

Document **CM**

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# Commissioning Manual

## Vanguard

### STANDARD MANUAL

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CONTROL REVISION

REV	DATE (dd/mm/yy)	DESCRIPTION	ELABORATED	REVISED	APPROVED
1	04/05/20	INITIAL DOCUMENT	ILZ	LGA	

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# 1 OBJECT

The present document provides guidance and instructions for the commissioning phase of the tracker. Keep in mind that this information is generic therefore the specifications for example (the tracker rows' rotation angle, row spacing, and the manner of transmitting wind alarms, etc) ... will be reflected in the plans and specific documentation of each installation.

It is mandatory to read the report prior to performing the checks and if there are any doubts, contact Trina Tracker technicians on site or directly contact our staff at our offices in Spain.

# 2 GENERAL, RESPONSIBILITIES AND SAFETY MEASURES

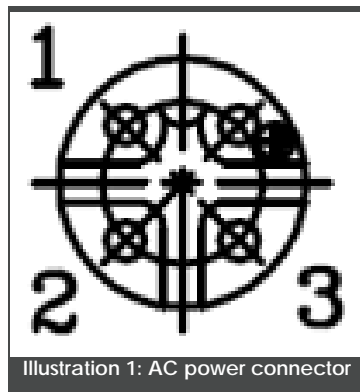
The team in charge of commissioning the solar tracker shall be qualified and specialized in this type of work. The damage caused by negligence caused by unqualified staff and improper use of the components will not be covered by the tracker's warranty nor will Trina Tracker be responsible for any replacements.

To proceed with the implementation please follow these recommendations:

1. Mechanical assembly must be fully completed and verified.
2. Only people carrying out the commissioning shall be within the area of the tracker's movement scope.
3. People conducting or commissioning shall be:
  - 3.1. Informed about the risks inherent in this type of assembly, with special attention to mechanical entrapment hazards and electrical hazards.
  - 3.2. Fully aware of the steps and implementation procedures contained in this manual.
  - 3.3. Armed with appropriate clothing and proper protection for this type of work.
  - 3.4. Aware that even though IP65 protection TCU protects against dust, unintentional immersion, water pressure and high temperatures. Workers shall also take into consideration the following aspects:
    - > If the unit will not be installed immediately, it is recommended to store it in its original packaging, in a dry and ventilated place.



- > Do not store with flammable liquids and materials. The temperature reached by the unit may facilitate the generation of fires.
- > When encountering any mechanical or electrical component that shows faults, do not use the product immediately and contact the supplier.
- > For proper installation and maintenance of the unit, tools must meet the standards for protection against direct and indirect electrical contacts.
- > The unit has internal shielding to prevent direct electrical contact.
- > In the case of powered systems to ensure protection against indirect contacts, all metal parts of the unit fed AC voltage shall be grounded



4. The steps and recommendations contained in this documentation shall always be followed bearing in mind that people's safety must prevail above everything else.

Trina Tracker is responsible for the supplied items only. The instructions in this manual must be followed faithfully; otherwise, the manufacturer is exempt from any liability, the same as modifications or alterations made without authorization from the manufacturer. The manufacturer is exempt from any responsibility for the proper functioning of the solar tracker and safety of persons handling the set.

The exclusive presence of authorized personnel during the installation of the solar tracker is recommended. Also, people working or traveling through the work zone are obliged to respect the basic safety standards for health & safety.

They shall be equipped with the appropriate personal protective equipment (helmet, gloves, harness, safety shoes, etc. ...) and to take preventive measures such as:

- not being under a suspended load
- wearing gloves to prevent injuries from surface irregularities and ferrous materials
- checking tethered parts
- ensuring that slings or cables have enough strength to withstand the weight of elements due to be raised and any other elements applicable.
- not handling electrical components without first ensuring that they have been disconnected.

- all operations must be performed using suitable tools, with insulating properties in the case of working with electrical components.

It is strictly forbidden to start trackers without the authorization of Trina Tracker and it is also mandatory the placement, installation and verification of the wind control system designed according to the specifications of each installation.

It is the client's responsibility to ensure power supply to proceed with the implementation of the trackers.

### 3 PRELIMINARY COMMISSIONING REQUIREMENTS

With sufficient advance notice (minimum of three weeks) prior to starting the preparatory work, the CLIENT shall provide Trina Tracker with all the preliminary information collected in the preparatory sheets, provided by Trina Tracker personnel which includes information such as: the location of the installation, persons of contact, size of the panels, tilt parameters for safety positions, slopes per tracker, etc., as well as the expected position (x, y coordinates table) of the controllers (TCUs) supplied by Trina Tracker; this information shall be provided by e-mail, in electronic format (.xls file). Trina Tracker will also indicate if remote or on-site support is desired for the preparatory tasks, the commissioning and if applicable, the performance tests.

The CLIENT must guarantee the following to Trina Tracker prior to starting the commissioning work:

- The installation is connected to the external electrical grid and is energized.
- All IPs should be delivered for every Trina Tracker devices (Mask Subnet, Gateway default)
  - > 3 IPs per NCU (Zigbee Communication)
  - > 2 IPs per NCU (RS485 Communication)
  - > 1 IPs per Industrial PC (Internet and Local Access)
- The industrial PC (data logger) is also connected to the installation's ethernet and continuous access to the internet is available at a minimum stable speed of 8 Mbps (upload/download).
- The network and all the elements are properly connected to the ground protection connections.
- In plants with wireless communications (Zigbee), the antennas of all the TCUs as well as NCUs are properly installed and extended as indicated in their respective installation manuals. The CLIENT has provided photographs showing how the antennas are installed.
- In plants with RS 485 bus communications, the installer (the CLIENT or a third party subcontracted by them) has completed the test procedures for this type of installation as



defined in the document included 'BUS WIRING VERIFICATION' and has provided a copy of the test results report .

- The CLIENT has acknowledged and accepted the express recommendations made by Trina Tracker to not carry out the commissioning tests with electrical power from the generator sets(1), due to the possible current instability problems they generate, which may damage the equipment. In cases where the tests are carried out using generator power, the CLIENT accepts that Trina Tracker will not be liable for any damage that occurs and that the equipment warranty will be null and void.

Once commissioning starts, the defined requirements in Annex II should be delivered by customer

## 4 PRELIMINARY INSPECTION

### 4.1. Tracker assembly components

As a first step client need to ensure that all the parts of a solar tracker are properly mounted and secured with the correct torque.

As a requirement it is essential that the pre-commissioning report (the documentation of the inspection confirming that the tracker structure has been assembled correctly) is validated by qualified Trina Tracker personnel. Trina Tracker will not be responsible for the assembly inspection of the trackers.

As a preventative measure and in case of doubt, ensure proper assembly and torque of the screws of the main parts such as:

- Correct fixing of the photovoltaic modules
- Correct fixing of the support structure of the drive unit
- Correct attachment of the TCU to the structure
- Correct fixing of TCU cables

The reason for a preventative check is to avoid damaging or breaking the photovoltaic modules or other parts that make up the solar tracker.

---

<sup>1</sup> This solution will only be accepted if the defined conditions in "COMMISSIONING WITH EXTERNAL POWER ODP01" are fulfilled

## 4.2. Prevention of physical interferences

Ensure that there are no elements that could interfere with the movement of each tracker within its working angle. Check both mounting elements and other natural items that may limit the movement of the tracker.

- Mounting elements: verify that the entire row of the tracker can move freely and that there is nothing to prevent its movement.
- Natural elements: Verify there are no other means preventing movement such as stones, stands or slopes. If any of these are detected, delay the start until the constraints are resolved or record the maximum angle of movement to change the parameters in our software and adjusting the proximity sensors to the new angle. Similarly replace the east and west boundaries as appropriate (such changes can only be done by our technicians or by written authorization from Trina Tracker).

## 4.3. Restricted working areas

For security reasons verify that there is nobody around the tracker to avoid possible entrapment risks that could cause injury (remote risk due to low speed of trackers).

#### 4.4. Verify proper voltage and battery STATUS

##### 4.4.1. Self-powered tracker

It is mandatory, after finishing mechanical commissioning that the power supply to all the NCUs installed in the project must be completed.

It is the client's responsibility to provide power to the NCU to carry out the commissioning phase. The client may provide power via power generators in cases where it is not available via the main supply on site.

As the TCUs are Self Powered, they shall be checked as described:

##### 4.4.1.1. TCU SP

1. If necessary, insert the fuse provided in the fuse holder, firmly pressing the lid (0.4Nm).



Illustration 2: Fuse insertion

2. Check the Battery status before connecting the panel cables by pressing the "Sleep ON/OFF" button for 3 seconds (until the LED flashes).

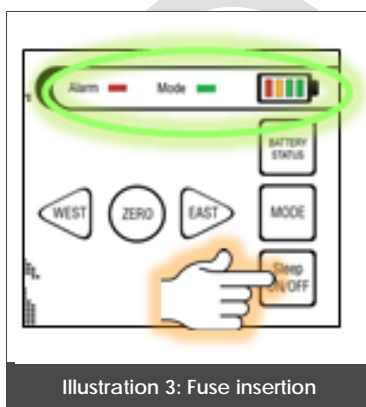
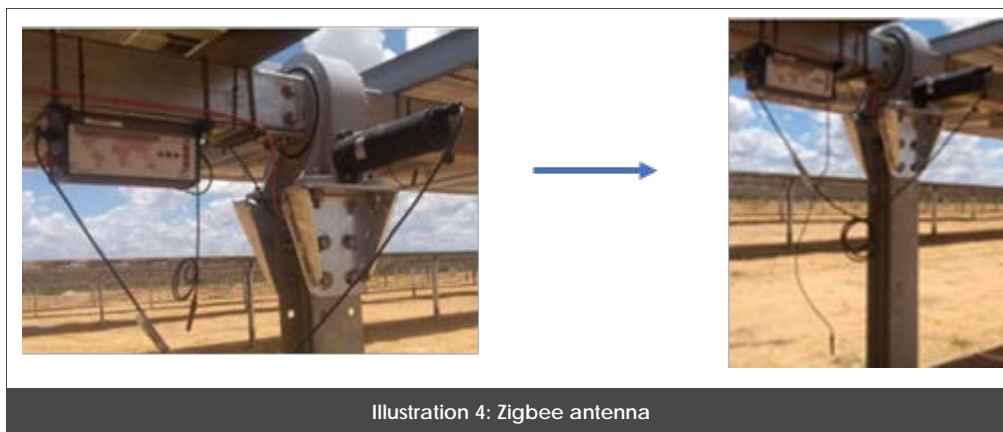
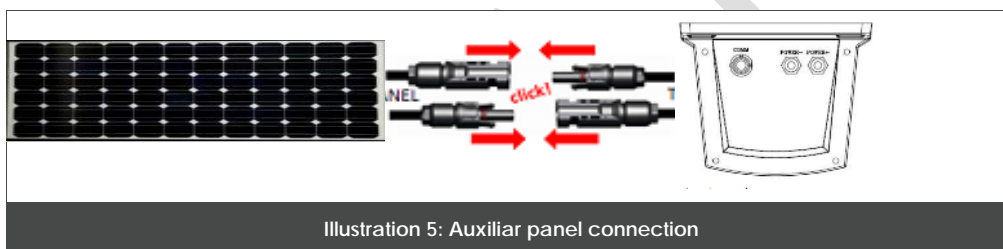


Illustration 3: Fuse insertion

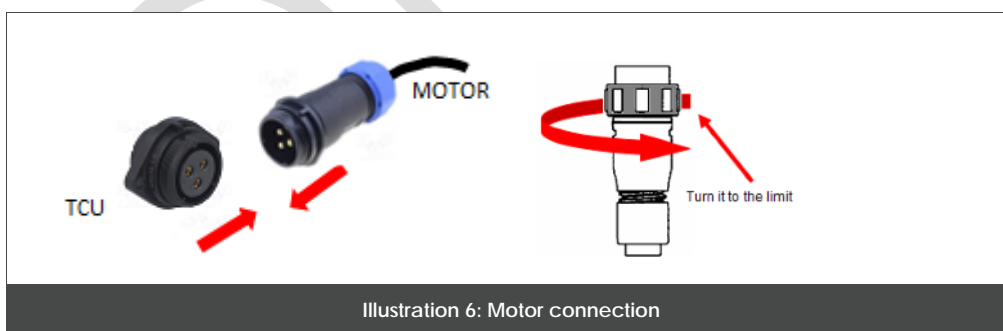
3. The ZigBee Antenna is delivered together with its connection cable, already connected to the TCU, and it can be left free hanging from the TCU or fixed in the tracker structure, in a place which does not hinder communications



4. Connect the power supply input through the cable panels.



5. Connect the motor cable to the TCU.



6. Press the "MODE" button several times, until the green LED "MODE" light flashes twice(MANUAL MODE).



7. Release the emergency stop button.



Follow all instructions and mark the row No. 04 Annex I as valid (OK) only if all specifications are met and verify that the behaviour of the electrical panel explained coincides with testing work.

#### 4.4.1.2. TCU SS

1. Verify that ZigBee communications antenna is connected to the TCU (It is factory delivered that way) and freely hangs from it:



Illustration 9: Zigbee antenna

2. Ensure that TCU PV panels are properly installed and connected to the TCU SS.

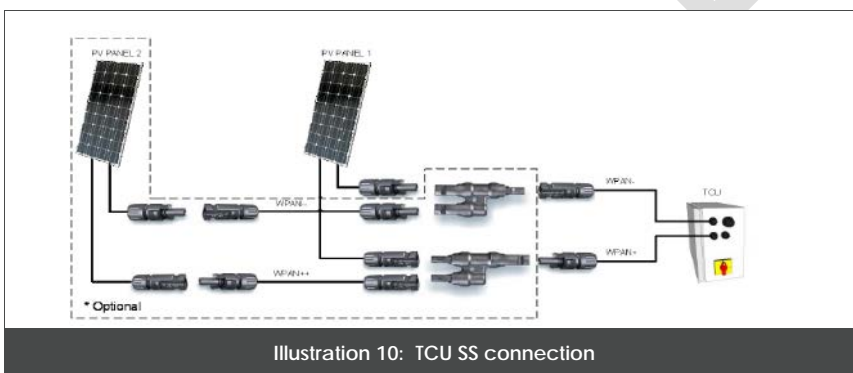


Illustration 10: TCU SS connection

3. Verify that the DC motor is correctly installed in the tracker and connected to the TCU SS by the WM1 cable:

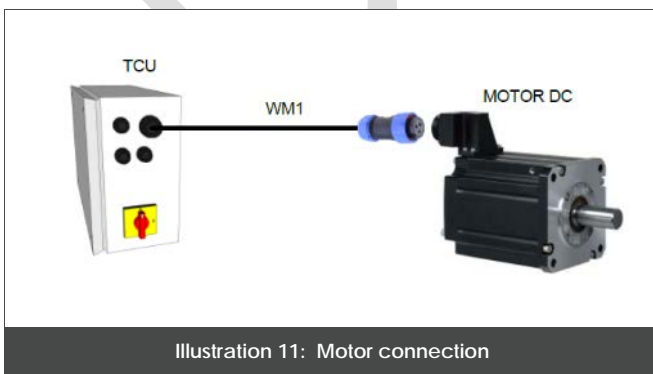
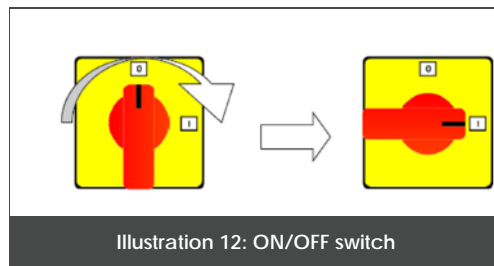


Illustration 11: Motor connection



4. Turn right the switch located on the right side of the TCU SS for switching it to I (ON) position.



Follow all instructions and mark the row No. 04 Annex I as valid (OK) only if all specifications are met and verify that the behaviour of the electrical panel explained coincides with testing work.

#### 4.4.2. Powered tracker

It is mandatory, after finishing mechanical commissioning that the power supply to all the NCUs installed in the project must be completed.

It is the client's responsibility to provide power supply to the electrical panel's tracker for carrying out the commissioning of the tracker. The client may provide power from power generators in cases where it is not available via the main supply. Trina Tracker recommend using generator sets capable of moving several trackers at the same time and this is recommended for each inverter. The following is a summary the available choices of generator:

- Maximum consumption of each tracker AC: 5.0 A per phase (4.0A @ 115VAC, 2.0A @ 230VAC)

For the next calculation  $\cos\phi = 0.7$  is used:

- Single-Phase generator (230V<sub>AC</sub>)
  - > Minimum power: 0.8kVA per each TCU
  - > Minimum power: 200% more than max power of the trackers connected

- Three-phase generator with neutral (380V<sub>AC</sub>)

Only one phase and neutral must be connected. For getting a voltage balanced and do not damage the TCUs, please connect same TCUs per phase.

- > Minimum power: 2.5kVA
- > Minimum power: 200% more than max power of the trackers connected

⚠ **Caution:** Do not use the generator set when connected to a tracker for welding work or other electrical consumption that produces peaks of heavy consumption, since generators are not able to respond quickly enough to load changes and produces surges to disconnect loads.

Once it is verified that the mains supply is adequate proceed to the switchboards. For safety reasons Trina Tracker supply the electrical panels with the breakers off. To power the electrical panels, follow the steps in the following order:

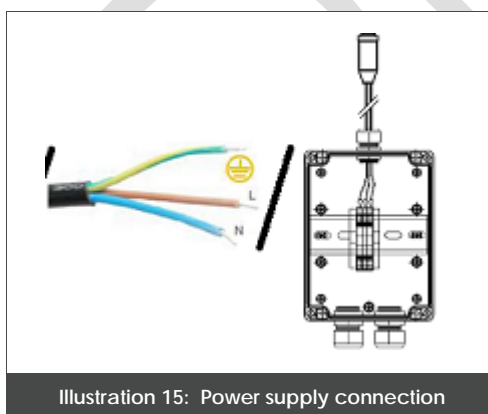
1. If necessary, insert the fuse provided in the fuse holder, firmly pressing the lid (0.4Nm).



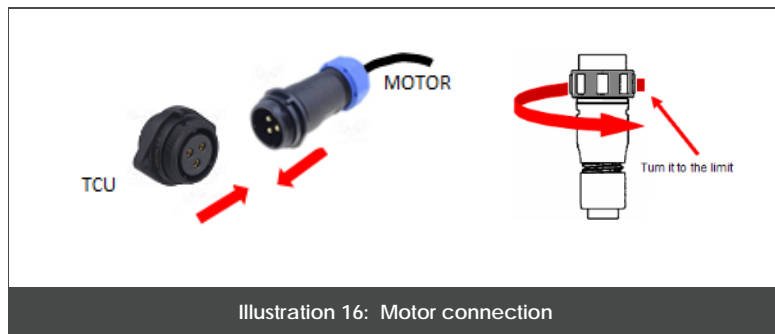
2. If necessary, press the "MODE" button for 3 seconds (until the LED flashes).



3. Connect the power supply input.



4. Connect the motor cable to the TCU.



5. Press the "MODE" key several times, until the green LED "MODE" flashes twice (MANUAL MODE).



6. Release the emergency stop button.



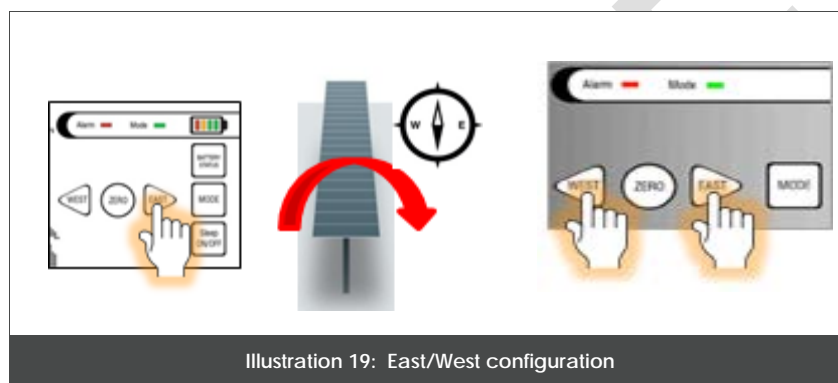
Follow all instructions and mark the row No. 04 Annex I as valid (OK) only if all specifications are met and verify that the behaviour of the electrical panel explained coincides with testing work.

## 5 TURN MOTOR / TCU

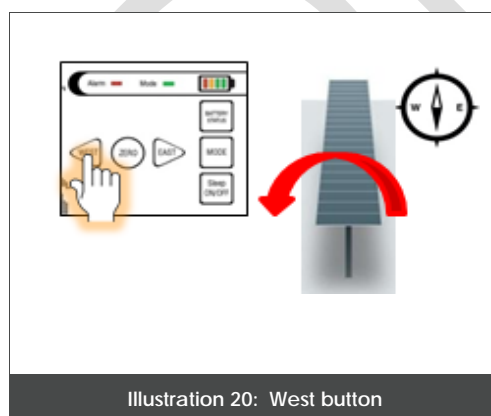
### 5.1. Check engine rotation

#### 5.1.1. TCU SP

1. Press the "EAST" button and check that the solar tracker is turning towards the east. If it turns in the opposite direction as intended proceed to hold the "EAST" button while pressing the "WEST" button to reverse the direction.



2. Press the "WEST" button and verify that the solar tracker turns west.



### 5.1.2. TCU SS

- Handy Terminal

There are two operations to move a tracker manually:

> Move tracker Westwards or Eastwards

- Access to Manual-Jogging screen.
- Press the central button to toggle between **Fast** or **Slow** speed.
- Press buttons **EAST** or **WEST** to start movement eastwards or westwards. The movement will continue while the button remains pressed or until it reaches one of its inclination limits.

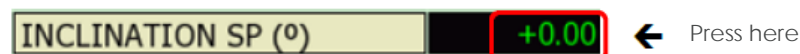
This operation is less accurate when trying to move the tracker to an exact inclination.

The real-time tracker tilt can be displayed:

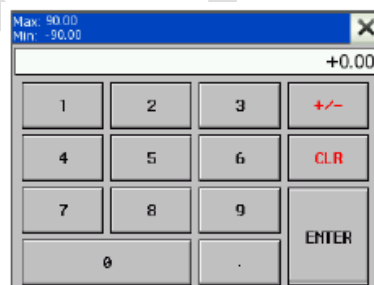


> Move tracker to an exact inclination

- Press  to go to the Manual-Setpoint screen.
- Press on the green digits of the "Setpoint Inclination" display:






The screen will show a keyboard:



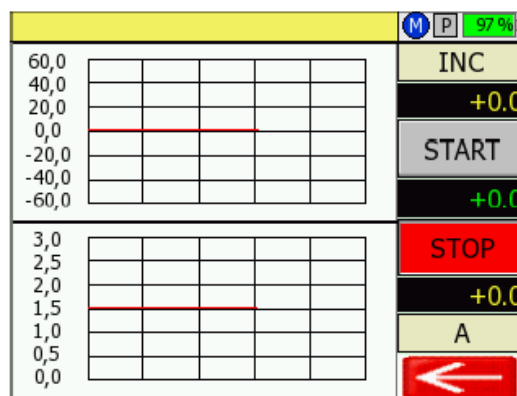
- Enter the desired inclination value for the tracker, in degrees, and press "ENTER".
- Press **START ROTATION** to start movement. The tracker will automatically stop when it reaches the selected position, i.e, when the displayed value in the "Tracker inclination" display matches the "Setpoint Inclination" value.

5. Press  to stop movement at any time.

It is also possible to move the tracker to an exact inclination by pressing  from the Manual-Setpoint screen to go to the screen of graphics.

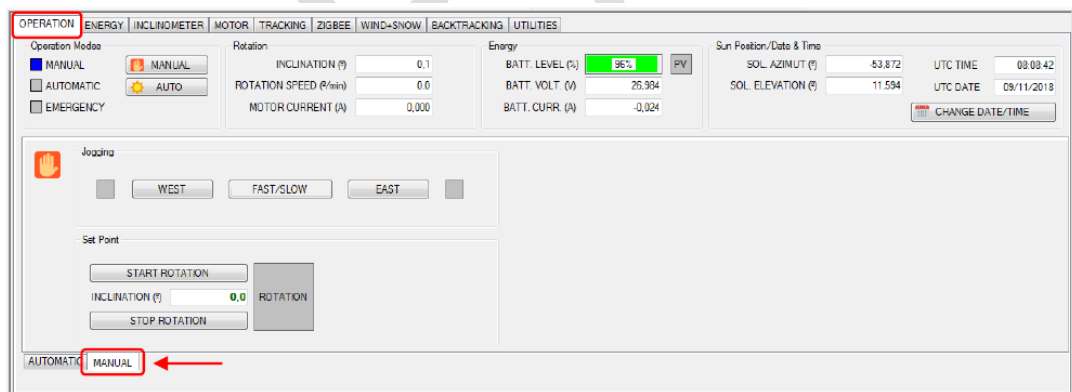
As in the former screen, entering a position value on the display and pressing  the tracker rotates until reaching that entered position. Press  to stop movement at any time.

It is possible on this screen to see the tracker inclination variation along the day and the DC motor current consumption as well.



- Computer

Click on the MANUAL tab (Sub-menu) to access the manual screen:



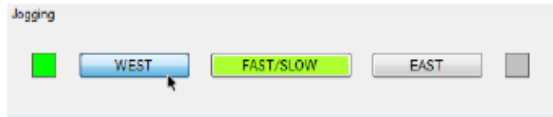
There are two ways of moving a tracker manually:

- > Move a tracker westwards or eastwards

1. In the "Jogging" section, click on the middle button to toggle  speed. (  )



- Click on the  or  buttons to start movement in desired rotation direction. Movement will go on while the button remains pressed or until reaching one of its inclination limits. The corresponding lamp will be ON while the movement lasts:



This movement is inaccurate and unhelpful if desired the tracker to reach an exact inclination.

The real-time tracker inclination can be displayed:

Rotation

INCLINATION (°)	10,1
ROTATION SPEED (°/min)	-7,7
MOTOR CURRENT (A)	0,205



Displays real-time tracker inclination

- > Move tracker to an exact inclination

- Click on the "INCLINATION (°)" display of the "Setpoint" section, enter the desired value with the computer numeric keypad and press the "ENTER ↵" key:

Set Point

<input type="button" value="START ROTATION"/>	<input type="text" value="0,0"/>	<input type="button" value="ROTATION"/>
<input type="button" value="STOP ROTATION"/>		

- Once the desired value is entered, click  to start movement:

Jogging

☒

Set Point

INCLINATION (°)

The "ROTATION" lamp will turn on, and also the lamp indicating the tracker rotation direction. The tracker will automatically stop when the desired inclination is reached, i.e., when the tracker inclination matches the setpoint value.

Movement can be stopped whenever desired by clicking

STOP ROTATION

DRAFT

## 5.2. Inclinometer angle adjustment

One of the most important steps is setting the inclinometer. The use of a digital level so that the level horizontal mark 0 degrees and 90 degrees vertical mark is recommended.



Illustration 21: Level

As well check that the incline of the TCU with the torque tube

The inclinometer is a transducer, integrated within the TCU, which generates the tracker inclination angle. During the tracker commissioning protocol, the inclinometer offset setup gives it a reference point, an accurate inclination measure that the system memorizes and uses to calculate the tracker position within the range set.

### 5.2.1. TCU SP

Steps to follow:

1. Place the level in the main solar panel, and then rotate the solar tracker east / west horizontal position (zero degrees elevation).

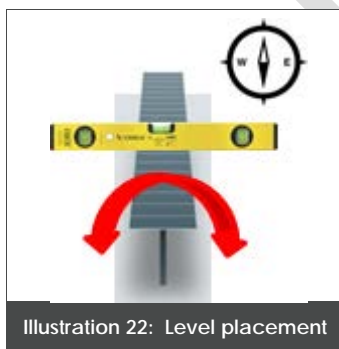
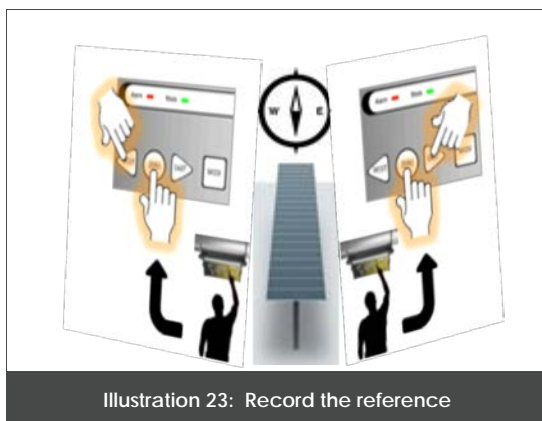


Illustration 22: Level placement

2. Record the reference point simultaneously pressing ZERO + EAST or ZERO + WEST, depending on its location relative to the axis solar tracker.



3. Green LED "MODE" now shall stop flashing and stay on for 3 seconds.



4. Press the emergency stop button.

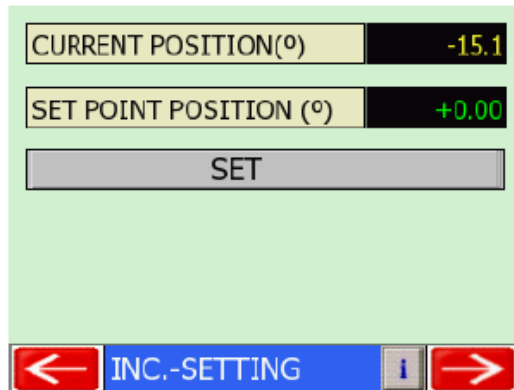


### 5.2.2. TCU SS

Follow next steps to perform the offset setup:

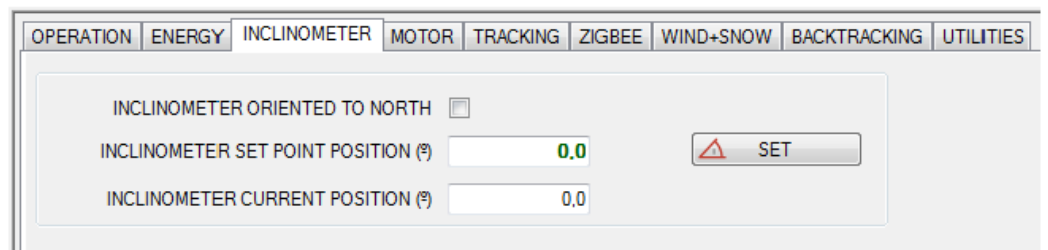
- Handy terminal

Follow the path: CONFIGURATION > INCLINOMETER to go to offset setup screen:



- Computer app

Click the INCLINOMETER tab on the Navigation Menu to go to offset setup screen:



It is necessary to login in order to modify these parameters.

The inclinometer offset setup is performed as follows:

1. Place a digital level in the flat of the panels:

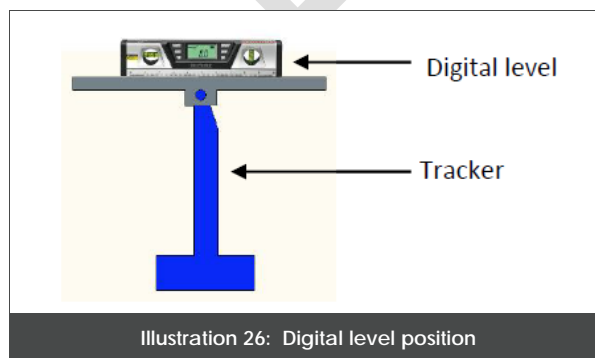


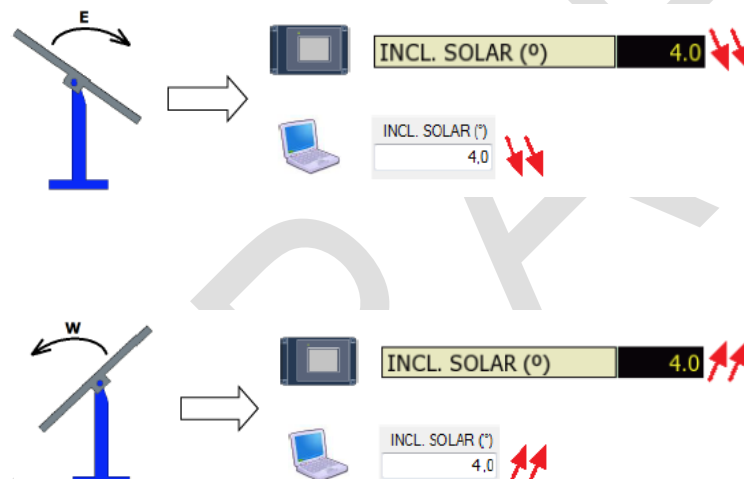
Illustration 26: Digital level position

2. Move the tracker manually until an exact position. It is recommended  $0^\circ$ , i.e., the tracker completely horizontal (The digital level has to measure  $0^\circ \pm 0.5^\circ$ ).
3. Enter the value which the digital level indicates in the "SET POINT POSITION ( $^\circ$ )" field.
4. Then press "SET" for the system to match the analogue signal measurement to the real one.
5. Check that the value displayed in "CURRENT POSITION ( $^\circ$ )" matches the value entered in "SET POINT POSITION ( $^\circ$ )".

For ensuring the inclinometer measuring is right, the TCU must be correctly fixed to the tracker rotation axis and rotate at the same time that it does so. However, the measurement will be completely opposite depending if the TCU is oriented North or South.

To check if the inclinometer is oriented properly, move the tracker manually eastwards first and then westwards (Read section 6.1 to know about moving a tracker manually). When doing it, it must be checked:

- - When moving the tracker eastwards, the inclinometer measurement must decrease:

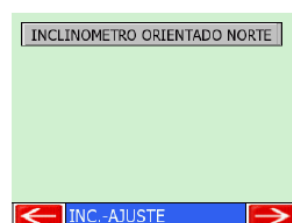


- - When moving the tracker westwards, the inclinometer measurement must increase:

If this is not the case, it is possible to digitally change the inclinometer orientation with the help of an operation terminal, as follows:

- Handy terminal

Follow the path: CONFIGURATION > ➔ INCLINOMETER >



\*\*LOGIN\*\* to go to inclinometer orientation setup screen:

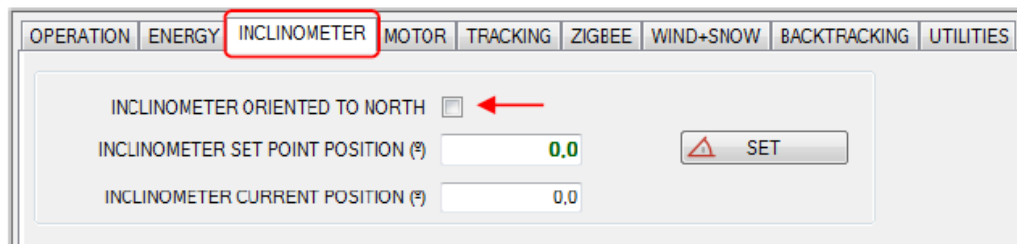


By pressing the button, it is possible to toggle between INCLINOMETER- NORTH ORIENTATION or INCLINOMETER-SOUTH ORIENTATION.

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6. Computer app

Click the INCLINOMETER tab on the Navigation Menu to go to inclinometer orientation setup option:



OPERATION	ENERGY	INCLINOMETER	MOTOR	TRACKING	ZIGBEE	WIND+SNOW	BACKTRACKING	UTILITIES
<div>INCLINOMETER ORIENTED TO NORTH <input type="checkbox"/> <span style="color: red;">←</span></div> <div>INCLINOMETER SET POINT POSITION (°) <input type="text" value="0.0"/></div> <div>INCLINOMETER CURRENT POSITION (°) <input type="text" value="0.0"/></div> <div><span>⚠</span> SET</div>								

7. It is necessary to login in order to modify this option.
8. Click the checkbox to toggle between INCLINOMETER ORIENTED TO SOUTH or INCLINOMETER ORIENTED TO NORTH.

## 6 PHYSICAL STOPS

It is necessary check if there is contact with the physical stops in the defined limits positions.

## 7 BARCODE SCANNING ONLY FOR TCU SP VERSION

With handheld scanner (PDA) and "Suntrack Scan" application, capture the barcode identifier of solar trackers.



## 8 PARAMETER SETTINGS ONLY FOR TCU SP VERSION

Perform network configuration and parameterization of solar trackers, using the "Suntrack Inject"



Suntrack Inject

tool installed on a PC.

For more details see "Commissioning Process" model file required solar tracker latest revision.

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# 9 WIND

## 9.1. Check wind alarms reception

### 9.1.1. TCU SP

The software incorporates limits maximum angle of movement at different values of wind that can be received (see PC software Manual NCU).

Wind Levels			
	km/h		s
Level 1 Thr	<input type="text" value="0"/>	Level 1 On Time	<input type="text" value="0"/>
Level 2 Thr	<input type="text" value="0"/>	Level 2 On Time	<input type="text" value="0"/>
Level 3 Thr	<input type="text" value="0"/>	Level 3 On Time	<input type="text" value="0"/>
Level 4 Thr	<input type="text" value="0"/>	Level 4 On Time	<input type="text" value="0"/>
Level 5 Thr	<input type="text" value="0"/>	Level 5 On Time	<input type="text" value="0"/>
Level 6 Thr	<input type="text" value="0"/>	Level 6 On Time	<input type="text" value="0"/>
Level 7 Thr	<input type="text" value="0"/>	Level 7 On Time	<input type="text" value="0"/>

	s
Level 1 Off Time	<input type="text" value="0"/>
Level 2 Off Time	<input type="text" value="0"/>
Level 3 Off Time	<input type="text" value="0"/>
Level 4 Off Time	<input type="text" value="0"/>
Level 5 Off Time	<input type="text" value="0"/>
Level 6 Off Time	<input type="text" value="0"/>
Level 7 Off Time	<input type="text" value="0"/>

The wind limits defines by Trina Tracker are:

- Wind speed upper to 40 km/h, limit tracker at +-30
- Wind speed upper to 50 km/h, limit tracker at +-15
- Wind speed upper to 60 km/h, limit tracker at +-0

The alarm activation time is 3 seconds and the deactivation time is 600 seconds

Their definition (wind thresholds and maximum rotation angles) will be defined by work and, for verification, the client must provide enough resources, so it can be verified in the process of commissioning (see PC software Manual TCU). Parameters may vary, and limit movement of a

Movement Limits	
Degrees	Degrees
L1 East Limit <input type="text" value="0"/>	L1 West Limit <input type="text" value="0"/>
L2 East Limit <input type="text" value="0"/>	L2 West Limit <input type="text" value="0"/>
L3 East Limit <input type="text" value="0"/>	L3 West Limit <input type="text" value="0"/>
L4 East Limit <input type="text" value="0"/>	L4 West Limit <input type="text" value="0"/>
L5 East Limit <input type="text" value="0"/>	L5 West Limit <input type="text" value="0"/>
L6 East Limit <input type="text" value="0"/>	L6 West Limit <input type="text" value="0"/>
L7 East Limit <input type="text" value="0"/>	L7 West Limit <input type="text" value="0"/>

tracker to another and therefore shall be configured on site using the "Suntrack Inject" tool.

### 9.1.2. TCU SS

With the handy terminal follow the path: CONFIGURATION > WIND/SNOW > \*\*LOGIN\*\* to access the wind and snow control screens:

Parameter	Value
MEDIUM WIND (°)	+15.00
LOW WIND (°)	+30.00
SNOW (°)	+0.00

Parameter	Value
LOW WIND-ENTER (s)	1.0
LOW WIND-EXIT (s)	1.0
MEDIUM WIND-ENTER (s)	1.0
MEDIUM WIND-EXIT (s)	1.0
HIGH WIND-ENTER (s)	1.0
HIGH WIND-EXIT (s)	1.0

- With the computer app:

Click the WIND/SNOW tab on the Navigation Menu to access the wind and snow control screen:

Section	Parameter	Value
Wind Positions	MEDIUM WIND (°)	15.0
	LOW WIND (°)	30.0
	Wind Timers	
	LOW WIND-ENTER (s)	1.0
	LOW WIND-EXIT (s)	1.0
	MEDIUM WIND-ENTER (s)	1.0
	MEDIUM WIND-EXIT (s)	1.0
Snow Positions	HIGH WIND-ENTER (s)	1.0
	HIGH WIND-EXIT (s)	1.0
	SNOW (°)	0.0

It is necessary to login in order to modify these parameters.



9.1.3. Check wind reading

All anemometers are tested before delivery. To verify that the anemometers are in good condition, verify that reading that provide the devices have shown consistency and speed values according to real existing wind work. The main feature of the NCU is the direct connection to the anemometer and so and only from these switchboards the wind speed can be read using the corresponding PC software. To this end, it has to communicate with the NCU (see PC software Manual NCU for TCU SP model and Operation manual for TCU SS model).

Wind Status/Alarm

km/h

Wind Speed

0

Wind Level

0

Wind Alarm

☐

Wind Sensor Failure

☐

9.2. Check reading SNOW (OPTIONAL)

9.2.1. Snow reading

The sensor operates by measuring the time required for an ultrasonic pulse travel to and from a target surface. This means that its output value represents the distance from the sensor to the nearest surface. To calculate the level of snow, one must know the total distance from the ground sensor (see PC software Manual NCU for TCU SP model and Operation manual for TCU SS

model).

Snow

m

Snow Level

0

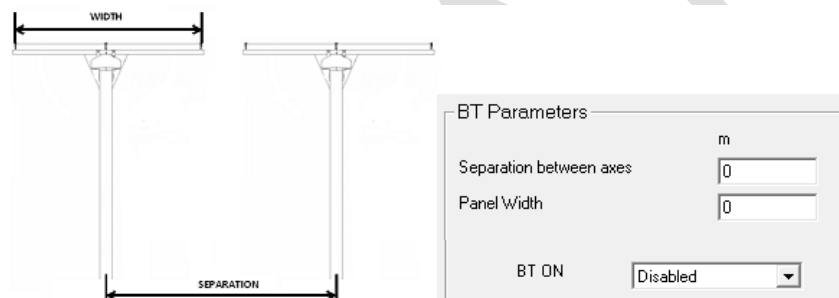
# 10 BACKTRACKING

## 10.1. tracker absent shadow

Backtracking is a tracking substate activated at dawn and dusk. In Backtracking state, the TCU determines the inclination angle which avoids shadows between panels of adjacent trackers and modifies the tracker position. This procedure is especially useful when losses due to a deviation angle are less than losses due to shadows in panels.

### 10.1.1. TCU SP

Parameters backtracking "row spacing (m)" and "width panels (m)" may vary from one to another tracker so must be configured on site using the "Suntrack Inject" tool".



### 10.1.2. TCU SS

Backtracking setup is performed as follows:

- Handy terminal

Follow the path: CONFIGURATION > BACKTRACKING > \*\*LOGIN\*\* to go to Backtracking setup screens:



- Computer app

Click the BACKTRACKING tab on the Navigation Menu to access the backtracking setup screen:

It is necessary to login in order to modify these parameters.

For further details please check 'Operation manual'

## 10.2. Slope W / E

Using the same criteria as above and the worst angle catching takes samples in each row tracker recorded.

You must enter the deviation between the orientation of the solar tracker and geographic north (If East is positive and West is negative). And if there is pending in the field, indicate the slope in degrees, the slope direction and the deviation between the slope falling and geographic north.

# 11 SYNCHRONIZATION

An IP will be enabled to synchronised the time in the NCUs .

# 12 FINAL TESTS

## 12.1. Automatic mode

Activate de automatic mode and visualize the alarms is by NCU software and with the TCU software (see PC software Manual NCU for TCU SP model and Operation manual for TCU SS model).) both local port and remote communication.

## 12.2. Sealing inputs / outputs presses

Verify that all the cable glades are properly tightened and those who are free closed by the corresponding shutter.

## 12.3. Check cleaning and general condition of the tracker

Perform a final inspection to ensure that the tracker is in good condition and that the tracker is in optimum condition for automatic operation:

- Power cable shall be connected properly, and motor cable must be plug-mounted
- Check the cleanliness of packaging material on the surface of the tracker (pallets, plastic, etc.)
- Check cleaning parts or components forming part of the tracker
- Other parts or debris remaining during the assembly process.

# 13 COMMUNICATIONS

The NCU sends commands and receives status information from trackers by a ZigBee communications network on the 2,4GHz free band. The TCU has a communications board connected to an external antenna. By this board, the control system receives wind information, time synchronization and remote orders from an NCU and it sends state information to it.

## 13.1. Zigbee

### 13.1.1. TCU SP

The communication between NCU and TCU will be completed after mechanical commissioning.

All the antennas shall be free of obstacles and move freely.

The communication fail defines by Trina Tracker for a Zigbee communication is **15 minutes**.

### 13.1.2. TCU SS

ZigBee communications assure high availability because of not depending on a physical layer as can be a cable. Security in communications is guaranteed by means of encryption by 128-bit AES algorithm.

Communications commissioning process is much faster than with wiring technology because of absence of connecting problems inherent to wiring buses.

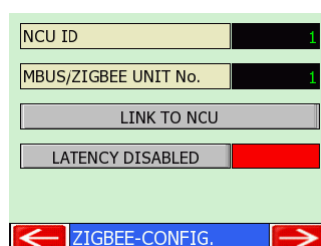
The communication fail defines by Trina Tracker for a Zigbee communication is **15 minutes**.

#### Communications with NCU

For the NCU to detect and incorporate a TCU to the communications network, it is necessary to setup the TCU as follows:

- [Handy terminal](#)

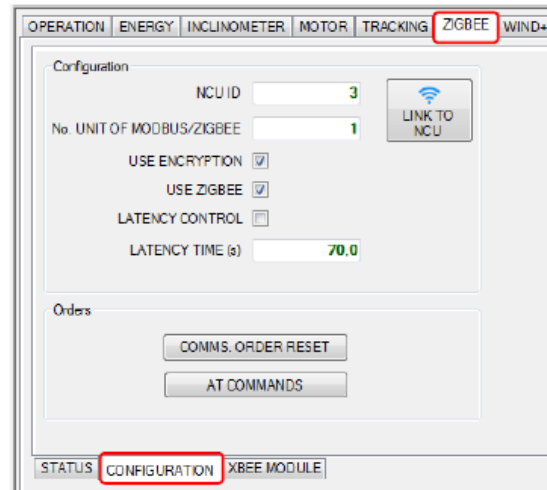
Follow the path: [CONFIGURATION > ZIGBEE > CONFIGURATION > \\*\\*LOGIN\\*\\*](#) to access to communications basic setup screen:



The screenshot shows a configuration interface with a light green background. At the top, there are two input fields: 'NCU ID' and 'MBUS/ZIGBEE UNIT No.', both containing the value '1'. Below these fields are two buttons: 'LINK TO NCU' and 'LATENCY DISABLED'. The 'LATENCY DISABLED' button has a red bar on its right side. At the bottom, there is a blue bar with a left arrow, the text 'ZIGBEE-CONFIG.', and a right arrow.

- Computer app

Follow the path ZIGBEE (Navigation Menu) > CONFIGURATION (Sub-menu) to access the



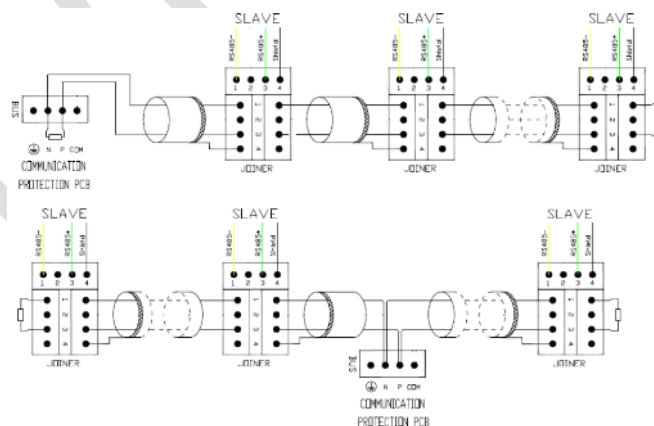
communications setup screen:

It is necessary to login in order to modify these parameters.

For further details read the 'Operation Manual'

## 13.2. RS485

The communication between NCU and TCU must be completed and connected prior the beginning of the commissioning works.



All the connection shall be done properly to avoid TCUs damaged. Please proceed with the manual provided by TRINA TRACKER and it is advisable make the verification as the document "Bus Wiring Verification".

The communication fail defines by Trina Tracker for a RS485 communication is **5 minutes**.

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# 14 REQUIREMENTS TO COMPLETE COMMISSIONING AND FINAL COMMISSIONING CERTIFICATE

The commissioning will have two phases:

- TCUs, NCUs configuration & TCU the operational tests: when this phase is finalized the *Provisional Acceptance Certificate* (Annex I) will be signed by Trina Tracker
- Performance tests (PR Test) will start after *Provisional Acceptance Certificate* (Annex I) is delivered and upon completion of the tests, both parties will sign the *final acceptance certificate*.

The commissioning will be considered completed when 100% (2) of the TCUs, NCUs are configured, the performance tests are done and the operational tests of the TCUs have been completed, which are:

- Configuration of the trackers in the safety position (cleaning, snow and wind) (100% of the TCUs) followed by
- Setting to Auto mode (100% of the TCUs) after the safety positions tests (unless otherwise indicated by the CLIENT).

Upon completion of the tests, Trina Tracker will sign the *Final Acceptance Certificate* using the form included in Annex I. From this moment forward and until the performance tests have begun, the CLIENT may not modify the configuration parameters of the equipment supplied by Trina Tracker or of the installation; any modification made by the CLIENT without the authorisation of Trina Tracker prior to the performance tests shall, to all effects, be deemed a final acceptance of the equipment by part of the CLIENT, with the same effect as if the installation had satisfactorily passed all the performance tests.

In case of cancellation of the commissioning by part of the CLIENT

- If Trina Tracker does not receive notification of the cancellation seven days prior to the scheduled start date, the CLIENT shall assume:
  - > All non-reimbursable costs incurred by Trina Tracker until that moment (e.g. flight reservations, hotels, etc.) according to the pricing chart of Trina Tracker services or specific offer.
  - > The cost of one complete workday for the technician (or technicians if more than one is assigned).

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<sup>2</sup> To comply with this percentage, only equipment shall be considered that is available at the time the tests are conducted and that are not affected by a problem not attributed to NCLAVE, which prevents conducting the tests on said equipment.



- If technicians from Trina Tracker have already arrived at the installation and need to return back to their company, the CLIENT will assume all the costs incurred (flights and changes in tickets, billeting, etc.) as well as the number of lost work days (beginning when they left Spain until they return).
- All cancelled commissioning operations must be rescheduled following the same procedure and notification times indicated in the previous section (Commissioning Scheduling process).

In case of delay of the commissioning by part of the CLIENT, If Trina Tracker does not receive notification of the delay seven days prior to the scheduled start date, the CLIENT shall assume the cost of the lost work days for the technicians from Trina Tracker deployed during the wait time, including non-reimbursable expenses (e.g. Flight reservations, hotels, etc.) at the costs stipulated in the pricing chart of Trina Tracker services or specific offer if any.

In case of extension and/or rescheduling of the Commissioning work

- An extension of the dates scheduled for the commissioning tests for reasons beyond the control of TRINA TRACKER (weather conditions, failures or deficiencies in the installation, electrical supply problems, lack of communication with the industrial PC, not being able to access or restricted access to the installation, etc.), will incur additional costs (due to the extension of the technical support, billeting, changes to or cancellation of flight and/or hotel reservations, replacement of technicians, etc.) which must be assumed in whole by the CLIENT at the prices stipulated in pricing chart of Trina Tracker services or specific offer if any.
- If such delays occur, the parties will agree on an extension or rescheduling of the work. In no case shall the CLIENT be able to request compensation or be able to file a claim with Trina Tracker if the new availability of technicians does not meet what is initially requested by the CLIENT.


#### 14.1. Performance Tests (PR TEST)

- The duration of the performance tests shall not exceed seven consecutive days, after which time, if the conditions listed below are met, all components shall be considered finally accepted and the stipulated warranty and after-sales period shall begin.
- The results of the performance tests last seven days consecutive since the start of the they are:
  - > 99% of the TCUs track correctly.
  - > 99% tracking time (daily time) without TCU communication alarm<sup>(3)</sup>
  - > 100% tracking time without NCU communication alarm
  - > 100% TCUs go to stow position when it is too windy (daily time)

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<sup>3</sup> As long as the relative location of NCUs and TCUs, and NCUs-TCUs mapping have followed the design recommended by NCLAVE.

- > 100% TCUs go to night position
- > 100% TCUs stop in set the turn limits
- > 99% of TCUs charge the battery and manage it properly
- > 99% of TCUs turn on properly and don't suffer sudden blackouts
- Preliminary commissioning requirements shall be guarantee during the PR Test for the calculation of the final results.
- If during the performance tests, any of the components do not pass the defined thresholds, Trina Tracker may review and correct (remotely or on site if they are physically present during the tests) these deficiencies. Any deficiency solved within 1 day after the notification, it will not consider an impact in the result of the performance.
- However, the possible existence of some components that have not passed the defined test thresholds after the test has been completed, shall not prevent the start of the guarantee period since this document will indicate which Trina Tracker components have not passed the tests and if Trina Tracker is responsible for these, the parties will agree on a deadline for Trina Tracker to correct the problems and notify the CLIENT, after which time, these components will be monitored again for an additional seven days to see if they pass the aforementioned tests.

	Vanguard Commissioning Check List	Ver.:1
		Rev.: 0

OPL	
Proyect	
Supervisor:	

Date	
Commissioning Engineer.:	

COMMISSIONING INSPECTION GLOSSARY				
Nº	Task	Description	ASSEMBLER	PEM ENGIN.
1	Initial test	Tracker assembly components (Pannel, TCU...)	✓	x
2		No interference or element that prevents movement	✓	x
3		No person working inside the tracker	✓	x
4		Verify proper voltage and battery status	✓	x
5	Mechanical and electrical inspection	Check the tighten of the stuffing box (Motor, COM...)	✓	x
6		Verify that the TCU is align with the torque tube	✓	✓
7		Verify the inclinometer angle adjustment	✓	x
8		Check engine rotation (East / West)	✓	x
9		Check engine consumption (Sw TCU)	✓	✓
10	Date/time UTC	Verify the right date and time configuration	x	✓
11	Stopper Sw	Verify the right contact of the physical Sw limit	✓	x
12	Wind	Verify that the 3 status of wind are working	x	✓
13		Check the right reading of the wind from Sw NCU.	x	✓
14	Backtracking	Check and adjust the shadow status in the backtracking	x	✓
15	Final test	Verify the automatic mode performance	✓	✓
16		Check the sealing inputs and output cables of TCU and NCU	✓	x
17		Check general condition of the tracker	✓	x