SUNNER

TCU USER MANUAL

TCU - TRACKING CONTROL UNIT

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1. ABOUT THIS MANUAL

This user manual describes the installation, operation, maintenance, and recycling of the product. Illustrations in this document are reduced to the essential information and may deviate from the real product.

1.1 VALIDITY

This document is valid for:

- SUNNER TCU SELFPOWERED STANDARD TEMPERATURE & LOW TEMPERATURE
- SUNNER TCU STRING STANDARD TEMPERATURE & LOW TEMPERATURE
- SUNNER TCU AC

1.2 TARGET GROUP

This document is intended for qualified persons and end users. Only qualified persons are allowed to perform the activities marked with a warning symbol and the caption "Qualified person". Tasks that do not require a particular qualification are not marked and can also be performed by end users. Qualified persons must have the following skills:

- Knowledge of how a SUNNER TCU works and is operated.
- Training in how to deal with the dangers and risks associated with installing, repairing, and using electrical devices and installations.
- Training in the installation and commissioning of electrical devices and installations.
- Knowledge of all applicable laws, standards, and directives.
- Knowledge of and compliance with this document and all safety information.

1.3 LEVELS OF WARNING MESSAGES

DANGER ⚠

Indicates a hazardous situation which, if not avoided, will result in death or serious injury.

WARNING ⚠

Indicates a hazardous situation which, if not avoided, could result in death or serious injury.

CAUTION ⚠

Indicates a hazardous situation which, if not avoided, could result in minor or moderate injury.

NOTICE

Indicates a hazardous situation which, if not avoided, can result in property damage.

2. SAFETY INSTRUCTIONS

DANGER ⚠

Please, read this manual before installing the unit, improper use of the unit can damage it permanently.

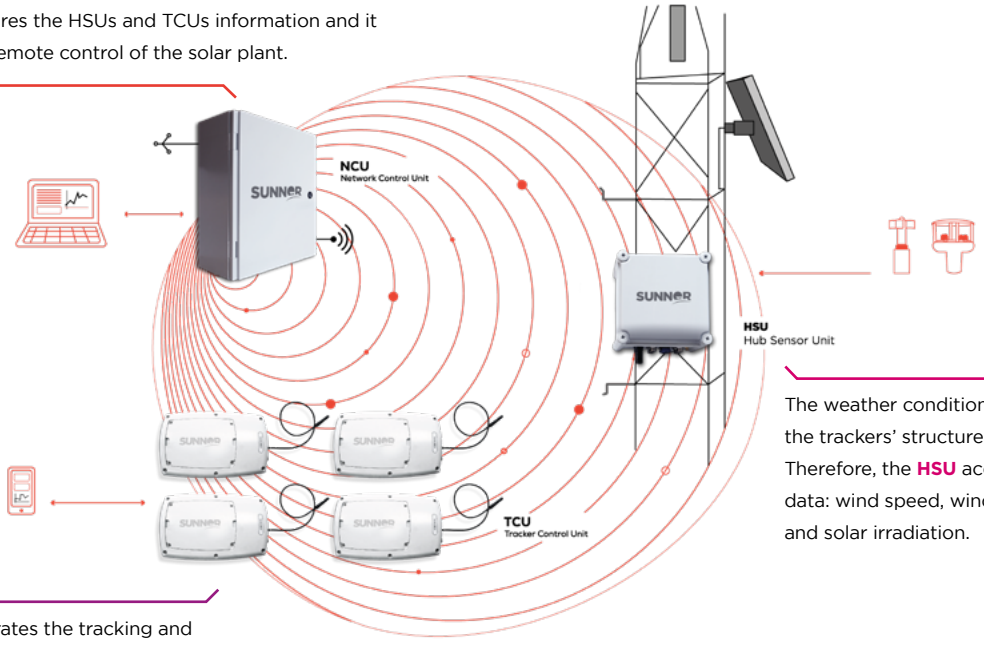
- Wear suitable personal protective equipment for all work on the product.
- The device is suitable for all indoor and outdoor, damp, or wet location.
- Install the unit in the recommended position.
- Wiring should be appropriate for the installation and protected from rodents.
  - All connections must be made before powering the unit.
  - Before any maintenance work power supply (PV dedicated module) and fuse must be disconnected.
  - Do not touch non-insulated parts or cables.

3. PRODUCT DESCRIPTION

3.1 SUNNER ECOSYSTEM DESCRIPTION

The SUNNER ecosystem maximizes energy generation from solar fields thanks to an efficient and robust system composed of three different devices: NCU (Network Control Unit), TCU (Tracker Control Unit) and HSU (Hub Sensor Unit)

The **NCU** acts as the Zigbee network coordinator that communicates the whole system. This way, the trackers can be sent to safe position depending on several weather alarms. Also, the NCU stores the HSUs and TCUs information and it allows real-time remote control of the solar plant.



The weather conditions can compromise the trackers' structure well-being. Therefore, the **HSU** acquires weather data: wind speed, wind direction, snow, and solar irradiation.

The **TCU** incorporates the tracking and backtracking algorithm needed to efficiently track the sun and it also adds multiple functional alarms.

3.2 TCU DESCRIPTION

The TCU manages the movement of the solar tracker with its integrated electronics.

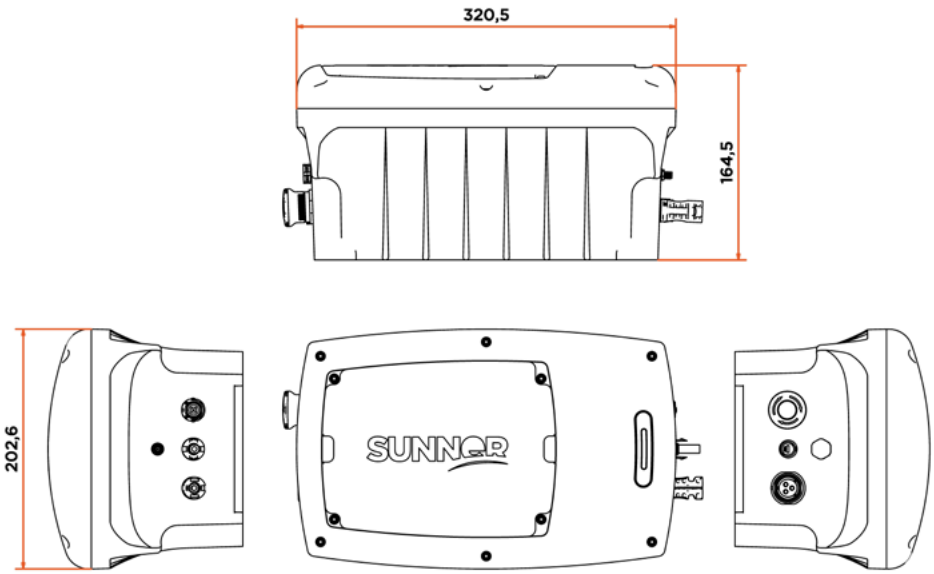
3.2.1 Main features

- Tracking & Backtracking algorithms.
- Smart Stow management.
- Integrated inclinometer.
- Charge/discharge battery and motor protections.
- Accurate SoC estimation (only in battery models).
- Low temperature models (from -30°C).
- Brushed & brushless motor technology models.
- Fast & simple commissioning procedure.
- Remote firmware update.
- Designed for outdoor use (suitable for wet location): IP65 and UV resistant enclosure.
- Easy battery change.
- Light status indicators
- The TCU can communicate through:
  * Zigbee with the NCU
  * RS485 with the NCU or for communicating with the PC
  * BLE (Bluetooth Low Energy) with a smartphone for commissioning with the App

Modbus is the communication protocol of the TCUs and a different slave ID should be assigned to each device. The factory slave ID is 245 but a number between 1 and 200 should be assigned to the TCUs so they can connect via zigbee or RS485 to the NCU.

Broadcast communication is **not** allowed.

3.2.2 Dimensions



3.3 SYMBOLS ON PRODUCT

Class II - double insulated

IP65 IP protection degree

CE compliance

4. STORAGE & UNPACKING

4.1 TCU STORAGE

The following requirements should be met if SUNNER TCU is not directly put into use:

- Do not unpack SUNNER TCU.
- Keep the storage temperature and humidity within the range indicated in the datasheet.
- SUNNER TCU should be stored in a clean and dry place and protected from dust and water vapor corrosion.
- Periodic inspections are required during the storage. Replace the packing materials if necessary.
- If SUNNER TCU has been long-term stored (more than 12 months), inspections and tests should be conducted by qualified persons before it is put into use.
- SELFPOWERED and STRING models include LiFePO4 battery. In order not to damage the battery, the following requirements should be met:
  - Temperatures > 45°C are only allowed during 1 month storage.
  - Temperatures > 35°C are only allowed during 3 month storage.
  - Temperatures > 25°C are only allowed during 6 month storage.
  - If SUNNER TCU is preserved for a long time, the battery should be recharged. If this time is longer than 6 months it must be recharged again, and if it is longer than 9 months it must be recharged and discharged again.
  - Failure to follow these instructions will affect permanently the battery performance.

4.2 UNPACKING

After receiving the product and before installing, conduct a thorough inspection.

- Check the packaging for visible damage.
- Check that the scope of the delivery is complete.
- Check the inner contents for damage.

5. INSTALLATION

5.1 SAFETY DURING INSTALLATION

DANGER ⚠

* Make sure there is no electrical connection before installation.

WARNING ⚠

* Do not install the SUNNER TCU in an environment with flammable and explosive objects or smoke.

CAUTION ⚠

* Wear proper protective equipment before performing operations on the SUNNER TCU.
* The lateral terminals and interfaces of the SUNNER TCU cannot directly contact the ground or other supports. The SUNNER TCU cannot be directly placed on the ground facing the connectors areas.

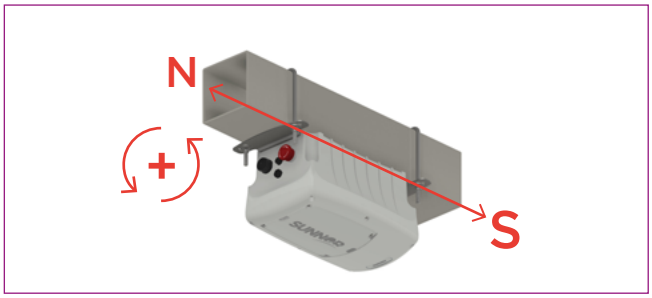
5.2 ENVIRONMENT REQUIREMENTS

A proper installation location largely ensures safe operation, service life, and performance of the SUNNER TCU.

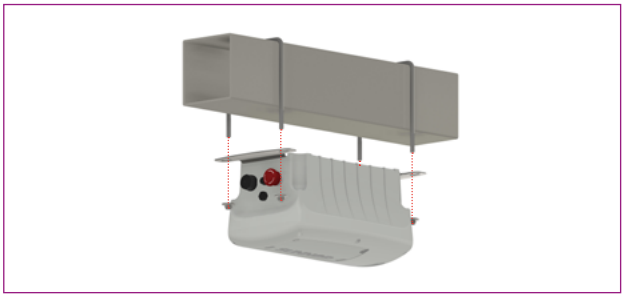
- The SUNNER TCU with protection rating IP65 can be installed both indoors and outdoors.
- The installation environment must be free of inflammable or explosive materials.
- The location should not be accessible to children.
- The ambient temperature and relative humidity of the environment must meet the requirements specified in the datasheet.
- It is recommended to install the SUNNER TCU in a sheltered area to avoid direct sunlight and bad weather (e.g. snow, rain, lightning, etc.). The SUNNER TCU will derate in high temperature environments for protection. If the SUNNER TCU is installed in direct sunlight, it may cause power reduction as the temperature rises and exceed limits shown in datasheet.

5.3 MOUNTING THE TCU

1. Place the TCU in a horizontal position, with the cover part faced to the ground.



2. The stop button should face north. Otherwise, during the commissioning the "inclinometer inverted" option will have to be configured.

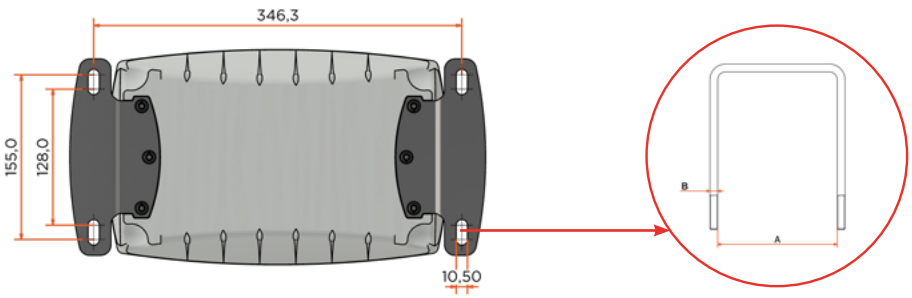


3. Fix the SUNNER TCU on the beam with two square U-bolts and four lock. The maximum recommended torque is **4 Nm.**

4. Connect the external antenna. It must be placed hanging down, facing to the ground.
- Metallic elements must be avoided near the antenna.
- The antennas of the different SUNNER TCU units need to be in line of sight.

The SUNNER TCU includes two brackets with four slotted holes to accommodate two square U-bolts. It is suitable for 120x120mm and 140x140mm beams. The two brackets can be modified for other beam sizes.

Measurement	Max	Min
A	140mm	120mm
B	M10	M8

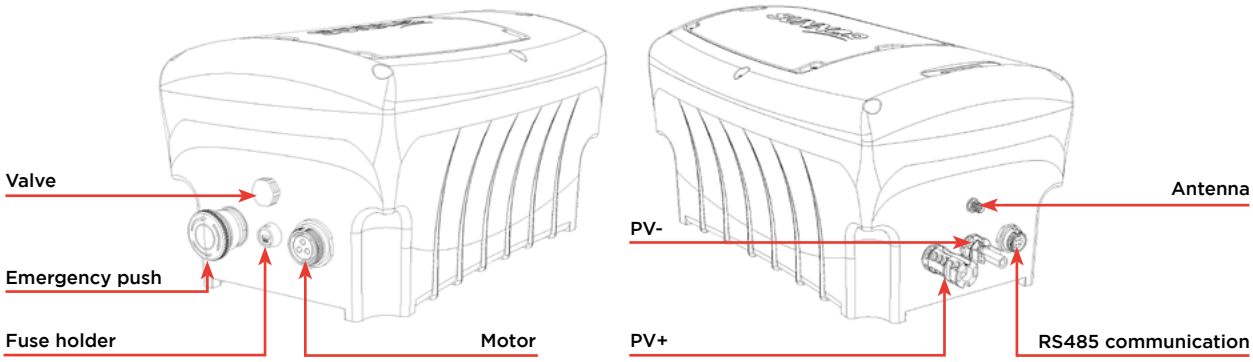


5.4 ELECTRICAL CONNECTION: TCU SELF POWERED

DANGER ⚠

* ONLY QUALIFIED PERSON

5.4.1 Overview of the connection area.



Connector	Section (AWG)	Reference	Pinout
PV +	**14**	PV-ADS4-EVO 2A/2.5	-
PV -	**14**	PV-ADB4-EVO 2A/2.5	-
Motor	**14**	SP2112/S3-1N(U)	1- MOTOR A 2- MOTOR B 3- NC
RS485 communication	**18**	SP1312/S4-N(CU)	1- GND 2- NC 3- B 4- A

5.4.2 Connection

The SUNNER TCU SELFPOWERED has been designed to be connected to a PV dedicated module. Follow the instructions in the installation guide **(IG_TCU_SP_SUNNER_vX.pdf)** to perform the installation correctly.

DANGER ⚠

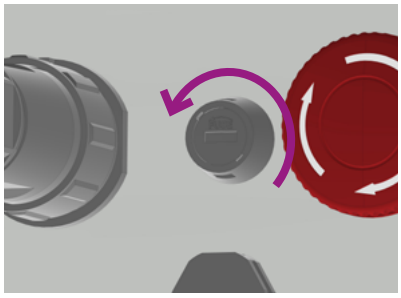
Danger to life due to electric shock when live components or DC cables are touched.

- Do not touch non-insulated parts or cables.
- Disconnect the product from voltage sources and ensure it cannot be reconnected before working on the device.
- Do not disconnect the DC connectors under load.
- Wear suitable personal protective equipment for all work on the product.
- Requirements for the dedicated PV module:
  - Voltage at maximum power point (Vmp) must be between 33 and 40Vdc
  - On the coldest day, based on statistical records, the panel open circuit voltage (Voc) must never exceed maximum input voltage of the TCU.
  - Power at maximum power point of the panel (Pmp) should be equal or higher than 30W.

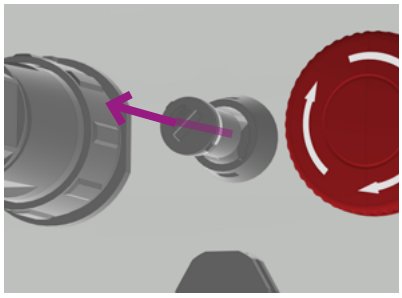
5.4.3 Battery fuse connection

The SUNNER TCU is factory switched off. To switch on the SUNNER TCU the battery 5x20mm fuse must be mounted:

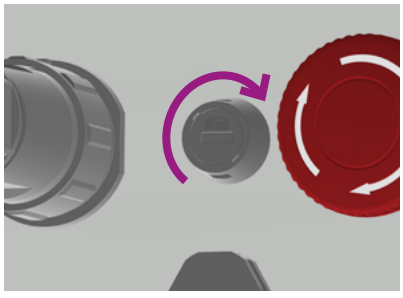
- Once the fuse is mounted the SUNNER TCU is switched on and communication with it can be established.
- For fuse replacement use BUSSMANN ref. S505-10-R.



1. Open the fuseholder by turning counterclockwise with a flat screwdriver.



2. Extract the fuseholder and insert the fuse included in the box.



3. Close the fuseholder by turning clockwise with a flat screwdriver

CAUTION ⚠

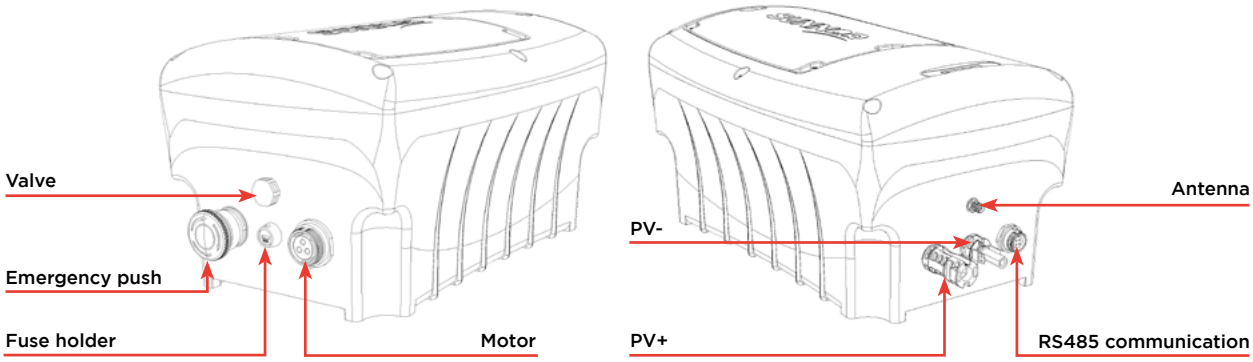
- Battery fuse and AC fuse are not same reference.
- Do not leave the TCU with the panel plugged in and without connecting the battery.

5.5 ELECTRICAL CONNECTION: TCU STRING

DANGER ⚠

* ONLY QUALIFIED PERSON

5.5.1 Overview of the connection area



Connector	Section (AWG)	Reference	Pinout
PV +	**14**	PV-ADS4-EVO 2A/2.5	-
PV -	**14**	PV-ADB4-EVO 2A/2.5	-
Motor	**14**	SP2112/S3-1N(U)	1- MOTOR A 2- MOTOR B 3- NC
RS485 communication	**18**	SP1312/S4-N(CU)	1- GND 2- NC 3- B 4- A

5.5.2 Connection

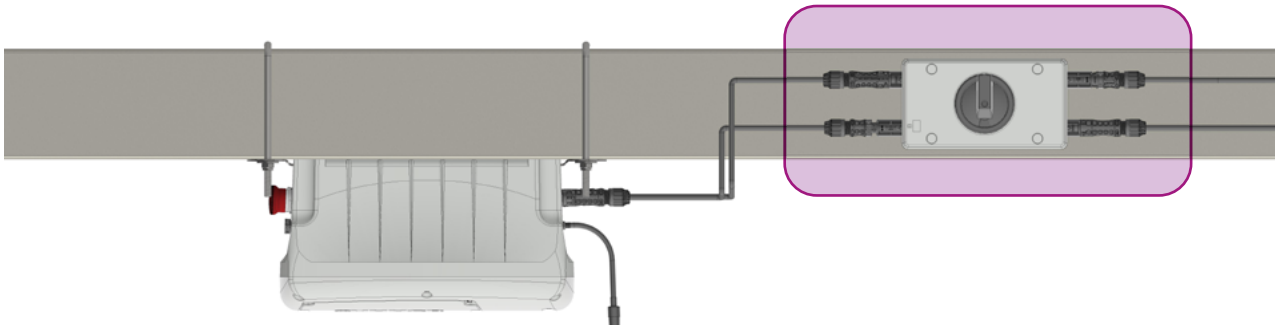
The SUNNER TCU STRING has been designed to be connected to a string of PV modules. Follow the instructions in the installation guide **(IG_TCU_STRING_SUNNER_vX.pdf)** to perform the installation correctly.

DANGER ⚠

Danger to life due to electric shock when live components or DC cables are touched.

- Do not touch non-insulated parts or cables.
- Disconnect the product from voltage sources and ensure it cannot be reconnected before working on the device.
- Do not disconnect the DC connectors under load.
- Wear suitable personal protective equipment for all work on the product.
- Requirements for the PV modules per unit:
  - All PV modules should be of the same type.
  - All PV modules should be aligned and tilted identically.
  - On the coldest day based on statistical records, the open-circuit voltage of the PV array must never exceed the maximum input voltage of the SUNNER TCU.
  - In order to switch the DC circuit, it is recommended to install an isolator switch (as shown in the image). Recommended ref. EDS6EL/20/4R.
  - -The SUNNER TCU can be operated with PV modules whose outputs are grounded or PV modules whose outputs are not grounded.
  - The SUNNER TCU must only be operated with PV modules of protection class II in accordance with IEC 61730, application class A.

Isolator switch connection:



NOTICE

Destruction of the SUNNER TCU due to overvoltage.

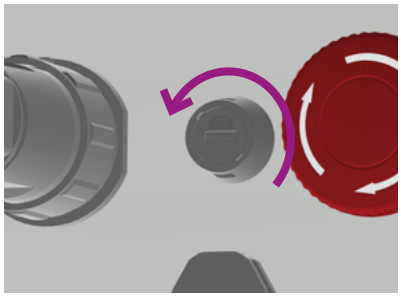
If the open circuit voltage of the PV modules exceeds the maximum input voltage of the SUNNER TCU, the SUNNER TCU can be destroyed due to overvoltage.

If the open-circuit voltage of the PV modules exceeds the maximum input voltage of the SUNNER TCU, do not connect any strings to the SUNNER TCU and check the design of the PV system.

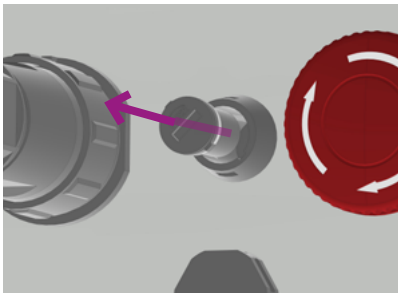
5.5.3 Battery fuse connection

The SUNNER TCU is factory switched off. To switch on the SUNNER TCU the battery 5x20mm fuse must be mounted:

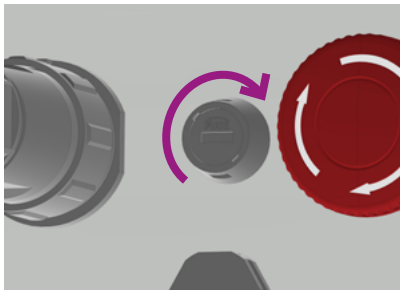
- Once the fuse is mounted the SUNNER TCU is switched on and communication with it can be established.
- For fuse replacement use BUSSMANN ref. S505-10-R.



1. Open the fuseholder by turning counterclockwise with a flat screwdriver.



2. Extract the fuseholder and insert the fuse included in the box.



3. Close the fuseholder by turning clockwise with a flat screwdriver.

CAUTION ⚠

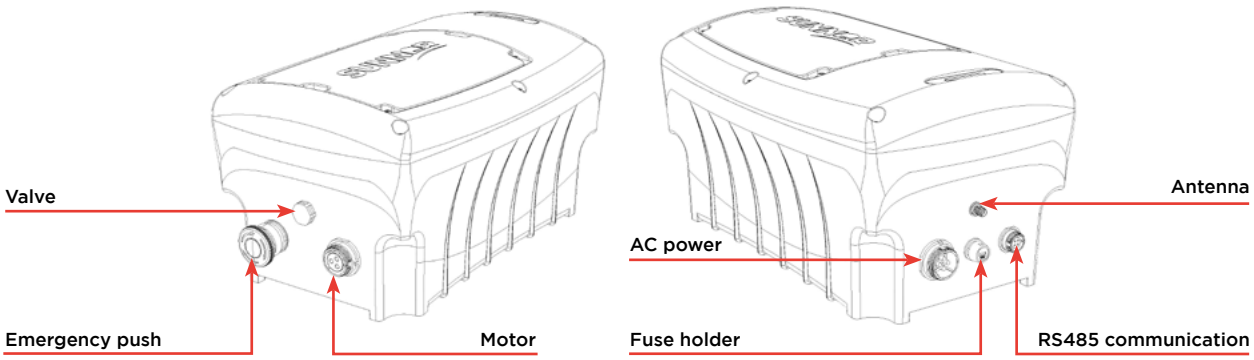
- Battery fuse and AC fuse are not same reference.
- Do not leave the TCU with the panel plugged in and without connecting the battery.

5.6 ELECTRICAL CONNECTION: TCU AC

DANGER ⚠

* ONLY QUALIFIED PERSON

5.6.1 Overview of the connection area



Connector	Section (AWG)	Reference	Pinout
AC Power	**16**	SP2112/P4-2N(U)	1- L 2- N 3- NC 4- GND
Motor	**14**	SP2112/S3-1N(U)	1- MOTOR A 2- MOTOR B 3- NC
RS485 communication	**18**	SP1312/S4-N(CU)	1- GND 2- NC 3- B 4- A

5.6.2 Connection

The SUNNER TCU AC has been designed to be connected to the AC grid. Follow the installation guide **(IG_TCU_AC_SUNNER_vX.pdf)** instructions to perform the installation in the correct way.

DANGER ⚠

Danger to life due to electric shock when live components or AC cables are touched.

- Do not touch non-insulated parts or cables.
- Disconnect the product from voltage sources and ensure it cannot be reconnected before working on the device.
- Do not disconnect the AC connector under load.
- Wear suitable personal protective equipment for all work on the product.
- Requirements for the AC grid:
  - AC voltage must be between 100 and 240Vac
  - AC frequency must be 50 or 60Hz

5.6.3 Requirements for AC connection

AC cable requirements as follows:

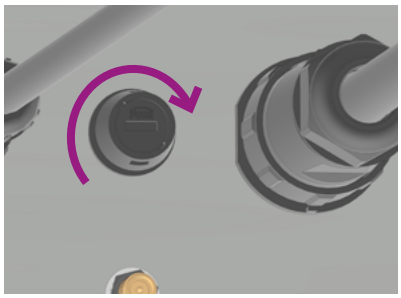
- Conductor type: copper wire.
- The conductors must be solid or fine-stranded. When using fine-stranded wire, bootlace ferrules can be used.
- Conductor cross-section PE: AWG16 to AWG11.
- Conductor cross-section of line conductor and neutral conductor: AWG16 to AWG11.
- The cable must be dimensioned in accordance with the local and national directives for the dimensioning of cables. The requirements for the minimum wire size derive from these directives. Examples of factors influencing cable dimensioning are nominal AC current, type of cable, routing method, cable bundling, ambient temperature, and maximum desired line losses.

Overvoltage category:
The product can be used in grids of overvoltage category III or lower in accordance with IEC 60664-1. That means that the product can be permanently connected to the grid-connection point of a building. In case of installations with long outdoor cabling routes, additional measures are required to reduce overvoltage category IV to overvoltage category III.

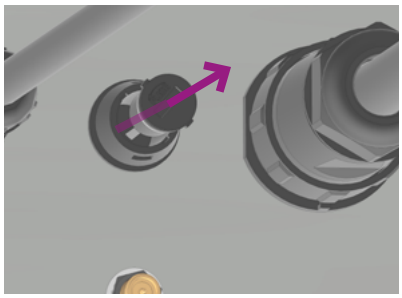
Connecting SUNNER TCU AC to the grid

The SUNNER TCU has been designed to be connected to the AC grid. Follow the provided instructions to perform the installation in the correct way.

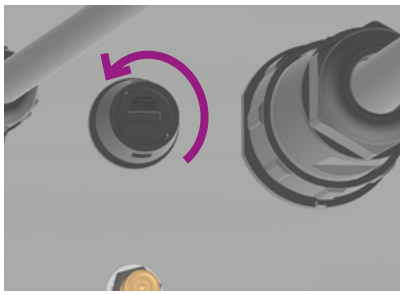
For AC fuse replacement use BUSSMANN ref. S505-4-R.



1. Open the fuseholder by turning counterclockwise with a flat screwdriver.



2. Extract the fuseholder and insert the fuse included in the box.



3. Close the fuseholder by turning clockwise with a flat screwdriver

CAUTION ⚠

- Battery fuse and AC fuse are not same reference.

6. COMMISSIONING

During the installation of a solar plant, all the TCUs should be commissioned. The commissioning process consists of uploading the desired operating configuration to each TCU. Parameters such as safe position angles, slave ID, PanID of the zigbee module, width of the panel, distance, and inclination to next tracker, etc. are configured.

First of all, an excel sheet must be filled out with the configuration parameters of each TCU of the solar plant. With that excel, a csv file will be generated and will be loaded into an Android smartphone App. With that App, we will connect to each one of the TCUs through Bluetooth connection and will upload their configuration. All the steps you should follow to commission a TCU with the App are described in the App user manual **(UM_APP_SUNNER_vX.pdf)**.

The TCU can be in different commissioning states during the installation, and they have some limitations due to security issues if the TCU is not completely commissioned. The operation for each of the states is described below:

- **Factory**

The TCU does not allow to be placed in AUTOMATIC mode. It can be placed in manual mode, and the motor can be turn on, but tilt angles greater than 10° are not allowed.

- **Tested**

The system has been tested, but the commissioning has not started yet. It has not been verified that the direction of the motor rotation and the sign of the measured tilt angle are correct. The TCU does not allow to be placed in AUTOMATIC mode. It can be placed in manual mode, and the motor can be turn on, but tilt angles greater than 10° are not allowed.

- **Configured**

The system has been configured, but it has not been checked yet if there is an offset in the tilt measurement. The TCU does not allow to be placed in AUTOMATIC mode. It can be placed in manual mode, and the motor can be turn on, but tilt angles greater than 30° are not allowed.

- **Commissioned**

The commissioning and configuration processes are complete. The system can be placed in AUTOMATIC mode, and the panel can be tilted until the configured maximum tilt angle values.

7. OPERATION

7.1 SYSTEM CONTROL

The TCU can be placed in three operation modes: OFF, MANUAL, and AUTOMATIC. If the operation mode is changed it will be saved and in case the TCU turns off it will remain in the same mode when it turns on again.

- **OFF mode**

In this operation mode, the TCU will not move even if the target tilt is updated. When the TCU is first turned on, it will start in this mode.

- **MANUAL mode**

In this operation mode, the user can command the TCU to activate the motor and rotate the panel to the West or East. The target tilt and safe positions will also be updated in this mode even if they are ignored.

- **AUTOMATIC mode**

When the TCU is in AUTOMATIC mode, it decides autonomously when to start and stop the motor and the direction of rotation. The TCU calculates continuously the ideal tilt angle (target angle) and measures continuously the current tilt angle. If the difference between the target and the current tilt angles is greater than the deadband, the TCU activates the motor and rotates the panel until the target angle is reached.

The target angle is calculated in all three operation modes, but it is only used when the TCU is working in AUTOMATIC mode. The basic premise in the calculation of the target angle is placing the panel perpendicular to the sun rays, following the trajectory of the sun throughout the day. But there are other conditions, like mutual shading or inclement weather, that are also considered for the calculation of the target angle. The goal is to maximize the yield of the solar panel while reducing the risk of the panel getting damaged.

When the TCU is in AUTOMATIC mode, it is possible to request the TCU to place the panel in a specific tilt angle or limiting the maximum and minimum angles.

7.2 CHANGE OF OPERATION MODE

In some cases, the TCU may reject the request to change its operation mode. All the required conditions to switch to AUTOMATIC and MANUAL modes are described below.

A request to change the TCU operation mode to AUTOMATIC mode will be rejected if any of the following conditions are active:

- The commissioning process has not been completed
- The emergency stop pushed button is pressed
- There is a locked motor alarm

- The current tilt angle is out of range
- The data and time have never been set

A request to change the TCU operation mode to MANUAL mode will be rejected if any of the following conditions is active:
- The emergency stop pushed button is pressed
- There is a locked motor alarm

A request to change the TCU operation mode to OFF mode will be always accepted. The TCU will decide autonomously to switch from MANUAL or AUTOMATIC mode to OFF mode if any of the following conditions are active.
- The emergency stop pushed button is pressed
- There is a motor locked motor alarm

7.3 SYSTEM ALARMS

The TCU has some alarms that indicate failures or unusual situations, and, in some cases, it can have consequences such as stopping the motor.

Motor overcurrent SW*	The motor current is bigger than the one that has been configured by the user.
Motor overcurrent HW*	The motor current is bigger than the maximum stablished by hardware. This value cannot be configured.
Motor driver fault*	The motor driver has detected a fault. It may have been caused by a short circuit in the motor terminals or a similar situation.
Tracker axis blocked*	The TCU tries to move the motor, but the tracker doesn't move or it moves in the wrong way.
Tracker low speed	The TCU tries to move the motor and the tracker starts moving but slower than expected. In AUTOMATIC mode it is only a warning that doesn't affect to the behavior of the TCU and in manual mode it is an alarm, and the state is changed to OFF.
Date and time never set	When the TCU is turned on the date and time are not known until the NCU introduces them. When this alarm is active, we cannot change to AUTOMATIC state and if it is already in AUTOMATIC the motor won't start moving until this information is given.
Communication lost with NCU	There has not been communication with the NCU during a time that has been configured. In this case, the safe position 1 is activated to protect the tracker from possible high-speed wind events.
Tilt out of range	When the tracker tilt angle exceeds the SW limit angle established in 5 degrees. The state won't change from AUTO to OFF, but the motor won't move until this condition has disappeared.
Emergency button	The motor will stop and the state will change to OFF.
Xbee fault	The communication with the zigbee module has failed. The TCU will automatically reset the module and try to communicate again.
BLE fault	The communication with the Bluetooth module has failed.
Accelerometer fault	There is an error with the accelerometer and the real tilt angle cannot be calculated.
RTC fault	The external Real Time Clock does not work properly. It is changed to the internal RTC that is not that precise, but the tracking algorithm can continue working.
Comm. With secondary MCU broken	The communication with the secondary MCU has failed. If after 15 minutes it is not restored, the safe position 1 is activated because we can't know the SOC of the battery and it could be a critical SOC level.
Flash memory defective	It has not been possible to read the flash memory.
No battery detected	The TCU is turned on but there is no connected battery.

** The 4 alarms mentioned above act in the same way. When any of these alarms are active when the TCU is in AUTOMATIC mode, the motor stops during "X" seconds and then it tries to move again. If after "Y" retries the fault continues the TCU changes to OFF state. "X" and "Y" can be configured by the user. In manual mode there are no retries, and if an alarm happens the TCU changes to OFF state directly.*

7.4 SYSTEM CONFIGURATION

The configuration of the TCU is stored in two different non-volatile memories (NVM): one of them is external and the other one is the internal memory of the microcontroller. After a reset or power cycle, the TCU initializes the configuration parameters with the values stored in the external NVM.

If during the initialization process the NVM is considered corrupted, the configuration parameters will be initialized from the internal memory. If this NVM is also considered corrupted, the configuration parameters will be initialized at the default values. An alarm will be activated to inform about this circumstance.

The communication parameters, like the slave ID or the Zigbee PANID, are stored in a different section of the NVM.

7.4.1 Communication

The TCU has three communication interfaces: RS485, BLE and Zigbee. The Modbus RTU protocol has been implemented in the three interfaces. The factory value of the Modbus slave ID is 245 and it can be configured via modbus.

- **RS485**

The communication parameters of the RS485 interface are: 19200 bauds, even parity, 8 data bits, 1 stop bit.

- **BLE**

A magnet should be used to turn on the BLE. This communication should only be used in the commissioning process. In the App, the name of the BLE should appear with the name "TCU_XXX_YY", where XXX indicates the modbus slave ID assigned to the TCU.

- **Zigbee**

Each TCU has a zigbee router that communicates with the zigbee coordinator or gateway. The coordinator is part of the NCU and all the TCUs connected to it should have the same PANID as the gateway. The TCUs also act as repeaters, creating a mesh network and making communication possible between the NCU and more distant TCUs.

After resetting the communications, the node identifier of the TCU's Zigbee is set as "TCU_SUNNER_ID_XXX", where XXX is the Modbus slave ID. This name will only be overwritten if its last name was also "TCU_SUNNER_ID_XXX". If the name has been changed manually from the gateway, this name will remain.

The TCU surveys if the communication with the NCU is alive, and if not, the TCU will automatically activate the safe position 1. The timeout for considering that communication with NCU is lost can be configured, and the factory value is 30 minutes. If this value is set to 0, the surveillance of the communication with the NCU is disabled.

7.4.2 Target angle calculation

When the system operates in AUTOMATIC mode, the TCU continuously computes the optimal tilt angle for the solar panel surfaces based on current conditions. During nighttime, this target angle remains fixed at a preconfigured value.

In daylight hours, maximizing energy production entails positioning the panel surfaces perpendicular to the sun's rays. Since single-axis trackers cannot directly face the sun, the maximum production is achieved by aligning the tracker rotation with the projection of the sun's position onto the tracking plane of rotation.

However, under certain circumstances, the TCU may determine that a different tilt angle is more suitable:

- When the sun is very low on the horizon, mutual shading between adjacent trackers can occur. To mitigate this issue, tracking angle is adjusted downwards (the tracker goes back) until shading is eliminated, a process known as back-tracking.
- In adverse weather conditions such as wind, snow, or hail, the target angle defaults to a predefined value. In these situations, the tracking angle no longer follows the sun but moves to a safe position. Safe positions are utilized both during daytime and nighttime.
- When the battery is very low, there is a possibility that the TCU may end up shutting down if it does not have enough power to charge. As a protective measure, the TCU itself activates the wind protection safe position so that if the TCU turns off, the panels are not at risk.
- If the communication between the TCU and NCU is lost, the TCU cannot have information about the weather, so wind protection safe position is activated too.

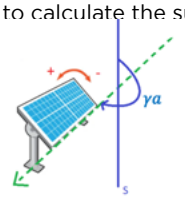
The necessary configuration parameters to calculate the target angle are listed below:

DATE AND TIME

The TCU needs to know the UTC date and time to calculate the sun position. This information will be given by the NCU and it is updated every second by the TCU with a Real Time Clock (RTC).

GEOGRAPHIC COORDINATES

The TCU needs to know the geographic coordinates of the tracker to calculate the sun position. If it knows the latitude, longitude, date, and time, the position of the sun will be known at



AXIS AZIMUTH OFFSET (γa)

It is the angle clockwise from north of the horizontal projection of the tracker axis. The default value is Ⓟ (180°). That indicates a tracker axis parallel to the NS axis in which the rotation angles facing to the west are considered positive.

TERRAIN SLOPE

The terrain slope gets defined by two values, the grade slope angle βg and the grade azimuth γg.

- The grade slope angle is the angle between slope plane and horizontal plane.
- The grade azimuth is the angle clockwise from north of the horizontal projection of falling slope.

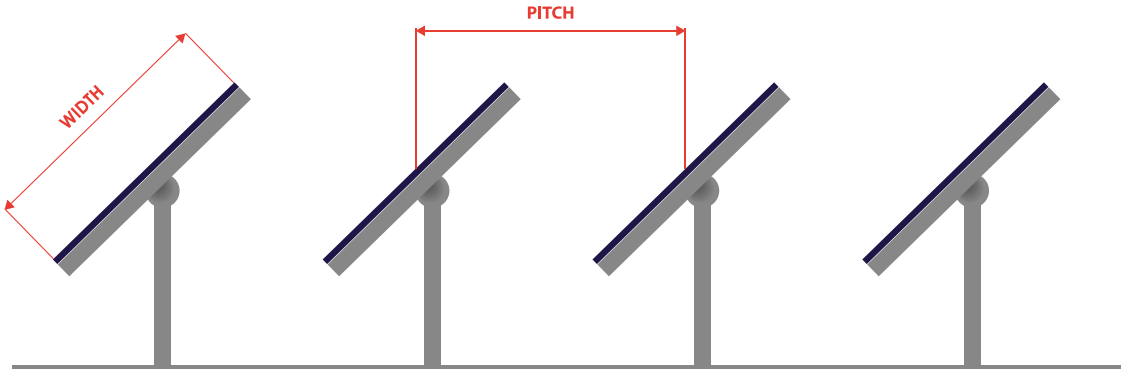
For example, if the direction of the slope is perpendicular to the NS axis, and it is falling from West to East, the value of the grade azimuth is 90°.

The default value of both parameters is 0.

BACKTRACKING

The goal of the backtracking strategy is to avoid shadow overlap between solar panels of adjacent trackers. The surface angles of the panels are moved away from their ideal values, just enough to get the shadow borderline outside of the border of the panel of the adjacent tracker. This approach ensures complete shadow avoidance while minimizing energy production losses due to non-optimal angles of incidence. The backtracking is enabled by default, but it can also be disabled.

Two of the parameters that the TCU needs for calculating the backtracking angle are the pitch (separation between axes) and the panel width. The default values are 9 meters for pitch and 3 meters for width.



If the terrain where the trackers are located is sloping, it will be necessary to introduce two new parameters to define that slope: The grade azimuth angle and the grade slope angle. These two parameters are 0 by default.

Grade azimuth angle γg

This parameter indicates the direction in which the slope of the terrain falls. For example, it could be from North to South, East to West, or any other direction relative to the cardinal points.

This parameter is measured in degrees and can take any value between 0° and 360°. The value you enter denotes the angle clockwise of the falling slope direction relative to the North-South axis.

Some examples:

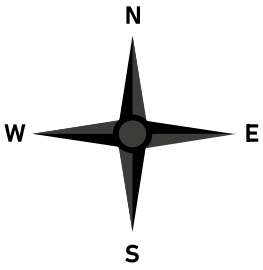
* 0° represents a slope falling directly from South to North
* 90° represents a slope falling from West to East. This means that the tracker located to the West is at a higher elevation compared to the tracker located to the East.
* 180° represents a slope falling from North to South
* 270° represents a slope falling from East to West, meaning the tracker positioned to the East is at a higher elevation than the tracker to the West.

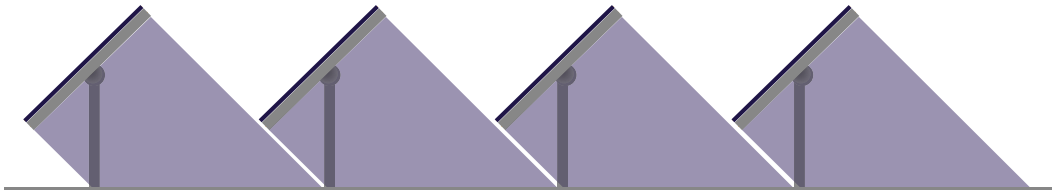
Grade slope angle βg

This parameter defines the steepness of the terrain incline. It represents the gradient of the slope.

The slope angle is measured in degrees and can range from 0° to 90°. However, the maximum value accepted by the TCU for this parameter is 45°.

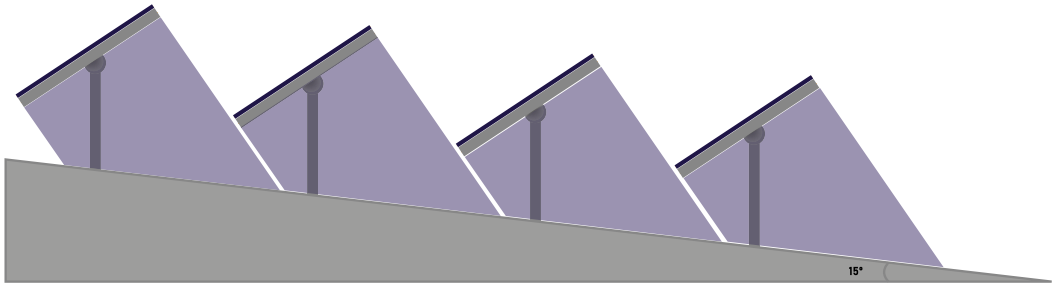
Example:





No slope

γg = 0°
βg = 0°



East falling slope

γg = 90°
βg = 15°

NIGHT POSITION

The tracker is placed in a predefined position at night. That angle is 5° by default and can be configured.

SAFE POSITION

In the presence of adverse weather conditions such as strong wind, snow, or hail, it is safer to place the panels in a predefined fixed position. The solar plant operator could also decide to place the panels in a fixed position for maintenance purposes (for example for cleaning the panels).

There are two types of safe position requests: the “local user requests” and the “remote NCU requests”. If the TCU receives requests to activate two different safe positions, the request coming from the NCU is prioritized.
Seven safe positions have been predefined. The tilt angles of those positions can be configured. The default values of the tilt angles of the safe positions are: 0 degrees [1], 10 degrees [2], 20 degrees [3], 30 degrees [4], 40 degrees [5], 50 degrees [6], and 55 degrees [7].

The NCU is responsible for activating the safe positions in the TCUs if a weather condition alarm is activated, or if the plant operator decides to use any of them. The safe position 1 has been reserved for wind alarms, the safe position 3 has been reserved for snow alarms, and the safe position 4 has been defined as cleaning position. No specific meaning has been assigned to the other 4 safe positions.

The TCU itself can also decide to activate the safe position 1 in three different situations:

- If the communication with the NCU is lost.
- In the selfpowered and string TCUs, if the battery SoC is below the configured critically low level.
- If the communication of the main MCU and the secondary MCU fails

At daytime, when the condition that activated a safe position disappears, the tracker starts to follow the sun again. At nighttime, when the condition disappears, the tracker remains in the safe position.

In some cases, it may be desirable to decide the orientation of a safe position based on the wind direction. For example, in the presence of strong wind, we may want to set the tilt angle to -25° if the wind is blowing from East to West and set the tilt angle to 25° if the wind is blowing from West to East. Each of the safe positions can be configured to be dependent on the wind direction or not. By default, all the safe positions are not dependent on the wind direction.

A Boolean value sent by the NCU indicates the wind direction. When the sign of the tilt angle of a safe position depends on wind direction the following criteria is used:

- If the wind is blowing from East to West, the sign of the tilt angle assigned to that safe position is inverted.
- If the wind is blowing from West to East, the sign of the tilt angle assigned to that safe position is not altered.

MAXIMUM TILT ANGLES

The target angle can never exceed the maximum west and east tilt angles. Those two values are configurable. The default value for the maximum east tilt angle is -55°, and for the maximum west tilt angle is 55°.

LIMITED TILT RANGES

In some cases, in the presence of strong wind, instead of placing the panels in a fixed position, it may be interesting to reduce the tilt range.

Seven tilt ranges have been predefined. The minimum tilt angles (East limits) and maximum tilt angles (West limits) of the seven ranges can be configured.
The default values of the maximum angles of the seven tilt ranges are: 35 degrees [1], 30 degrees [2], 25 degrees [3], 20 degrees [4], 15 degrees [5], 10 degrees [6], and 5 degrees [7].

The default values of the minimum angles of the seven tilt ranges are: -35 degrees [1], -30 degrees [2], -25 degrees [3], -20 degrees [4], -15 degrees [5], -10 degrees [6], and -5 degrees [7].

7.4.3 Motor parameters

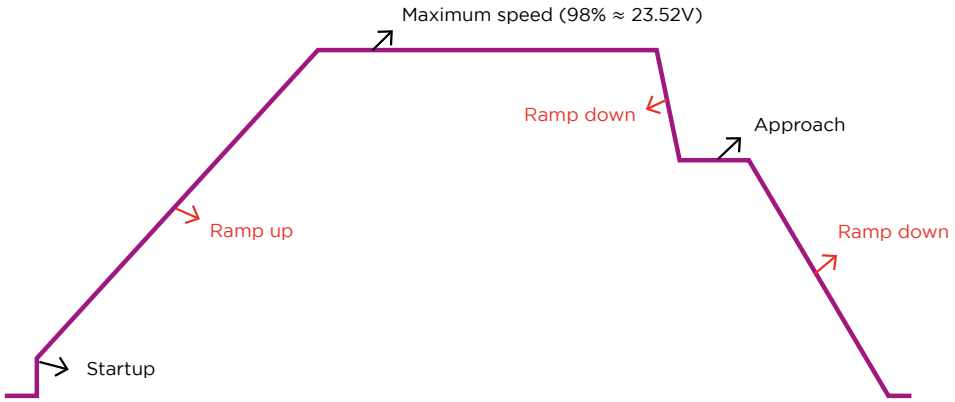
SPEED OF THE MOTOR

The speed and direction of rotation of the motor are controlled by the TCU with a DC output. The voltage range of that output is [-24V, 24V].

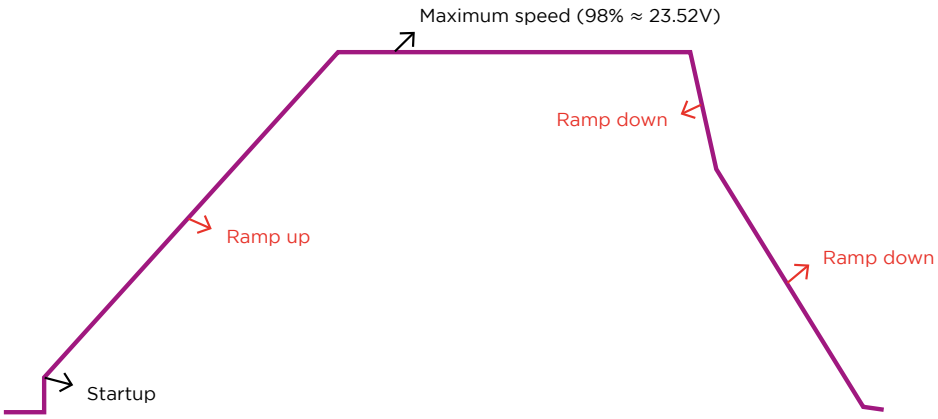
A PWM signal is used to generate that voltage. The higher the duty cycle of that signal, the higher the absolute value of the generated voltage, and the higher the speed.

There are several parameters to configure how the PWM signal is generated, and therefore to configure how the TCU controls the rotation speed of the motor.

When the system is in AUTOMATIC mode and the TCU decides it is time to change the tilt angle of the tracker, the motor starts at the startup speed. The speed is then progressively increased until it reaches the maximum value. The motor keeps rotating at the maximum speed until the tracker's tilt angle gets close to the target tilt angle. Then the speed is progressively decreased until it reaches the approach value. The motor keeps rotating at the approach speed until the target angle is reached. Finally, the speed is progressively reduced to brake the motor.



When the system is in manual mode, the motor starts at startup speed and then accelerates until the maximum speed is reached. When the user commands to stop the motor, the speed progressively decreases until the motor is completely stopped.



The values shown on the pictures above are configurable by modbus:

- The initial value of the duty cycle of the PWM signal is 10% by default.
- The ramp up of the duty cycle when the motor is getting accelerated is 20%/sec (0.4% every 20ms) by default.
- When the TCU is working in manual mode and the duty cycle reaches the maximum configured value, the acceleration ends. That maximum value of the duty cycle is 98% by default.
- When the TCU is working in AUTOMATIC mode and the duty cycle reaches the maximum configured value, the acceleration ends. That maximum value of the duty cycle is 98% by default.
- The ramp down of the duty cycle when the motor is getting braked is 85%/sec (1.7% every 20ms) by default.
- When the motor is getting braked and the duty cycle drops below a minimum value, the ramp down takes a fixed, non-configurable, value (30%/sec). That minimum value of the duty cycle is 66.7% by default.

DEADBAND

When the system is in AUTOMATIC mode, the TCU recalculates continuously the target tilt angle. If the difference between the current tilt angle and the target tilt angle is greater than a configurable value (deadband), the motor is activated.

The motor does not stop when it reaches the target angle but continues moving until the deadband value is moved away again in the other direction.

The deadband will be modified by the TCU depending on the battery level and if the backtracking is active or not. There are 4 possible options that can be configured by modbus:

- Backtracking is not active and low-capacity alarm is not active. Default value 1.3°.
- Backtracking is active and low-capacity alarm is not active. Default value 1.3°.
- Backtracking is not active and low-capacity alarm is active. Default value 2.59°.
- Backtracking is active and low-capacity alarm is active. Default value 2.59°.

Once the motor is turned off, a minimum time is required before allowing the motor to be turned on again. That minimum time can be configured, and its default value is 100 ms.

SURVEILLANCE OF THE MOTOR

Several surveillance functions have been implemented to detect a malfunctioning or blocked motor, and there are some thresholds that can be configured by modbus.

If the motor current exceeds a specific limit for a specific time, a motor overcurrent fault is activated, and the motor is stopped. The default values are 7000 mA and 1000 ms.

If the TCU is powering the motor but the tilt angle is not changing, a blocked motor alarm is activated, and the motor is stopped. The default value of the evaluation period is 10 seconds.

If the TCU is powering the motor but the measured rotation speed is considered too low, a low-speed motor alarm is activated. In AUTOMATIC mode it is only a warning and the motor does not stop, but in manual mode the motor stops and the state changes to OFF. The default value of that evaluation period is 15 seconds.

The minimum speed threshold is configured with two parameters. The first parameter contains the motor speed at no load and its default value is 200 milli degrees per second. The second parameter contain the fraction of the motor speed at no load that should be used as threshold. Its default value is 115, which represents a 115/256 fraction. With those default values, this alarm will be activated if the measured motor speed is lower than 89,8 milli degrees per second for 15 seconds.

The rotation speed is estimated using tilt measurements. The time between tilt samples used for speed estimation is 5000ms by default.

7.4.4 Selfpowered and string type TCU's

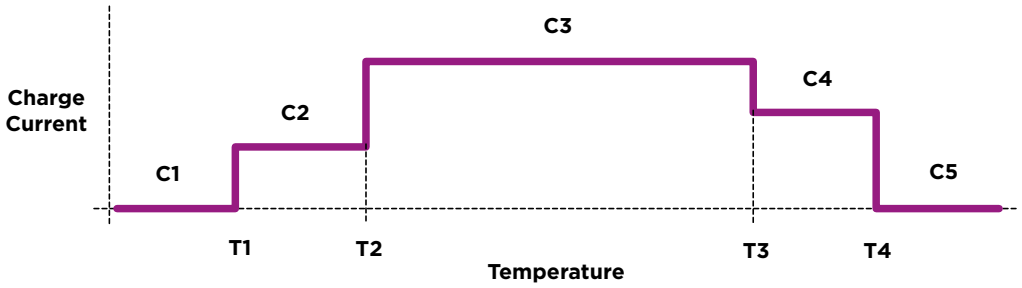
Some configuration parameters only apply to selfpowered and string type TCUs. These parameters are related to the battery and do not affect to the power supply model because it does not have it.

CONFIGURATION OF THE BATTERY CHARGER

Battery charge is controlled using a JEITA algorithm. By default, it is enabled but it can be disabled.

The implemented JEITA algorithm considers five temperature regions. They are limited by four temperature thresholds and their default values are 273 K (T1), 283 K (T2), 318 K (T3), and 333 K (T4).

A maximum charge current has been defined for each of those regions. Their default values are 0 mA (C1), 1200 mA (C2), 3000 mA (C3), 1000 mA (C4), and 0 mA (C5).



The nominal charge current (CC mode current) default value is 3000 mA. The nominal charge voltage (CV mode voltage) default value is 27600 mV.

The end of charge current threshold default value is 100 mA, and it is used to determinate that the charge is complete (batteries are fully charged).

The panel voltage at the maximum power point, used by the MPPT charger control algorithm, is 35000 mV by default.

PRESERVATION OF THE BATTERY

Keeping the batteries permanently fully charged could shorten its life. To extend the battery life, it is possible to configure the desired SoC range with the maximum allowed SoC [%] and the minimum allowed SoC [%]. Their default values are 85% and 70%. When the SoC exceeds the maximum value, the charger will turn off. When the SoC drops below the minimum value, the charger will turn on.

On the other side, to calibrate the SoC calculation a fully charge of the batteries is required. It is possible to configure the frequency at which a fully charge of the batteries will be allowed. The number of days when a fully charge is not allowed can be configured and its default value is 4 days. At the end of that period, a fully charge of the batteries is allowed. When the batteries get fully charged, the day counter is reset to zero.

A charger in active mode for a very long time could be an indication of the malfunctioning of the charger. An alarm has been defined to indicate that the charger has been on for too long. The threshold can be configured, and its default value is 36000 seconds. Another alarm has been defined to indicate that the charger has been on CV mode for too long. The threshold can be configured, and its default value is 7200 seconds. These alarms have no effect in the behaviour of the TCU and will be disabled when the battery is fully charged.

CONDITIONS TO MOVE MOTOR

To start moving motor in AUTOMATIC mode, a minimum SOC must be reached. This SOC is 10% by default. This is only needed the first time since startup occurs and is not considered when a safe mode is active.

CONFIGURATION OF LOW CONSUME MODELS

Four low consume modes have been defined for the selfpowered and string type TCUs depending on the SOC level of the battery:

- **Normal mode**

The system works normally following the sun if it is in AUTOMATIC mode and no measures are applied to reduce consumption.

- **Low-capacity mode**

When the battery level drops below 50% the TCU changes to Low-capacity mode. The operation is very similar to normal mode but the deadband changes so the engine must make less starts to consume less energy. The battery level must exceed 55% to return to normal mode.

- **Very low-capacity mode**

When the battery level drops below 30% the TCU changes to Very low-capacity mode. In this mode the system can behave in two different ways depending on if safe positions are wind direction dependents.

If all the safe positions are not wind dependent, the behaviour will be the same as for “Low SOC” state.

If any of the safe positions are wind dependent the target angle goes to 0°. In this way we are ready to go to the safe position either positive or negative. If the natural movement of the tracker following the algorithm must go through 0, the tracker will continue moving normally until 0° are achieved and will remain in this position. Otherwise, it will move to 0° immediately.

The battery level must exceed 35% to return to Low-capacity mode.

- **Not enough capacity mode**

When the battery level drops below 20% the TCU changes to Not enough capacity mode. In this mode safe position 1 is active and the tracker will move to the required angle, that is 0° by default. If the safe position 1 is wind dependent the TCU will move to +-X° and will remain there even if the wind direction changes.

The battery level must exceed 25% to return to Very low-capacity mode.

- **Critically low capacity mode**

When the battery level drops below 10% the TCU changes to Critically low-capacity mode. The behaviour of the TCU in this mode is the same as in Not enough capacity mode.

CONFIGURATION OF THE BATTERY HEATER

In certain places the temperature can reach very low values, and that can make the battery to decrease its performance. In addition, if we charge or discharge the battery at these temperatures, it can be damaged. To solve this problem the TCU can have an external heater PCB that turns on and off based on various pre-set thresholds. The heater will only be used for string configuration, because is the only one that can supply enough current.

First, it is possible to configure if the TCU has a heater connected. Otherwise, the heater will not work. The temperature threshold for turning the heater on and off must be configured too. Depending on whether the battery is getting charged or discharged, the activation threshold will change between the value of one register and the other.
This threshold is used with a hysteresis and its value is 1 by default, so the turning on/off values must be the value of the threshold +-0.5°C.

If the battery is being charged this value is 15°C by default and if it is being discharged -5°C. This is done like that because when the battery is being charged the PV string should supply enough current for activating the heater and the battery would not be discharged.

7.5 SUNNER CONFIG TOOL

The SUNNER Config Tool (SCT) is a private C# application owned by IED and designed to provide an intuitive user interface for interacting with a solar TCU and HSU.

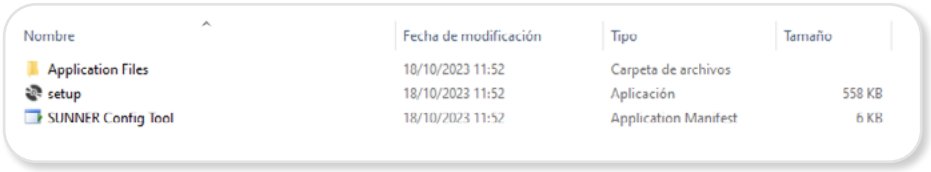
The application allows authorized users to monitor and control the TCU and HSU's behavior by reading and writing Modbus registers, viewing status information, and configuring the control unit's settings.

7.5.1 Main features

- Read and Write Modbus Registers: The application facilitates communication with the control units by reading and writing Modbus registers. This enables users to access and modify various parameters within the control unit.
- Status Monitoring: Users can easily monitor the status of the TCU and HSU. This includes information about weather conditions, current position, operational mode, and other relevant data.
- Configuration: The interface provides a user-friendly way to configure the settings of the TCU and HSU. Users can adjust parameters related with alarms, motor, target and tilt angle, battery etc.
- User Access: The application supports different levels of user access to ensure security. User authentication and authorization mechanisms are implemented to restrict access to certain features based on user roles.

7.5.2 Installation process

IED will provide the app suited for the need of the client. Providing the access rights depending on the needs of the client. Download the app and execute the **setup.exe** file.

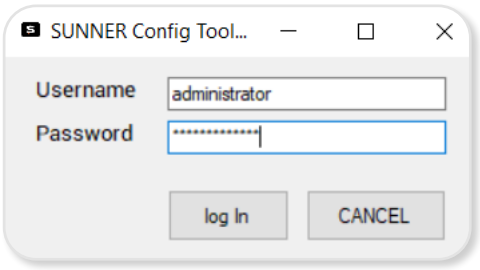


Note: If the app is already installed and requires an update, we recommend uninstalling the existing version and then installing the new one.

7.5.3 Log In

Launch the SUNNER Config Tool using the login credentials supplied by IED. There are two types of accounts available:

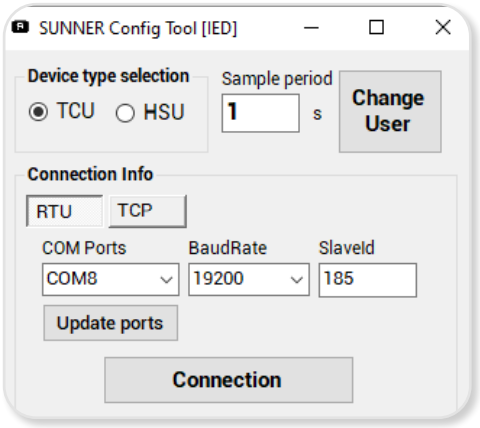
User Account: This type of account is limited to reading information.
Administrator Account: With this account, you have the capability to both read and configure TCU/HSU parameters.

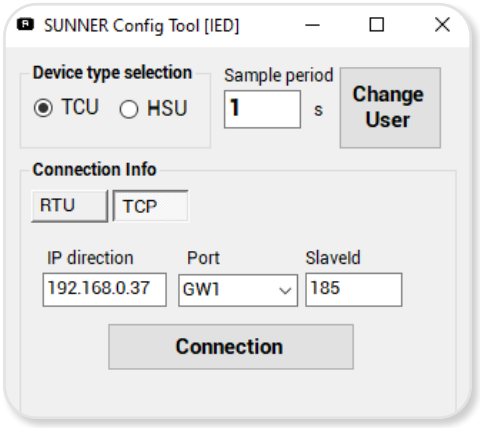


7.5.4 Device selection

After successfully logging in, the application provides the user with the option to select the desired device type for access. There are several choices to make:

- Choose Device Type: Select either 'TCU' or 'HSU.'
- Select Sample Period: It is recommended to set the sample period to 1 second. However, if the network experience is slow, you can consider increasing this value.
- Choose Connection Type: There are two available options:
  - **RTU:** if your PC is connected to the TCU or HSU via an RS485 cable, choose this option. Specify the COM Port, set the baud rate to 19200, and input the Slave ID.
  - **TCP:** You can choose this option if your PC is connected to the SUNNER ecosystem's Ethernet network. Write the IP address of the NCU, select the gateway 1 or 2, and provide the Slave ID.

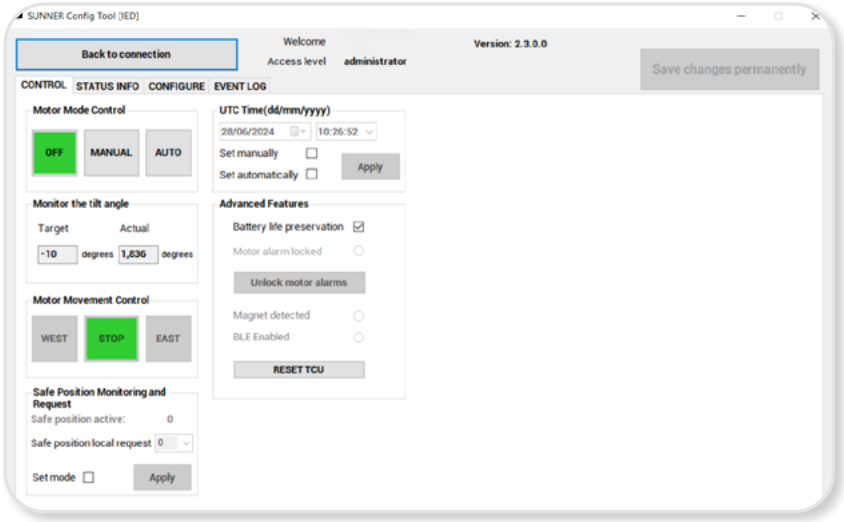




7.5.5 Control tab

A new window will appear, displaying the username and access level in the upper part. To switch users, please follow these steps:

- Select 'Back to Connection' to return to the previous screen.
- Next, choose 'Change User' to switch to a different user account.



Within the TCU control interface, users have access to three tabs, each offering different functionalities. The first tab is referred to the 'Control' and manages the following features:

- Motor Mode Control: Users can control the operation mode of the TCU. For more detailed information, please refer to Section 7.2 CHANGE OF OPERATION MODE
- Tilt Angle Monitoring: This section allows users to monitor both the actual and target tilt angles.
- Motor Movement Control: Users can manually operate the motor using this feature, only when the control is in manual mode.
- Safe Position Monitoring and Request: This section enables users to monitor if any safe position is active and request a move to one. For a comprehensive understanding of 'local user request,' please consult Section 7.4.2 Target Angle Calculation in the sub-section “Safe position”.
- Time Setting: Users can set the time manually or automatically synchronize with the PC's date and hour. When 'AUTOMATIC' is selected, the time will be synchronized with the PC upon user confirmation. Be careful, the time has to be in UTC format.
- Battery Life Preservation: Users have the option to activate 'Battery Life Preservation.' For a detailed explanation of this feature, please refer to Section 7.4.4 Selfpowered and string type TCU’s in the sub-section “Preservation of the battery”.
- Unlock motor alarms: Resets any motor alarm that may be active and displayed within the ‘Motor alarm locked’ icon.
- Reset Configuration: The 'Reset Configuration to default values' button reverts all TCU settings to their default values, as initially set at the factory.
- Magnet Detection and Bluetooth Low Energy Activation: This section provides information on magnet detection and BLE activation.

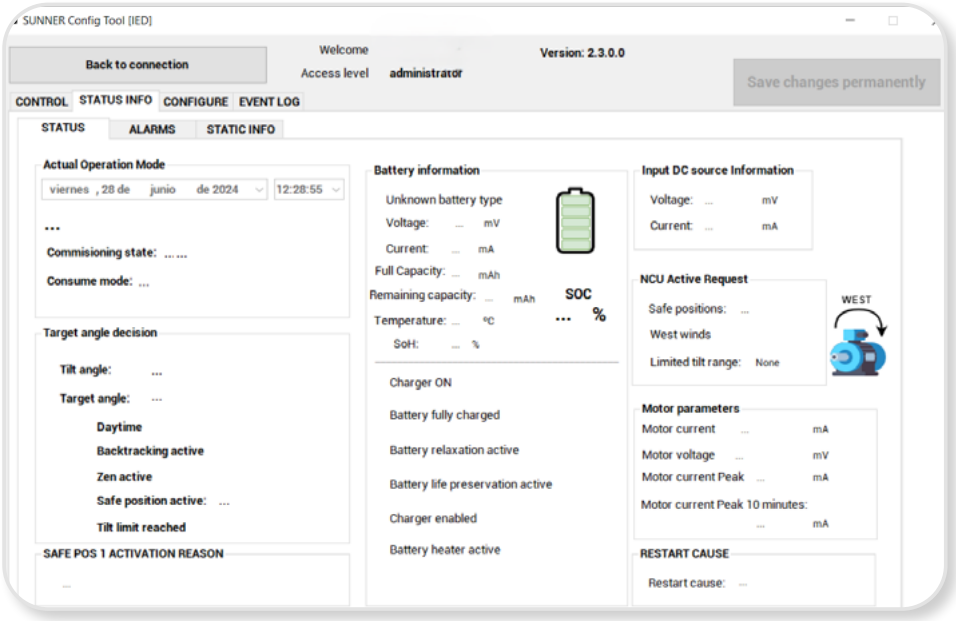
7.5.6 Status info tab

In this tab users can visualize different information related with the power supply, battery, alarms, information of the TCU, etc.

- **Status**

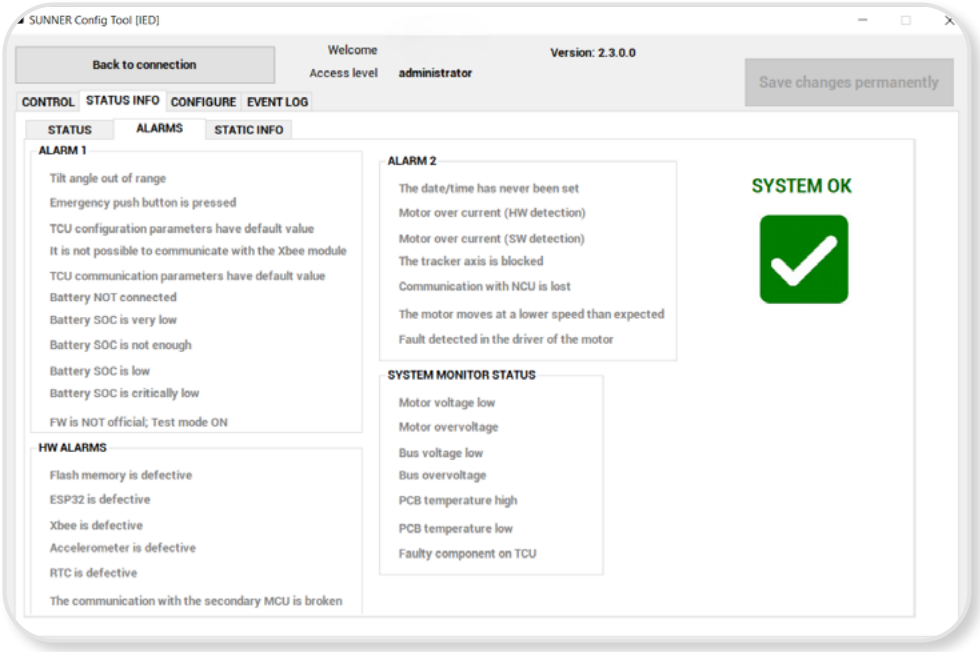
In the "Status" tab, users can access essential information about the TCU's status. This tab includes the following details:

- Actual Operation Mode: Provides information about the TCU's current operation mode. Additional details about the commissioning state and consumption mode are also available here.
- Target Angle Decision: Displays the actual target and tilt angle information. Users can also find extra information, where active bits are highlighted. For instance, in this example, the "Daytime" bit is active.
- Battery Information: If the TCU has a battery, this section provides information about its status.
- Safe Position 1 Activation reason: Offers information related to the activation of safe positions 1.
- Input DC Source Information: Details about the input DC power source are available in this section.
- NCU Active Request: Provides information about any active requests from the NCU (Network Control Unit).
- Motor parameters: Offers insight into various motor parameters.
- Restart Cause: Displays the cause of the last TCU restart.

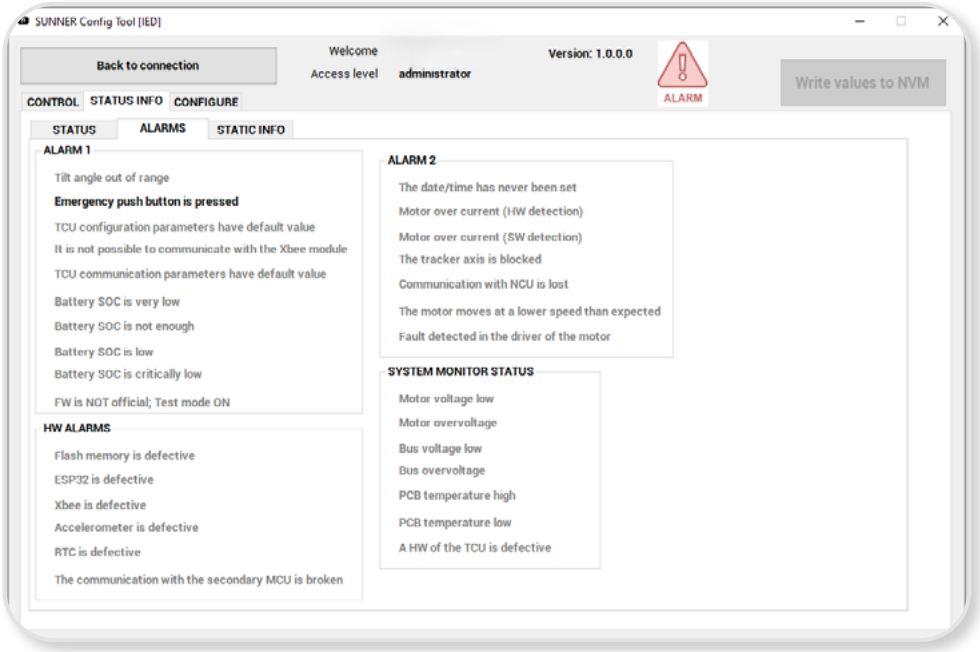


- **Alarms**

If the TCU is functioning correctly, all alarms will be deactivated, and you will see the "System OK" icon displayed in this area.

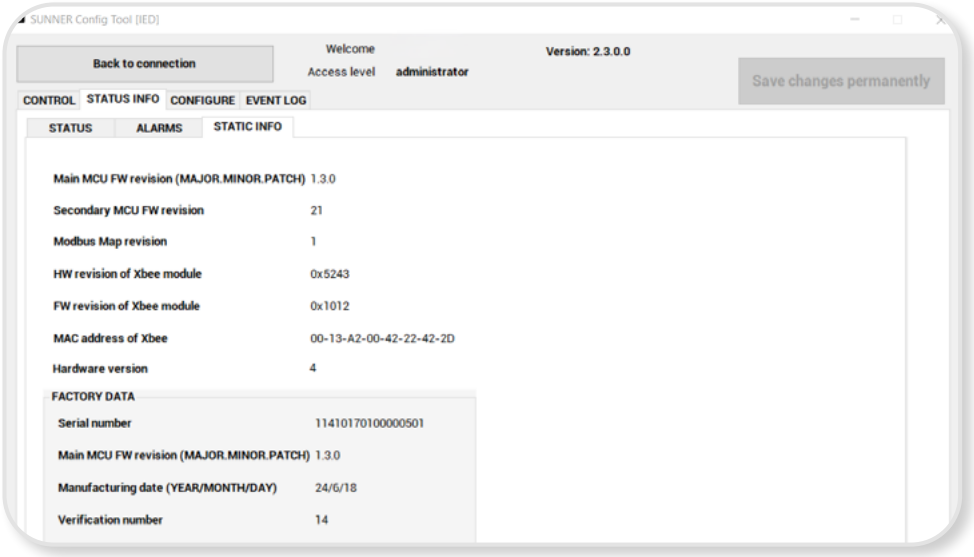


In the event of an active alarm, the alarm icon will be displayed, and the specific alarm will be highlighted. For instance, in the image below, the "Emergency push button is pressed" and “Battery SOC is low” alarms are currently active.



- **Static info**

The "Static Info" tab will provide information about the firmware revision and factory data, allowing users to identify which TCU is currently in operation.



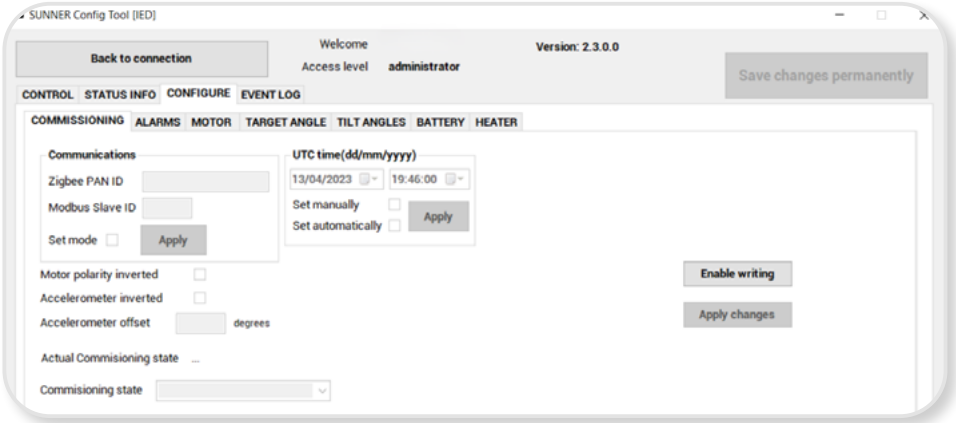
7.5.7 Configure tab

The "Configure" tab is where users can adjust TCU parameters. To begin configuring any parameter, start by pressing the "Enable Writing" button; this action unlocks the parameters within the tab. After making the desired changes, press the "Apply Changes" button to implement the modifications in the TCU.

Users can then test the applied modifications in the TCU. Once these adjustments are satisfactory, they should be saved in the Non-Volatile Memory (NVM) by pressing the "Save changes permanently" button. Failure to do so will result in the loss of all changes made once the TCU reboots.

- **Commissioning**

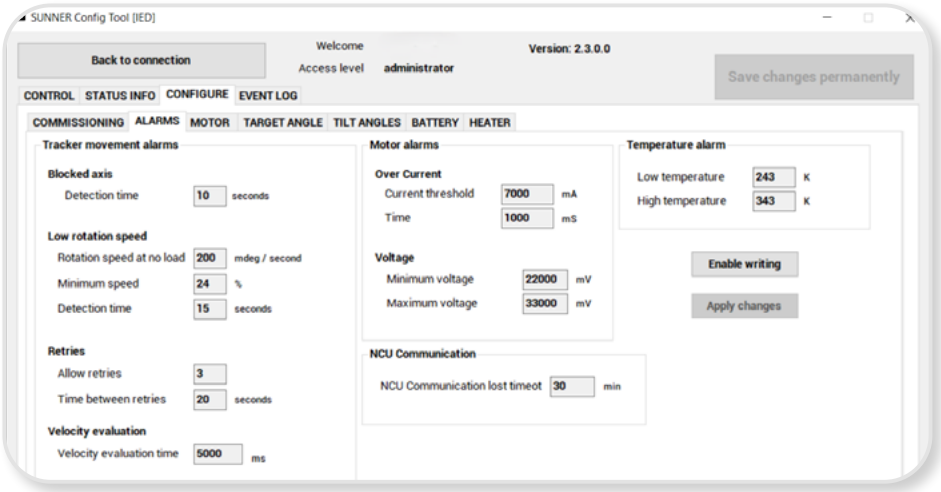
The "Commissioning" tab enables users to configure parameters associated with the commissioning phase. For more detailed information, please refer to the 6. COMMISSIONING.



- **Alarms**

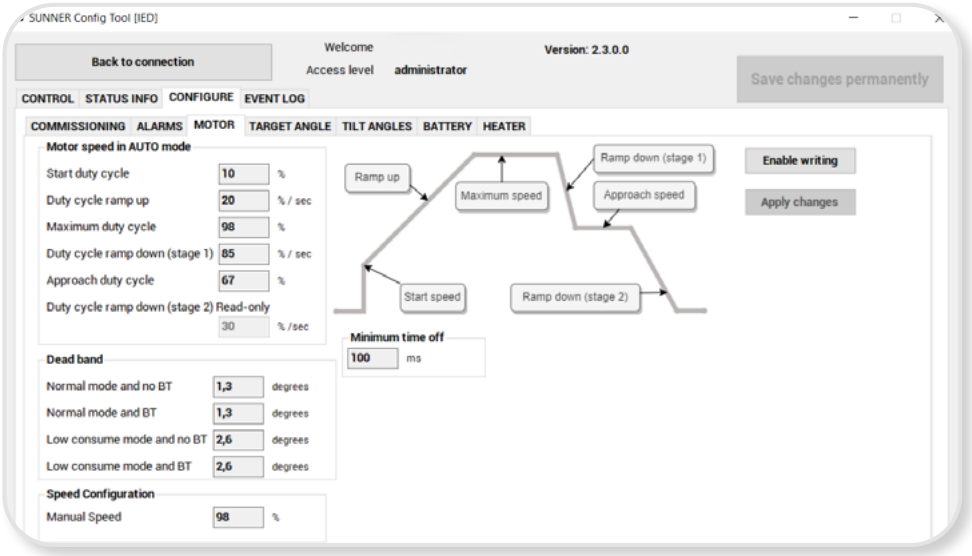
The "Alarms" tab allows users to configure various alarm parameters related to tracker movement, motor operation, NCU communication, and temperature. For more information you can consult section 7.3 SYSTEM ALARMS.

Additionally, concerning NCU communication, the TCU continuously monitors communication with the NCU. If communication with the NCU is lost, the TCU will automatically activate safe position 1. Users can configure the NCU communication lost timeout, with the factory default value set at 30 minutes. If the timeout is set to 0, surveillance of NCU communication is disabled.



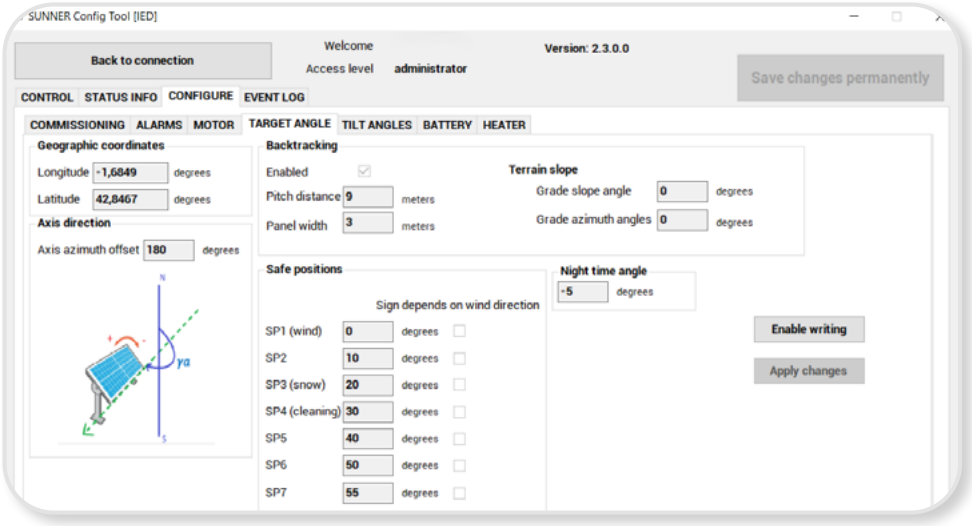
- **Motor**

The "Motor" tab provides users with access to configure motor parameters. For more comprehensive details on these motor parameters, please refer to the Chapter 7.4.3 Motor parameters.



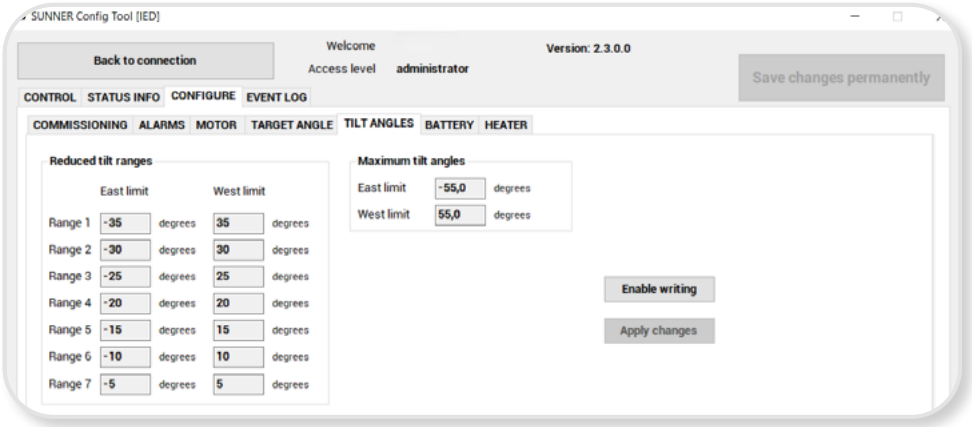
- **Target angle**

The "Target Angle" tab grants users access to configure target tilt parameters. For a deeper understanding of these target angle calculations and parameters, please consult the Chapter 7.4.2 Target angle calculation.



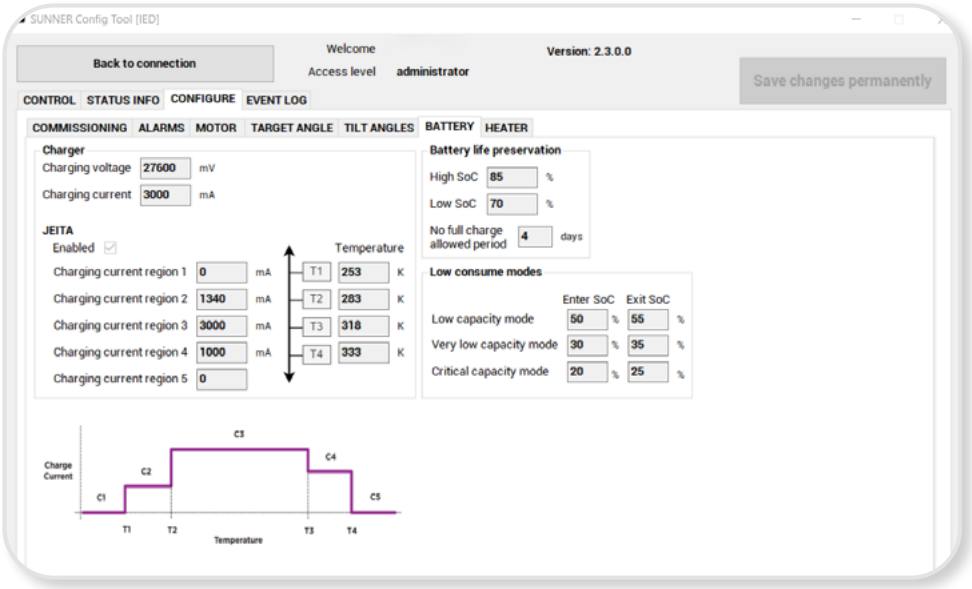
- **Tilt angle**

The "Tilt Angle" tab allows users to configure both the maximum tilt angle and the reduced tilt angles. For detailed information on setting the maximum tilt angles or limited tilt ranges, consult the Chapter 7.4.2 Target angle calculation. “Maximum Tilt Angles” and “Limited Tilt Ranges” sub-sections.



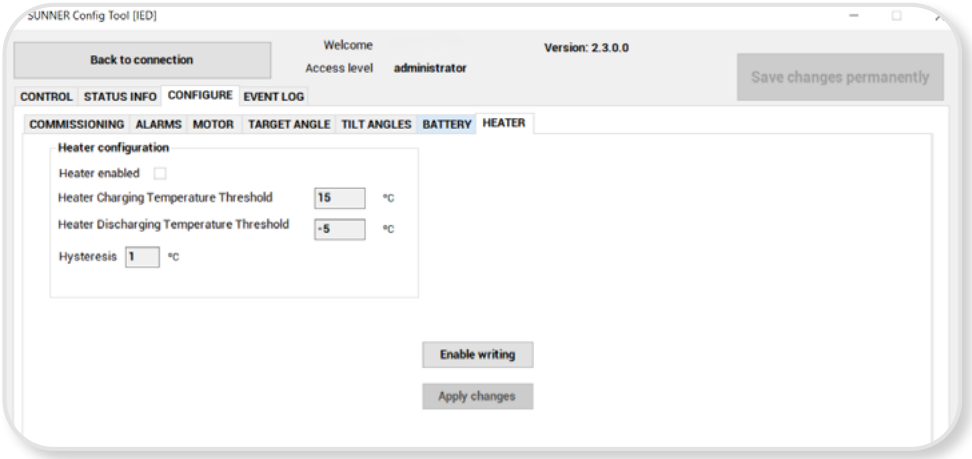
- **Battery**

The "Battery" tab provides users with access to read battery parameters. Please note that this information will only be applicable to selfpowered and string-type TCU units. If your TCU falls into one of these categories, you can find more details about the battery in the Chapter 7.4.4 Selfpowered and string type TCU's Configuration of the Battery Charger.



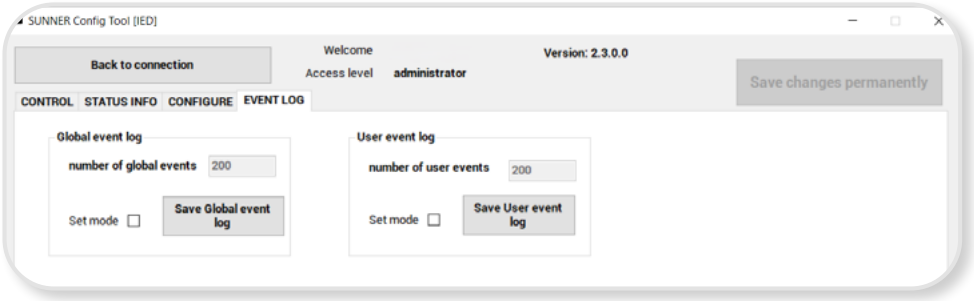
- **Heater**

"Heater" tab allows users to configure heater activation and deactivation temperature thresholds and hysteresis. There is also a box to indicate if the TCU has a heater or not. You can find more details about the heater in the Chapter 7.4.4 Selfpowered and string type TCU's Configuration of the Battery Heater.



- **Event log**

The "Event log" tab allows users to read the last events registered by the TCU in a ".csv" file. In "global events" all events are stored, while in "user events" only events where the user has something to do, such as configuration changes, etc., are stored.



7.6 STATUS INDICATOR

LED indicator	LED state	TCU status
	Turned OFF Turned ON 2Hz 100ms blink every 2,5s	No alarm Active alarm Commissioned but not in AUTO mode Not commissioned
	Turned ON 1Hz 5Hz	Battery OK Low battery No battery
	Turned ON 1Hz 5Hz	NCU comm. OK No NCU comm. Bluetooth error

***During TCU power on, the LEDs will turn on alternately for 5 seconds.**

8. MAINTENANCE

8.1 BATTERY REPLACEMENT

The main battery is a rechargeable LiFePO4, 25.6V 6000mAh. The battery must be charged every 6 months to ensure its lifetime (>6 years).

DANGER ⚠

Danger to life due to electric shock when live components or DC cables are touched.

- Do not touch non-insulated parts or cables.
- Disconnect the product from voltage sources and ensure it cannot be reconnected before working on the device.
- Do not disconnect the DC connectors under load.
- Wear suitable personal protective equipment for all work on the product.

CAUTION ⚠

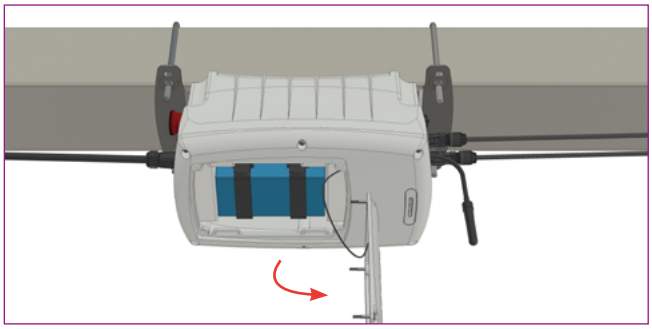
* Do not dispose of batteries in a fire. The batteries may explode.
* Do not open or damage batteries. Released electrolyte is harmful to the skin and eyes. It may be toxic.
* A battery can present a risk of electrical shock and high short-circuit current. The following precautions should be observed when working on batteries.
  a. Remove watches, rings, or other metal objects.
  b. Use tools with insulated handles.
  c. Wear rubber gloves and boots.
  d. Do not lay tools or metal parts on top of batteries.
  e. Disconnect charging source prior to connecting or disconnecting battery terminals.
  f. Determine if battery is inadvertently grounded. If inadvertently grounded, remove source from ground. Contact with any part of a grounded battery can result in electrical shock. The likelihood of such shock can be reduced if such grounds are removed during installation and maintenance (applicable to equipment and remote battery supplies not having a grounded supply circuit).

NOTICE

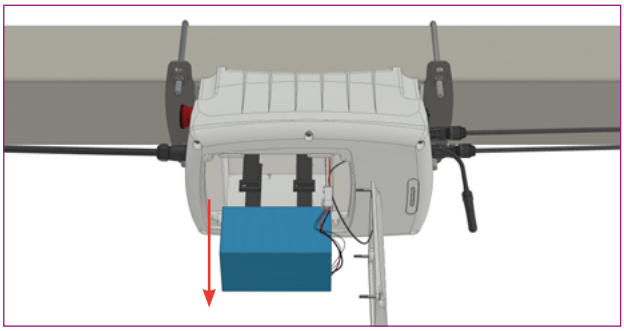
* Do not open the large cover, as it is only for manufacturer maintenance. Unauthorized opening will void warranty.

Battery replacement instructions:

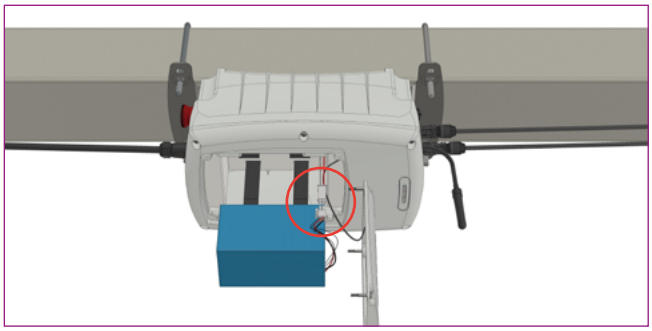
1. Disconnect the TCU power supply (PV+ and PV- in SP model/ isolator switch in STRING model) and disconnect the battery by loosening the fuse holder.



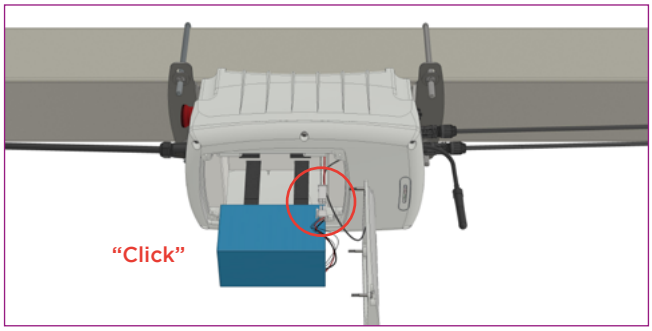
2. Open the SUNNER TCU small battery lid by removing the four T20 torx head screws. The lid stays hanging thanks to the anti-fall cable.



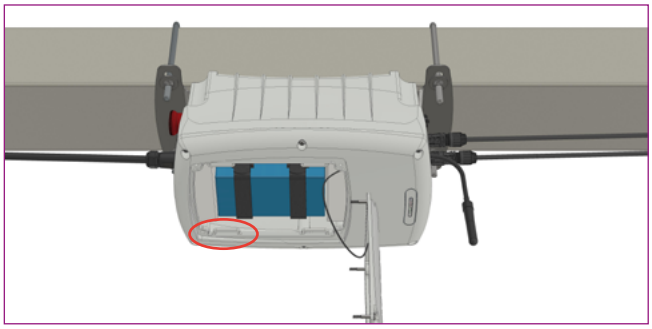
3. Remove the battery by loosening the cinch straps. Hold the battery securely in your hand.



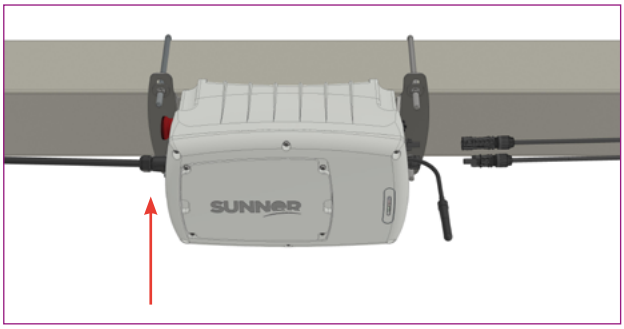
4. Unplug the battery (*).

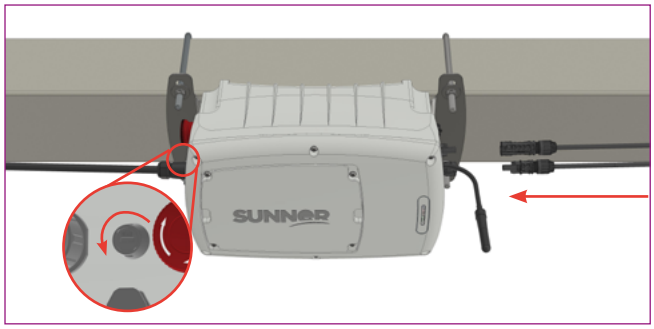


5. Replace the battery and plug the battery verifying the cable is correctly inserted. Take note of the cable positions to prevent cable pinching (*).



6. Secure the battery with the cinch straps.
To facilitate the insertion of the battery into the housing, slots are added to insert the end of the straps during the process, if needed.

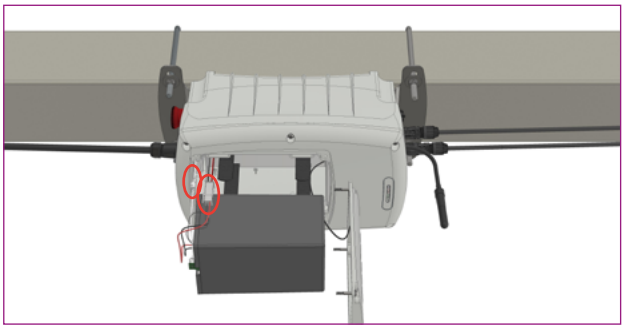


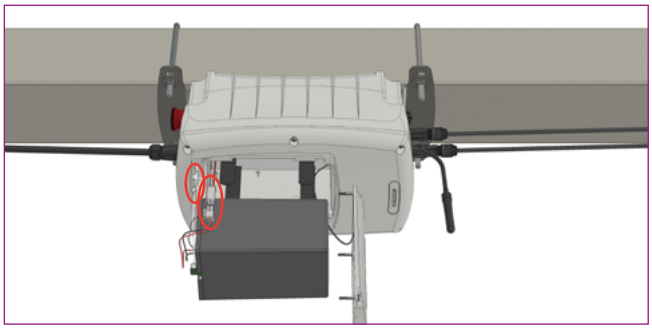


7. Screw the lid to the SUNNER TCU with a T20 torx screwdriver bit and a recommended tightening torque of 1 Nm. Care must be taken to avoid any cable pinching.

8. Connect the battery by tightening the fuse holder and connect the TCU power supply.

(*) Note that for TCU LOW TEMPERATURE models with heater, the entire battery holder, including the battery and heater, must be unplug/ plug.





8.2 CLEANING INSTRUCTIONS

1. Unplug the unit. Without opening the lid, wipe a cloth dampened with water and use with mild soap if needed over the surface. Indoors, the unit can be cleaned with soft, clean cloth to remove any oil, grease, or grim.

2. Before using any cleaning or decontamination methods except those recommended in this manual; please contact IED to ensure that the proposed method will not damage the unit.

9. TROUBLESHOOTING

If the TCU fails, the fault information is displayed on the APP interface or in the Sunner Config Tool software for the PC. The fault types and troubleshooting methods for different TCU models are detailed in the table below. Some of the faults may be common for all the models and others depend on each model. If the trouble cannot be fixed following the steps, contact Sunner customer service.

FAULT TYPE	CORRECTIVE MEASURES
TCU does not communicate with the NCU by zigbee	1. Check that the antenna is well connected and in good condition. 2. Check that blue led is blinking at 1Hz (No comm. with NCU). 3. Approach the magnet and connect to the TCU with the APP. Check if there are any active alarms. 4. Check the PANID and slave ID are correct. 5. If everything is OK do a power reset.
BLE does not turn on	1. If red led is on it could be a communication fault with BLE module 2. Approach the magnet. If blue led blinks at 5Hz there is a BLE error 3. Connect via RS485 with SCT 4. Approach the magnet and check if magnet is detected. If not, the reed sensor is broken
RS485 communication cannot be established	1. Check battery fuse is connected and is not broken 2. Check PV panel is supplying voltage to the TCU
Operation mode does not change	1. Check the motor is not moving
Motor doesn't change to MANUAL mode	1. Check emergency push button is not pressed 2. Check motor locked alarm is not active
Motor doesn't change to AUTO mode	1. Check the commissioning state is COMMISSIONED (0) 2. Check emergency push button is not pressed 3. Check motor locked alarm is not active 4. Check out of range alarm is not active 5. Check "time never set" alarm is not active 6. Check inclinometer is not faulty
Motor is in AUTO mode but it doesn't move	1. Check "time never set" alarm is not active 2. Check out of range alarm is not active 3. Check that the SOC of the battery is higher than the minimum to start moving it
Motor doesn't move	1. Check motor cable is connected
Motor moves but axis alarm blocked alarm activates	1. Check the TCU is placed in the proper direction 2. Select "inclinometer inverted" option if the TCU has been mounted back to front
Overcurrent HW/SW or driver fault	1. Check that the motor cable connected to the TCU is not defective 2. Check there is not a short current in the TCU motor connector pins
TCU battery is not getting charged	1. Ensure PV panel is supplying voltage 2. Read battery temperature. If it is -38.9° the NTC sensor is not connected

10. RECYCLING

For disposal in EU countries
This product is an electrical and electronic equipment (WEEE) and should not be mixed with general waste. For proper recycling, please take this product to designated collection points where it will be accepted free of charge.

Alternatively, in some countries, you may return your product to your local distributor when purchasing an equivalent new product.

Correct disposal of this product will help to save valuable resources and prevent potential negative effects on human health and the environment.

Contact your local authority for details of the nearest designated collection point. Penalties may apply for improper disposal of this waste in accordance with your national legislation.

For disposal in countries outside the European Union
To dispose this product, contact your local authorities or distributor and ask for the correct method of disposal.
Please note that when purchasing our product, you have the obligation in accordance with the regulations in force, to make available to an authorized manager the waste of associated packaging, for proper environmental management.

DISCLAIMER. Installation Instructions and Warranty Policy

Users are advised that failure to strictly adhere to the installation guidelines outlined in this manual will result in the nullification of the associated warranty provided by IED. Any damage or malfunction arising from non-compliance with the specified instructions releases IED from liability. It is the user's responsibility to follow the instructions accurately to maintain warranty coverage. IED reserves the right to deny warranty claims for products that have been improperly installed or operated.