**Trina**Tracker

# Commisioning Manual
## Agile 1P

STANDARD MANUAL

ENGINEERING DEPARTMENT

# REVISION CONTROL

| REV | DATE (dd/mm/yy) | DESCRIPTION | ELABORATED | REVISED | APPROVED |
|---|---|---|---|---|---|
| 1 | 04/05/20 | INITIAL DOCUMENT | ILZ | LGA | |
| 2 | 21/07/21 | TCU UPDATES | LGA | | |
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**Trina**Tracker

# CONTENT

**Trina**Tracker

# FIGURES

# 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 TrinaTracker 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 TrinaTracker 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.

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> 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



**Illustration 1: AC power connector**
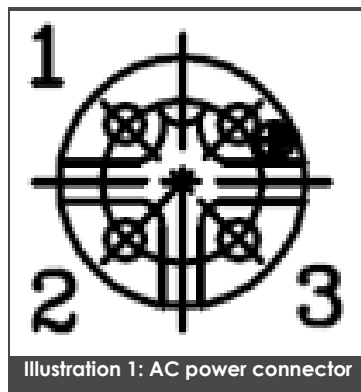
4. The steps and recommendations contained in this documentation shall always be followed bearing in mind that people's safety must prevail above everything else.

TrinaTracker 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.

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It is strictly forbidden to operating the trackers without the authorization of TrinaTracker 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 starting 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 TrinaTracker with all the preliminary information collected in the preparatory sheets, provided by TrinaTracker 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 TrinaTracker; this information shall be provided by e-mail, in electronic format (.xls file). TrinaTracker 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 TrinaTracker 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 TrinaTracker devices (Mask Subnet, Gateway default) if it is not Trina TCU.

  > 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). Not supplied with Trina TCU.

- The network and all the elements are properly connected to the ground protection connections.

- In plants with wireless communications (Zigbee or LoRa), 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 TrinaTracker 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 TrinaTracker 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 TrinaTracker personnel. TrinaTracker 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.

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[1] This solution will only be accepted if the defined conditions in "COMMISSIONING WITH EXTERNAL POWER ODP01" are fulfilled

## 4.2.  Prevention of physical interferances

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 that 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 TrinaTracker).

## 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).
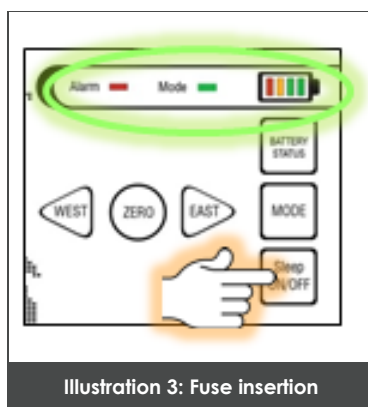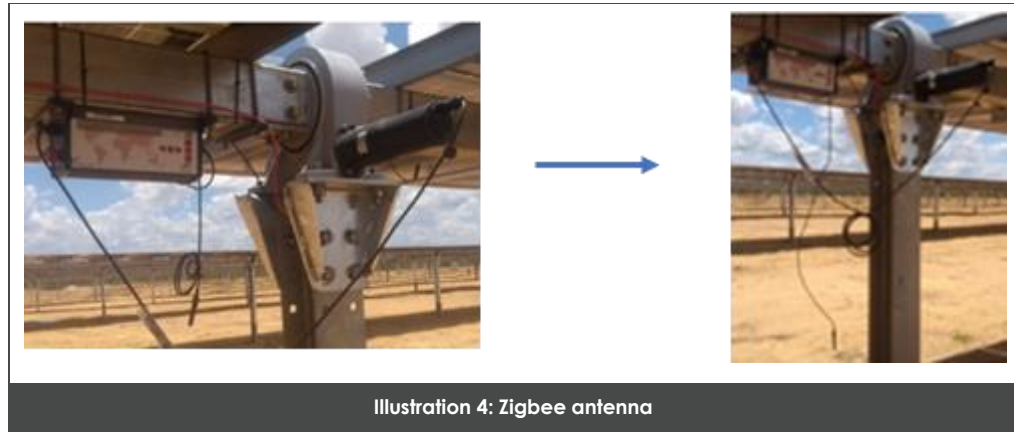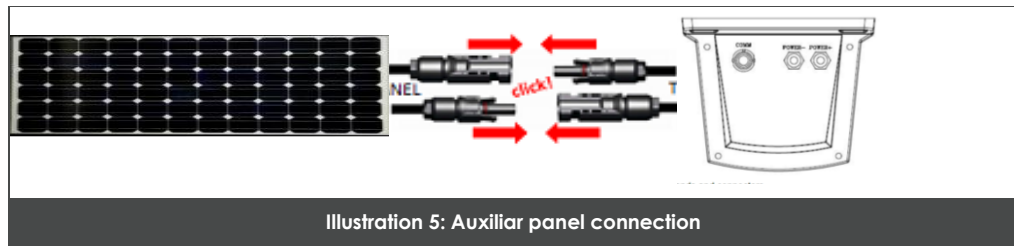


**Illustration 3: Fuse insertion**

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
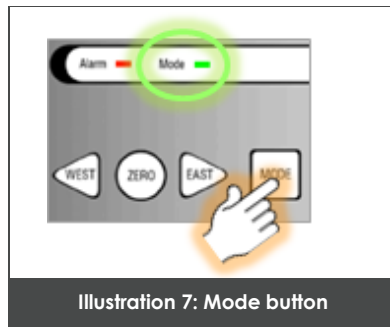


**Illustration 4: Zigbee antenna**

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



**Illustration 5: Auxiliar panel connection**

5. Connect the motor cable to the TCU.



**Illustration 6: Motor connection**
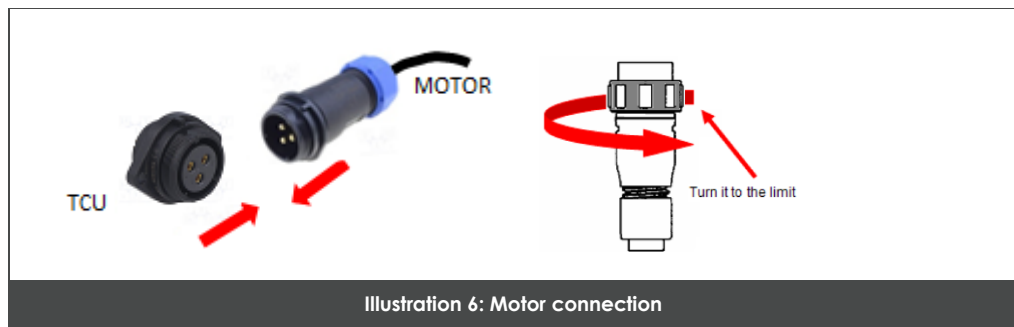
6. Press the "MODE" button several times, until the green LED "MODE" light flashes twice(MANUAL MODE).



**Illustration 7: Mode button**

7. Release the emergency stop button.



**Illustration 8: 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.



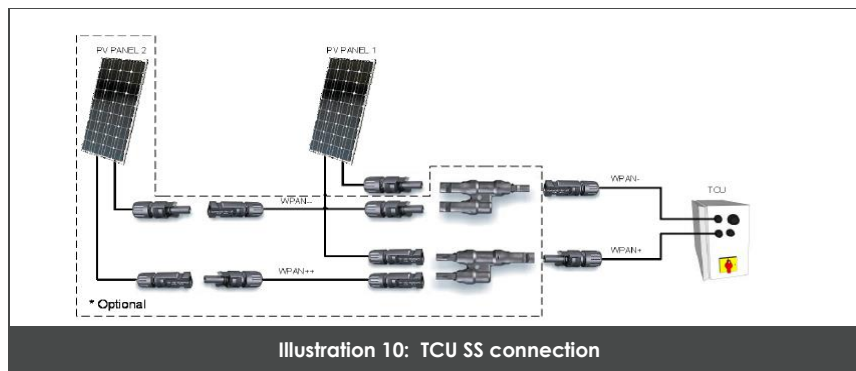**Illustration 10:  TCU SS connection**

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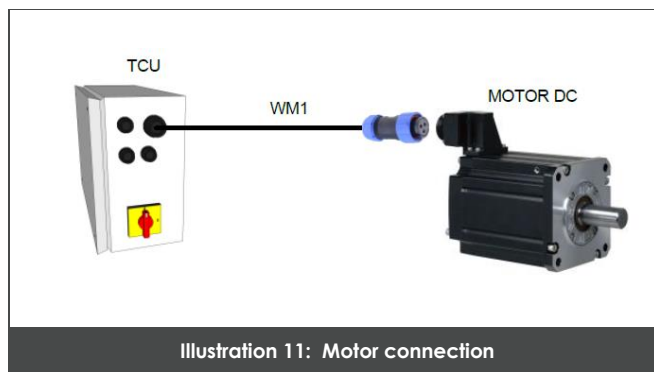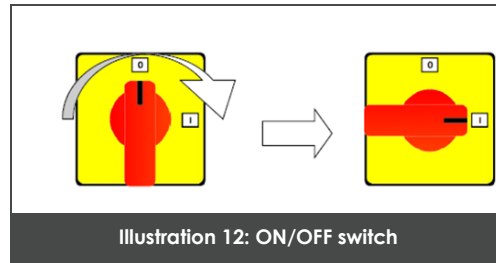


**Illustration 11:  Motor connection**

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



**Illustration 12: ON/OFF switch**

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. TrinaTracker 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 $\cos\varphi = 0.7$ is used:

- Single-Phase generator (230V$_{AC}$)

  > Minimum power: 0.8kVA per each TCU

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

- Three-phase generator with neutral (380V$_{AC}$)

  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 TrinaTracker 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).



**Illustration 13:  Fuse insertion**

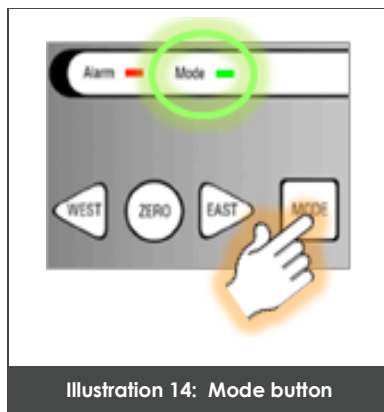**2.**  If necessary, press the "MODE" button for 3 seconds (until the LED flashes).



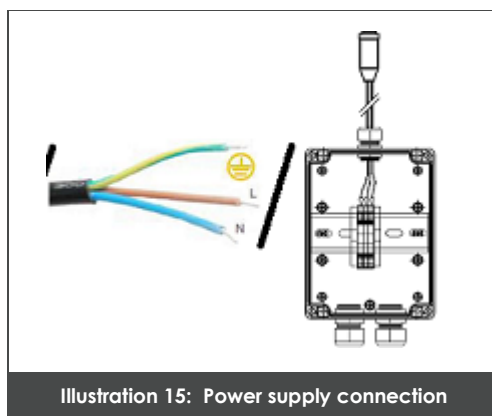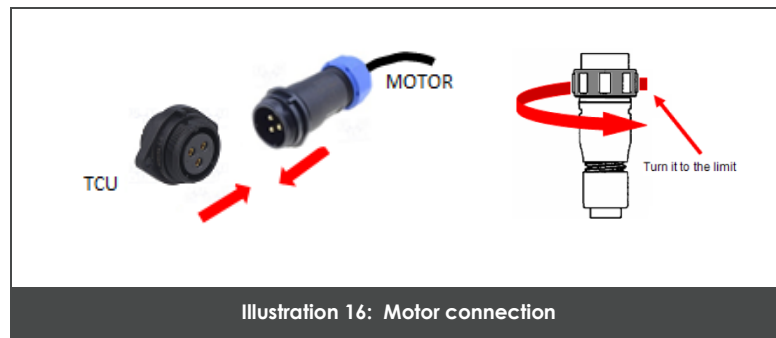**Illustration 14:  Mode button**

**3.**  Connect the power supply input.



**Illustration 15:  Power supply connection**

**4.** Connect the motor cable to the TCU.



**Illustration 16:  Motor connection**

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



**Illustration 17:  Mode button**

**6.** Release the emergency stop button.



**Illustration 18:  Emergengy 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.
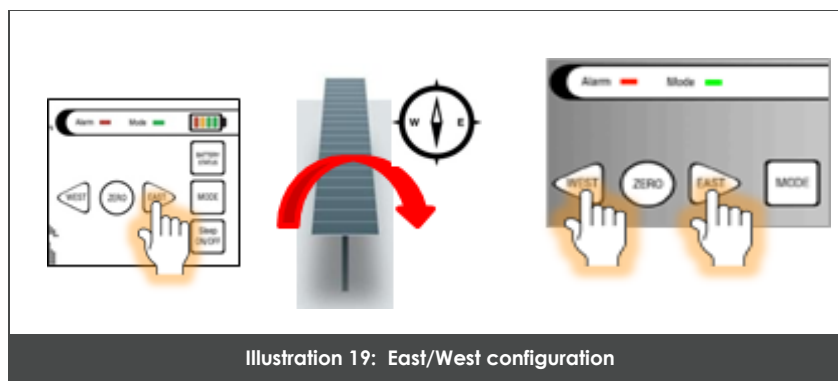


**Illustration 19:  East/West configuration**

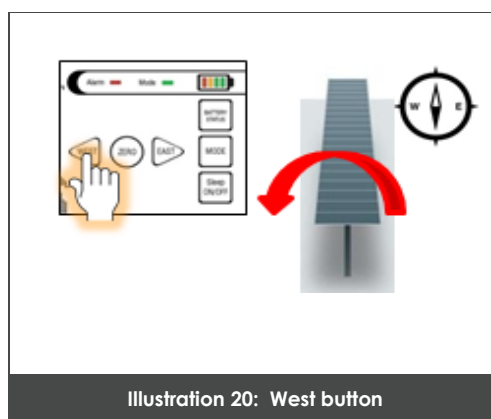2. Press the "WEST" button and verify that the solar tracker turns west.



**Illustration 20:  West button**

## 5.1.2.TCU SS

- **Handy Terminal**

There are two operations to move a tracker manually:

> Move tracker Westwards or Eastwards

1. Access to Manual-Jogging screen.

2. Press the central button to toggle between **Fast** or **Slow** speed.

3. 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.

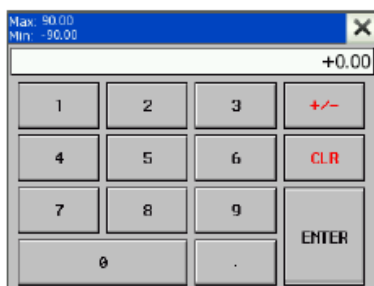The real-time tracker tilt can be displayed:

|  | SOLAR | TRACKER |
|---|---|---|
| INCLINATION | -13.82 | -14.10 |

← Displays tracker tilt in real-time.

> Move tracker to an exact inclination

1. Press **→** to go to the Manual-Setpoint screen.

2. Press on the green digits of the "Setpoint Inclination" display:

| INCLINATION SP (º) | +0.00 |
|---|---|

← Press here

The screen will show a keyboard:



3. Enter the desired inclination value for the tracker, in degrees, and press "ENTER".

4. 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 [STOP ROTATION] 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 [START] the tracker rotates until reaching that entered position. Press [STOP] 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.
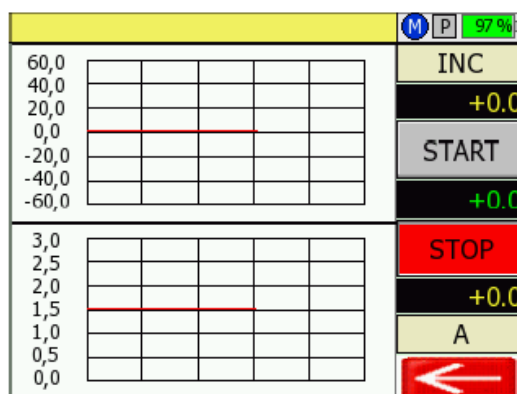


- **Computer**

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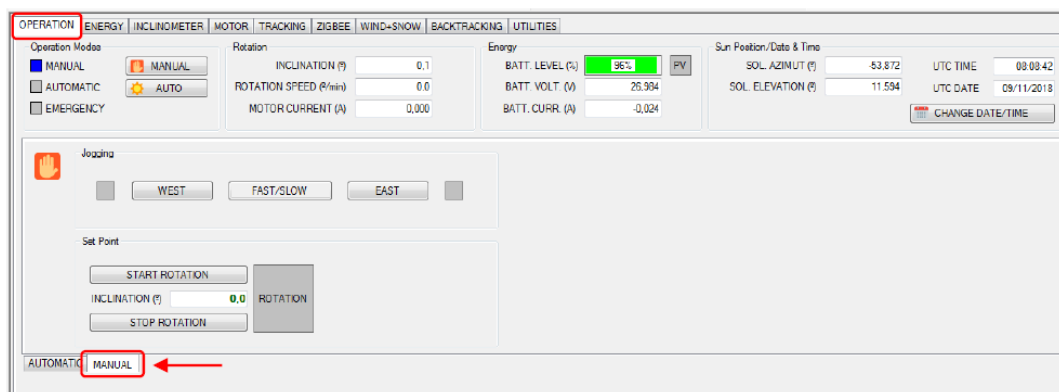


There are two ways of moving a tracker manually:

> Move a tracker westwards or eastwards

**1.** In the "Jogging" section, click on the middle button to toggle [FAST/SLOW] ( ) or slow ( [FAST/SLOW] ) speed.

**2.** Click on the [ EAST ] or [ WEST ] 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:



← Displays real-time tracker inclination
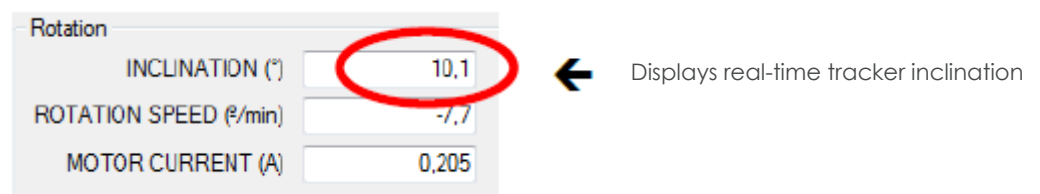
> Move tracker to an exact inclination

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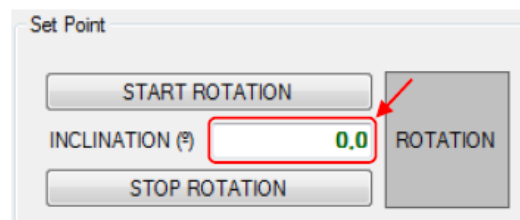


**2.** Once the desired value is entered, click [ START ROTATION ] to start movement:



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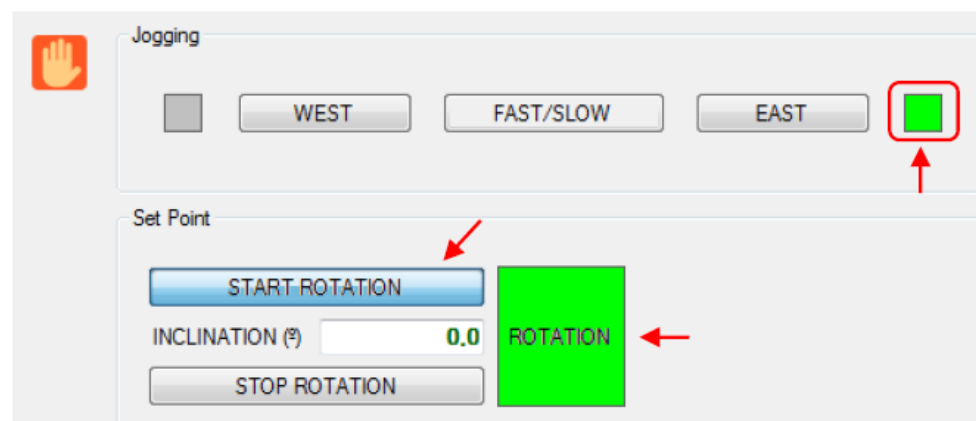
The "ROTATION" lamp will turn on, and also the lamp indicating the tracker rotation direction. The tracker will automatically stop when the desired inclination is reached, i.e., when the tracker inclination matches the setpoint value.

Movement can be stopped whenever desired by clicking

STOP ROTATION

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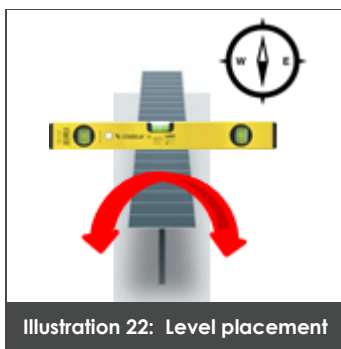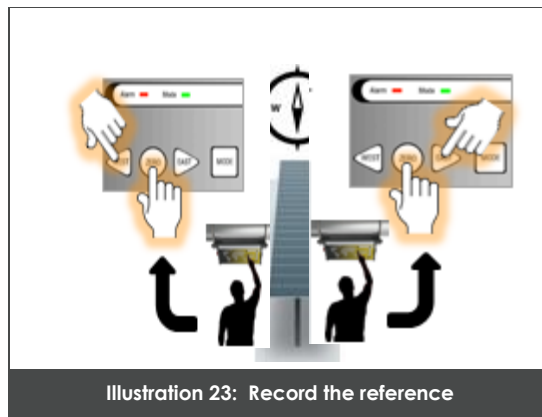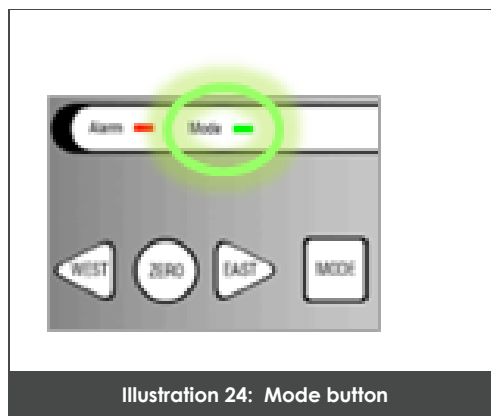
2. Record the reference point simultaneously pressing ZERO + EAST or ZERO + WEST, depending on its location relative to the axis solar tracker.



**Illustration 23:  Record the reference**

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



**Illustration 24:  Mode button**

4. Press the emergency stop button.



**Illustration 25:  Emergency 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:
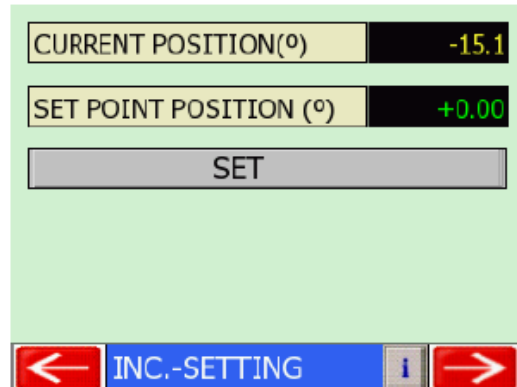


- Computer app

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°, i.e., the tracker completely horizontal (The digital level has to measure 0°± 0.5°).

3. Enter the value which the digital level indicates in the "SET POINT POSITION (°)" field.
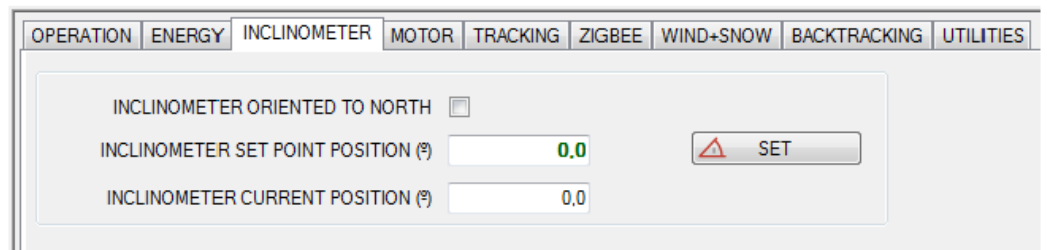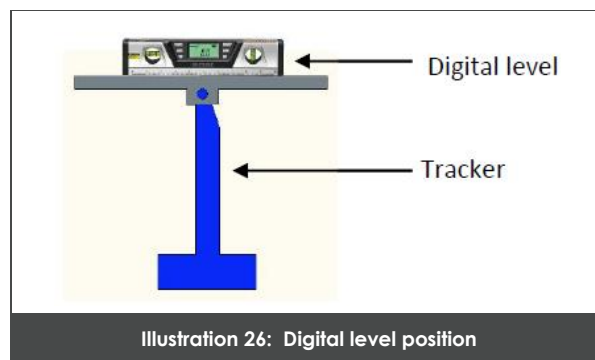
4. Then press "SET" for the system to match the analogue signal measurement to the real one.

5. Check that the value displayed in "CURRENT POSITION (°)" matches the value entered in "SET POINT POSITION (°)".

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
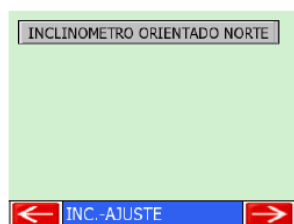


inclinometer orientation setup screen:

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

**6.** Computer app

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



**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.

## 5.2.3. TCU ST
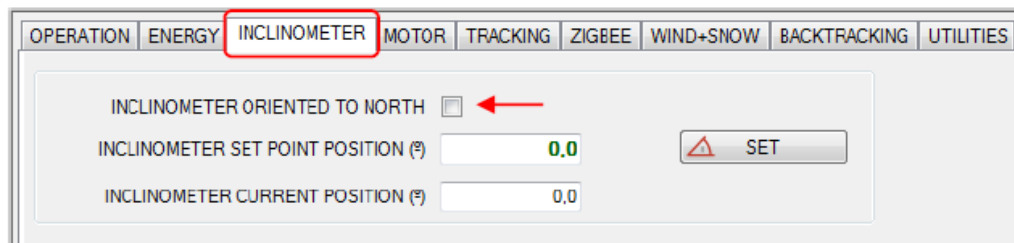
This function is mainly used to calibrate the zero of the tracker. Firstly, use the working mode of "manual eastward" or "manual westward" to place the tracker at the zero position, then switch to the "manual mode" mode", and then click "Zero Correction" to calibrate the tracker at the zero position. The setting interface is shown in Figure below. Please note that before the zero correction, please confirm that the operating mode is manual
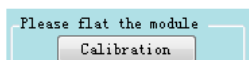
# 6 PHYSICAL STOPS

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.



**Illustration 27: Barcode scanning**

# 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.

# 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).



The wind limits defines by TrinaTracker 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

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:
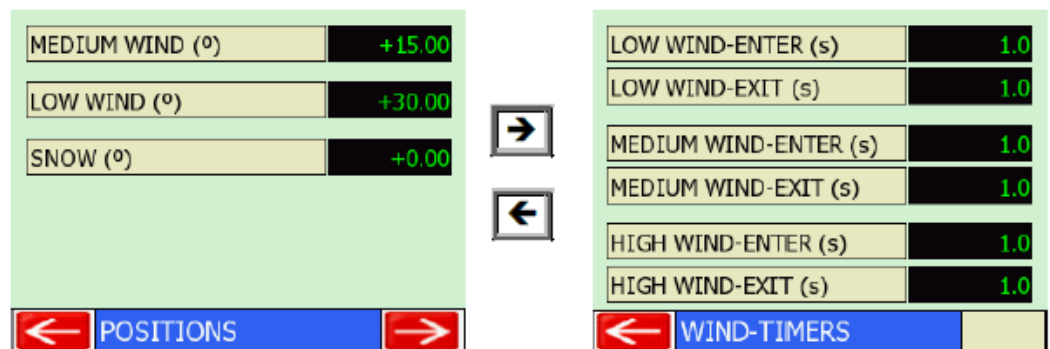


- With the computer app:

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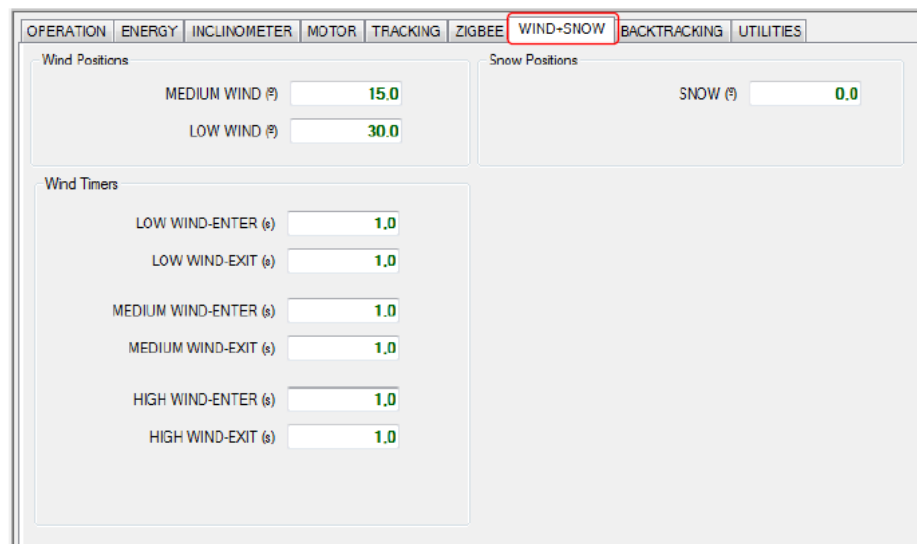


It is necessary to login in order to modify these parameters.

### 9.1.3.TCU ST

The wind speed classification protection needs to set the corresponding parameter valueaccording to the value from small to large. The setting interface is shown in picture below
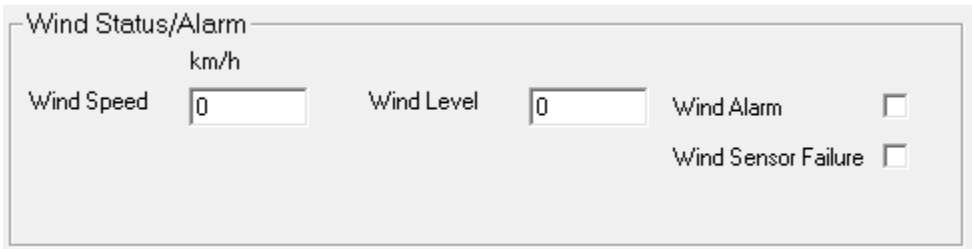


### 9.1.4.Check wind reading

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).



## 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).

# 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".
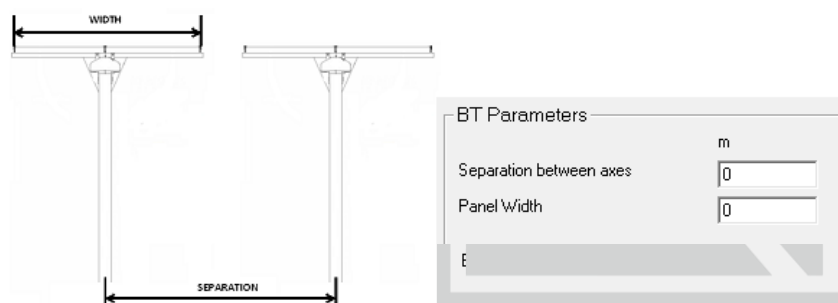


### 10.1.2.TCU SS

Backtracking setup is performed as follows:

• Handy terminal

Follow the path: CONFIGURATION > BACKTRACKING > **LOGIN** to go to Backtracking setup screens:
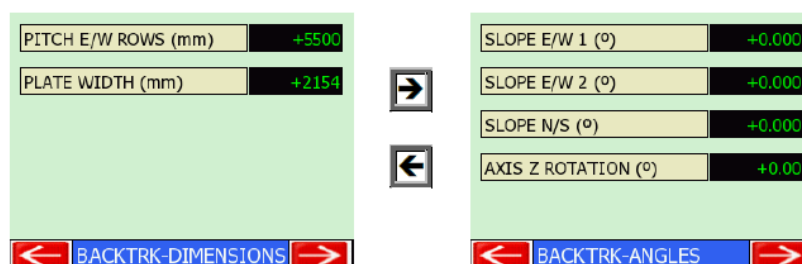
- Computer app

  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.

### 10.2.1.TCU ST

Backtracking setup is performed as follows

- Each TCU must be configured with width, length , and east-west slope (west high and east low being positive), as shown in figure below. So the TCU is able  to minimized shadows between the trackers.

```
=======Array Para=======
☐ Width:      [      ] mm
☐ Length:     [      ] mm
☐ East Slope: [      ] °
☐ West Slope: [      ] °
```

- Configure initial parameter as latirude longitude and timezona

```
=====Astronomic Para====
☐ Longitude: [      ] °
☐ Latitude:  [      ] °
☐ TimeZone:  [      ]
```

# 11 SYNCRONIZATION

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

In the case of ST TCU note that the NCU will set the default to Beijing UTC time, NCU ( UTC + 8). If you want to change the UTC you will need to set your reginal time in UTC+8.

# 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 TrinaTracker 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 TrinaTracker 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:



- 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.
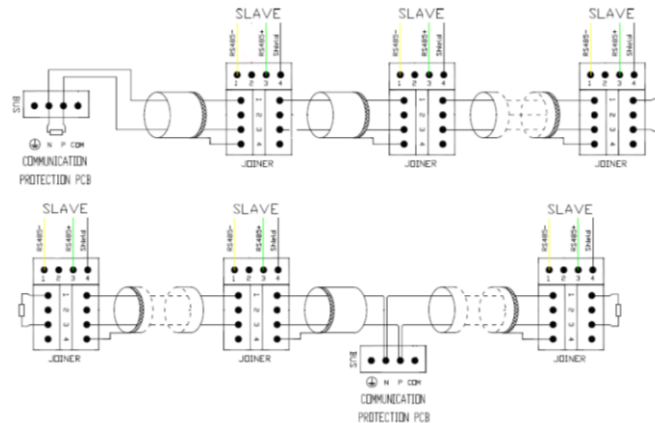


All the connection shall be done properly to avoid TCUs damaged. Please proceed with the manual provided by TRINATRACKER and it is advisable make the verification as the document *"Bus Wiring Verification".*

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

# 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 TrinaTracker

- 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, TrinaTracker 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 TrinaTracker or of the installation; any modification made by the client without the authorisation of TrinaTracker 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 TrinaTracker 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 TrinaTracker until that moment (e.g. flight reservations, hotels, etc.) according to the pricing chart of TrinaTracker 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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[2] 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 TRINATRACKER, which prevents conducting the tests on said equipment.

- If technicians from TrinaTracker 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 TrinaTracker 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 TrinaTracker deployed during the wait time, including non-reimbursable expenses (e.g. Flight reservations, hotels, etc.) at the costs stipulated in the pricing chart of TrinaTracker 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 TRINATRACKER (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 TrinaTracker 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 TrinaTracker 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[3]

  > 100% tracking time without NCU communication alarm

  > 100% TCUs go to stow position when it is too windy (daily time)

---

[3] As long as the relative location of NCUs and TCUs, and NCUs-TCUs mapping have followed the design recommended by TRINATRACKER.

> 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, TrinaTracker 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 TrinaTracker components have not passed the tests and if TrinaTracker is responsible for these, the parties will agree on a deadline for TrinaTracker 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.

| **Trina**Tracker | Agile Commissioning Check List | Ver.:1 |
|---|---|---|
| | | Rev.: 0 |

| OPL | | Date | |
|---|---|---|---|
| Proyect | | Commissioning | |
| Supervisor: | | Engineer.: | |

### COMMISSIONING INSPECTION GLOSSARY

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

# 1 REMOTE DATA ACQUISITION

## 1.1. Introduction

Due to the constant evolution and new advances in technology, TrinaTracker R+D+I department is working on monitoring tools to improve commissioning, maintenance, aftersales and transmit the project status with more efficiency to the operations management. The objective is to allow the quickest response to our clients if any, taking the control of the tracker, meteorological sensors, and rest of the equipment allowing them to check the status of the PV plant through the web platform tools.

## 1.2. TrinaTracker Cloud

The new web platform can be managed through any device with internet connection (smartphone, PC, tablet…) through the web browser:



Once you have logged with your own username and password, all y the information of each client is showed and there are different roles allowing to access to specific projects or whole.

## 1.3. Data acquisition

All the data collected by this new tool is property of the owner of each project and any distribution without the authorization of the owner is not allowed.

The owners can revoke the authorization of this monitoring tools whenever they want.

## 1.4. Remote connection

The applications access the installations via the internet using port forwarding from the NCUs to the TrinaTracker public IP addresses via the router and/or the firewall of the project network.

That means that the NCUs that are installed will communicate to the TrinaTracker Server via the internet with the highest possible security.

## 1.4.1.Port forwarding

All the NCUs of the project must be forwarded to the following public domain addresses:

- TRINATRACKER 1: 82.223.234.47

- TRINATRACKER 2: 81.42.249.44

- TRINATRACKER 3: 81.43.72.137

TrinaTracker should receive one IP address (Public IP of the project) and the corresponding  forwarding port from each NCU.