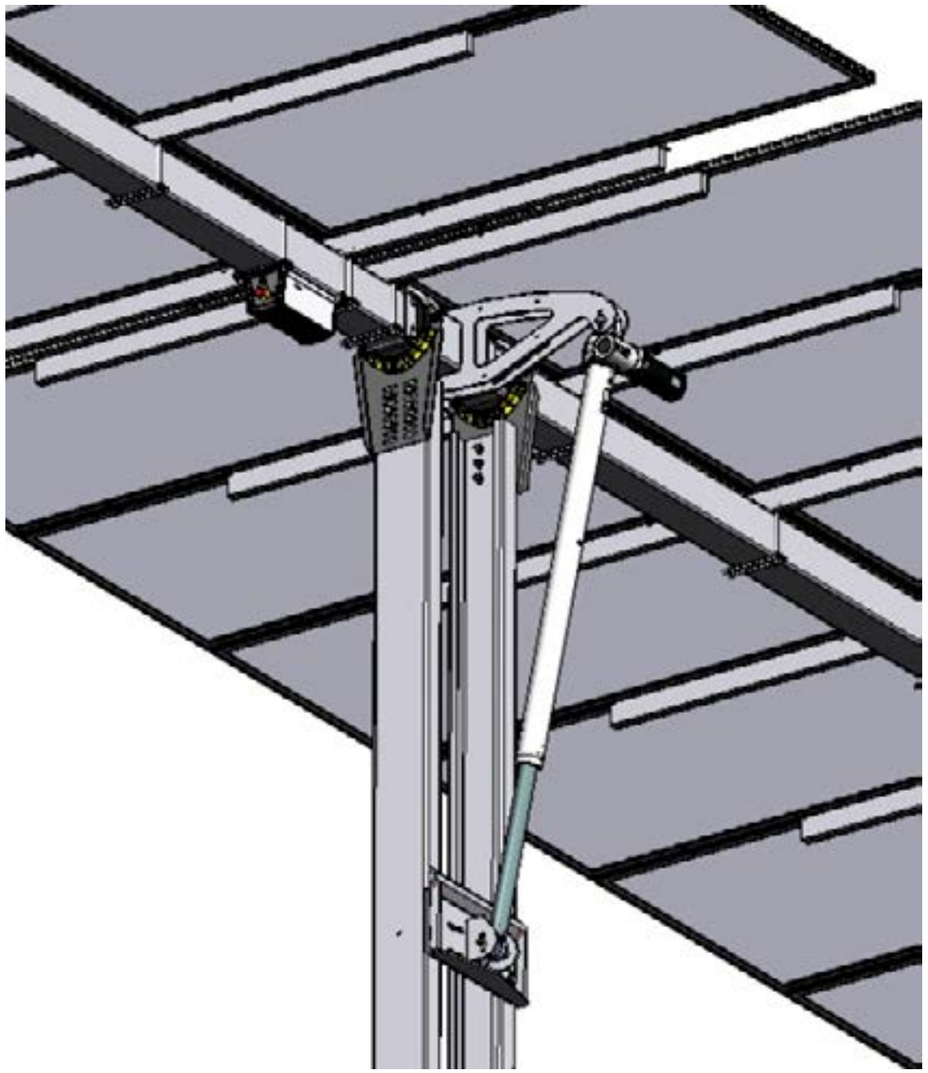
Solutions

Decrease stop velocity (“Axis parameters”)

**It is important to know at what time and in what position the blockage occurs, and if it is repetitive.

3.4 Mechanical problems in Vanguard 450-2P with linear

In this section, TrinaTracker will try to explain how to solve the problems that may occur with the Vanguard 450-2P linear actuator.



PROBLEM	PROBABLE CAUSES	INSPECTION / SOLUTION
00-THE MOTOR DOES NOT START.	I. The motor does not have a power supply.	1. Check the voltage at the motor input (see the specification plate on the motor). 2. Supply the motor.
	II. The supply cable or the connectors are broken.	1. Check the cable and the connections. 2. Fix the cable and the connections.
	III. The motor MCB in the solar tracker control box has tripped.	1. Check the motor MCB. 2. Adjust protection settings.
	IV. Motor MCB is broken.	1. Check the motor MCB. 2. Replace the MCB.
	V. Motor fault.	1. Check the external condition of the motor for dents / deformations / cracks / breakages / loose or lost components / lubricant leakages that could be the source of the motor fault. 2. Check the power cable, the condition of the connectors and the tightening torque. If it is poorly sealed, water can enter the engine and cause a fault. 3. Disconnect the motor and remove it from the Actuator (1). 4. Connect the motor to a supply and check it separately from the Actuator by comparing it with a new one. 5. Install it in a nearby tracker, supply power and check that it works. 6. If the problem persists, replace the motor.
01-THE MOTOR MCB IN THE SOLAR TRACKER CONTROL BOX HAS TRIPPED.	I. Short circuit in the line.	1. Check the line. 2. Correct the circuit.
	II. The line is connected incorrectly.	1. Check the line 2. Correct the circuit.
	III. Short circuit in the motor.	1. Disconnect the motor and remove it from the Actuator (1). 2. Replace it with a new one and check it. 3. Replace the motor (Consult TrinaTracker).
	IV. Earth fault in the motor.	1. Disconnect the motor and remove it from the Actuator (1). 2. Replace it with a new one and check it. 3. Replace the motor (Consult TrinaTracker).
	V. Voltage drops.	1. Check the voltage at the motor input. 2. Provide a better power supply.
02-THE MOTOR STARTS AND STOPS REPEATLY OR RUNS AT A NON-UNIFORM SPEED OR DOES NOT MAKE A CONSTANT SOUND.	I. Motor fault.	1. Check the external condition of the motor for dents / deformations / cracks / breakages / loose or lost components / lubricant leakages that could be the source of the motor fault. 2. Check the power cable, the condition of the connectors and the tightening torque. If it is poorly sealed, water can enter the engine and cause a fault. 3. Disconnect the motor and remove it from the Actuator (1). 4. Connect the motor to a supply and check it separately from the Actuator by comparing it with a new one. 5. Install it in a nearby tracker, supply power and check that it works. 6. Replace the motor (Consult TrinaTracker).

(1) It is not necessary to secure the solar tracker before removing the Actuator motor. Actuators without motors are mechanically irreversible, or capable of supporting the tracker in the current position.
(2) TrinaTracker can supply a special device for this operation. Contact our Technical Support.

PROBLEM	PROBABLE CAUSES	INSPECTION / SOLUTION
03-THE ENGINE HAS DIFFICULTY STARTING.	I. The supply voltage deviates from the nominal voltage (see the specification plate on the motor) by more than 10%, at least during start-up.	1. Check the voltage at the motor input during start-up. 2. Provide a better power supply
	II. The amperage of the power supply is insufficient (see the specification plate on the motor), at least during start-up.	1. Check the current at the motor input during start-up. 2. Provide a better power supply
	III. Solar tracker overload.	1. Check the current at the motor input (see the specification plate on the motor) during start-up. 2. Revise the load on the tracker
	IV. Motor fault.	1. Check the external condition of the motor for dents / deformations / cracks / breakages / loose or lost components / lubricant leakages that could be the source of the motor fault. 2. Check the power cable, the condition of the connectors and the tightening torque. If it is poorly sealed, water can enter the engine and cause a fault. 3. Disconnect the motor and remove it from the Actuator (1). 4. Connect the motor to a supply and check it separately from the Actuator by comparing it with a new one. 5. Install it in a nearby tracker, supply power and check that it works. 6. Replace the motor (Consult TrinaTracker).
04- THE MOTOR TRIES TO START BUT SUDDENLY STOPS.	I. Solar tracker blocked.	1. Check for possible blockages in the tracker structure. 2. Remove the cause of the blockage.
	II. Solar tracker overload.	1. Check the level of load on the tracker. 2. Revise the load on the tracker.
	III. The limit of the actuator's stroke has been exceeded: the rod is over-extended or over-retracted (see the Actuator data sheet).	1. Check the position of the rod (see the actuator data sheet). 2. Disconnect the motor and remove it from the Actuator (1). 3. Move the Actuator manually to try to unlock it (2). • Clockwise (CW) →The rod extends. • Anticlockwise (CCW) →The rod retracts. 4. Secure the tracker and remove the rod fixings. 5. 5. Put a steel bar across the terminal-rod and turn it firmly to try to unblock the Actuator. • Clockwise (CW) →The rod retracts. • Anticlockwise (CCW) →The rod extends. 6. Replace the Actuator (Consult TrinaTracker).
	IV. Motor fault.	1. Check the external condition of the motor for dents / deformations / cracks / breakages / loose or lost components / lubricant leakages that could be the source of the motor fault. 2. Check the power cable, the condition of the connectors and the tightening torque. If it is poorly sealed, water can enter the engine and cause a fault. 3. Disconnect the motor and remove it from the Actuator (1). 4. Connect the motor to a supply and check it separately from the Actuator by comparing it with a new one. 5. Install it in a nearby tracker, supply power and check that it works. 6. Replace the motor (Consult TrinaTracker).

PROBLEM	PROBABLE CAUSES	INSPECTION / SOLUTION
05-THE MOTOR HAS OVER-HEATED OR HAS A HIGH CONSUMPTION COMPARED TO SIMILAR MOTORS IN THE SOLAR PLANT.	I. Tracker overload.	1. Check the current at the motor input (see the specification plate on the motor). 2. Reduce the load on the tracker.
	II. The supply voltage is greater than 110% of the nominal voltage (see the motor nameplate).	1. Check the voltage at the motor input. 2. Adjust the supply voltage.
	III. AC motor: A phase is missing.	1. Check the connections of the phases. 2. Correct any faulty contacts.
	IV. Motor fault.	1. Check the external condition of the motor for dents / deformations / cracks / breakages / loose or lost components / lubricant leakages that could be the source of the motor fault. 2. Check the power cable, the condition of the connectors and the tightening torque. If it is poorly sealed, water can enter the engine and cause a fault. 3. Disconnect the motor and remove it from the Actuator (1). 4. Connect the motor to a supply and check it separately from the Actuator by comparing it with a new one. 5. Install it in a nearby tracker, supply power and check that it works. 6. Replace the motor (Consult TrinaTracker).
	V.Mechanical fault in the actuator.	1. Check the external condition of the actuator for dents / deformations / cracks / breakages / loose or lost components / lubricant leakages that could be the source of the motor fault. 2. Re-lubricate the spindle as explained in “Spindle lubrication” in the “Maintenance operations” section and complete one run. If the malfunction persists, repeat the operation a second (even a third) time. 3. Secure the tracker, disconnect the motor and remove the tracker Actuator. 4. Supply the motor and check the actuator separately from the tracker (compare it with a new one). 5. Replace the Actuator (Consult TrinaTracker).
06-THE ACTUATOR VIBRATES EXCESSIVELY OR MAKES AN UNUSUAL SOUND COMPARED TO SIMILAR ACTUATORS IN THE SOLAR PLANT.	I. Vibration in the area of the motor / motor reducer →Fault with the motor / motor reducer.	1. Check the external condition of the motor / motor reducer for dents / deformations / cracks / breakages / loose or lost components that could be the cause of motor / motor reducer fault. 2. Disconnect the motor and remove the motor / motor reducer from the Actuator (1). 3. Supply the motor and check the motor / motor reducer separately from the Actuator by comparing it with a new one. 4. Install it in a nearby tracker, supply power and check that it works. 5. Replace the motor / motor reducer (Consult TrinaTracker).

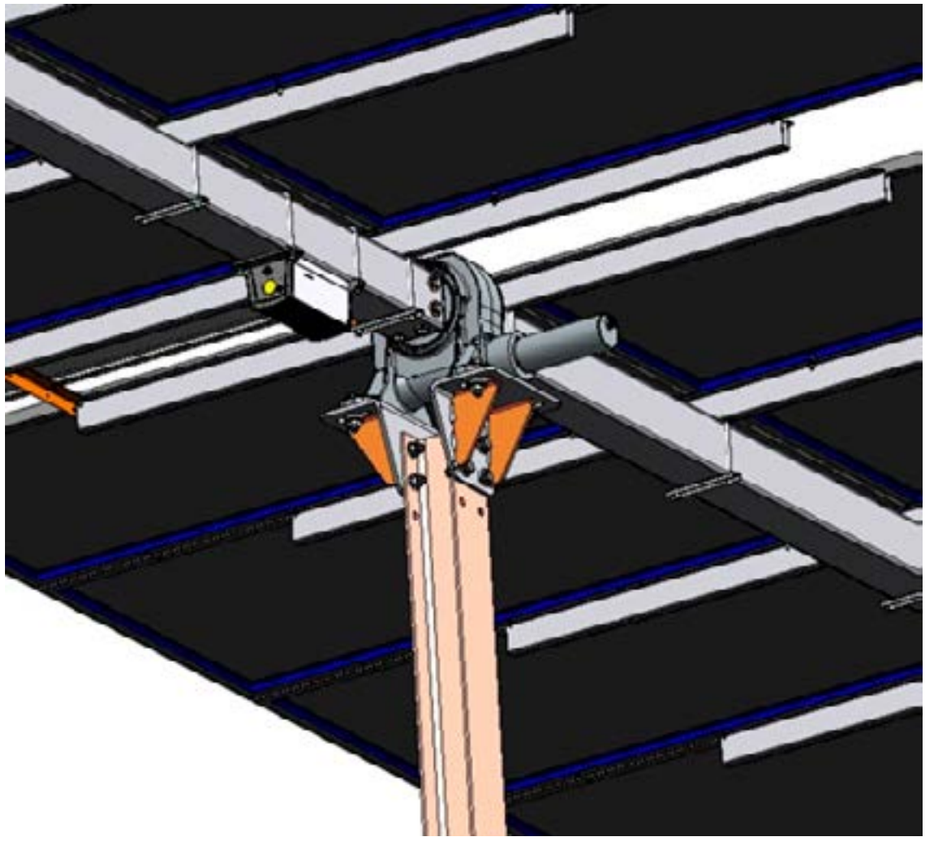
(1) It is not necessary to secure the solar tracker before removing the Actuator motor. Actuators without motors are mechanically irreversible, or capable of supporting the tracker in the current position.
(2) TrinaTracker can supply a special device for this operation. Contact our Technical Support.

PROBLEM	PROBABLE CAUSES	INSPECTION / SOLUTION
06-THE ACTUATOR VIBRATES EXCESSIVELY OR MAKES AN UNUSUAL SOUND COMPARED TO SIMILAR ACTUATORS IN THE SOLAR PLANT.	II. Vibration in the area of the worm wheel reducer / spindle →Mechanical fault in the Actuator.	1. Check the external condition of the actuator for dents / deformations / cracks / breakages / loose or lost components / lubricant leakages that could be the source of the motor fault. 2. Re-lubricate the spindle as explained in “Spindle lubrication” in the “Maintenance operations” section and complete one run. If the malfunction continues, repeat the operation a second (even a third) time. 3. Secure the tracker, disconnect the motor and remove the tracker Actuator. 4. Supply the motor and check the actuator separately from the tracker (compare it with a new one). 5. Replace the Actuator (Consult TrinaTracker).
07-SEVERE LOSS OF VELOCITY OF ROD MOVEMENT.	I. Solar tracker overload	1. Check the current at the motor input (see the specification plate on the motor). 2. Revise the load on the tracker.
	II. Voltage drops.	1. Check the voltage at the motor input. 2. Provide a better power supply
08-ROD MOVES IN THE WRONG DIRECTION.	I. The motor is connected incorrectly.	• DC motor: Swap the phases. • AC motor: Swap two phases.
09-THE MOTOR ROTATES, BUT THE ROD DOES NOT MOVE.	I. The worm wheel is completely worn.	1. Disconnect the motor and remove it from the Actuator (1). 2. Connect the motor to a supply and check it separately from the Actuator by comparing it with a new one. 3. Manually activate the Actuator (2). • Clockwise (CW) →The rod extends. • Anticlockwise (CCW) →The rod retracts. 4. Secure the tracker and remove the Actuator. 5. Install the motor in the Actuator, provide it with power and check the Actuator separately from the tracker. 6. Replace the Actuator (Consult TrinaTracker). If the worm wheel is found to be complete worn, TrinaTracker recommends inspecting the level of wear of the worm wheels in the solar plant, as described in “Inspecting worm wheel wear” in “Maintenance operations”. Excess wear could cause the tracker to be exposed to the action of the wind in a fixed position, resulting in very serious damage.
10. THE ROD FREELY ENTERS AND EXITS THE OUTDOOR TUBE.	I. The spindle screw is completely worn.	1. Secure the tracker and remove the Actuator. 2. Push and pull the rod to check that it can be easily moved 3. by hand. 4. Replace the Actuator (Consult TrinaTracker). If the screw is found to be complete worn, TrinaTracker strongly recommends to quickly inspect the level of wear of the screws in the solar plant, as described in “Inspecting spindle screw wear” in “Maintenance operations”. Excess wear could cause the sudden collapse of the tracker,leaving it exposed to wind action, and cause death or serious injury to personnel as well as very significant damage to the tracker.

(1) It is not necessary to secure the solar tracker before removing the Actuator motor. Actuators without motors are mechanically irreversible, or capable of supporting the tracker in the current position.
(2) TrinaTracker can supply a special device for this operation. Contact our Technical Support.

3.5 Mechanical problems in Vanguard 450-2P with slewing drive

In this section, TrinaTracker will try to explain how to solve the problems that may occur with the Vanguard 450-2P Tracker with slewing drive.



PROBLEM	PROBABLE CAUSES	INSPECTION / SOLUTION
00-THE MOTOR DOES NOT START	I. The motor does not have a power supply.	1. Check the voltage at the motor input (see the specification plate on the motor). 2. Turn on the motor.
	II. The supply cable or the connectors are broken.	1. Check the cable and connections. 2. Fix the cable and connections.
	III. The motor MCB in the solar tracker control box has tripped.	1. Check the motor MCB. 2. Adjust the MCB settings.
	IV. Motor MCB is rusty.	1. Check the motor MCB. 2. Replace the MCB.
	V. Motor fault.	1. Check the external condition of the motor for dents / deformations / cracks / breakages / loose or lost components / lubricant leakages that could be the source of the motor fault. 2. Check the power cable, the condition of the connectors and the tightening torque. If it is poorly sealed, water can enter the engine and cause a fault. 3. Switch off the engine and remove it from the turning mechanism. 4. Provide it with a power supply and check it separately from the turning disk by comparing it with a new one. 5. Install, supply and verify it on a nearby tracker. 6. If the problem persists, replace the motor.
01-THE MOTOR STARTS AND STOPS REPEATLY OR RUNS AT A NON-UNIFORM SPEED OR IT DOES NOT HAVE A UNIFORM ALARM.	I. Motor fault.	1. Check the external condition of the motor for dents / deformations / cracks / breakages / loose or lost components / lubricant leakages that could be the source of the motor fault. 2. Check the power cable, the condition of the connectors and the tightening torque. If it is poorly sealed, water can enter the engine and cause a fault. 3. Switch off the engine and remove it from the turning mechanism. 4. Provide it with a power supply and check it separately from the turning module by comparing it with a new one. 5. Install, supply and verify it on a nearby tracker. 6. If the problem persists, replace the motor (Consult TrinaTracker).
02- THE MOTOR STARTS AND OPERATES UNDER NO LOAD, BUT DOES NOT COMMUNICATE THE MOVEMENT TO THE TURNING MODULE.	I. Reducer fault.	1. Disconnect the motor and check it under no load. 2. If there is no problem, check the motor + reducer under no load. 3. Provide a power supply to the assembly. 4. If the problem persists, replace the reducer (Consult TrinaTracker).
03- THE MOTOR + REDUCER START AND OPERATE WITHOUT A LOAD, BUT DO NOT COMMUNICATE THE MOVEMENT TO THE TURNING MODULE.	I. Turning module fault.	1. Disconnect the motor and check it under no load. 2. If there are no problems, check the motor + reducer under no load. 3. If there are no problems, check the motor + reducer + turning module. 4. Provide a power supply to the assembly. 5. If the problem persists, replace the turning module (Consult TrinaTracker).

3.6 MAINTENANCE TIPS FOR THE Vanguard 450-2P

MAINTENANCE TABLE		VANGUARD 450-2P			CLIENT		
Date: _____ Signature of person responsible: check	Estimated duration	Frequency	Registration of tracker (1)	Registration of tracker (2)	Registration of tracker (3)	Registration of tracker (4)	Registration of tracker (5)
1.1 Tightening torque che	10min	Annually					
1.2 Controller check	See Annex I. Controller						
1.3 Support checks	2min	Annually					
1.4 Galvanization and structure checks	10min	Annually					
1.5 Bearing checks	5min	Annually					
1.6 Operational parameters checks	10min	Annually					
1.7 Actuator check	See Annex II. Actuator						

TrinaTracker