SOLTRK

Control unit for PV tracking systems

The German user manual is the original document

User Manual NF11ST3xxAC

Contents

1 Notes on this Document

1.1 Target Group

This document is a user manual aimed at installers and operators. It contains a description on the installation, commissioning and operation of the SOLTRK.

The appendix includes summary tables on

- the LED functions
- the channel lists
- error codes and descriptions
- a description of commands for remote operation
- the manual control functions

The activities described in this document are only to be performed by qualified electricians. They are marked with a danger notice.

1.2 Validity

This user manual applies to SOLTRK firmware version 1.6 and Sunny WebBox software version 1.42 and above.

This user manual only describes the functional units of the SOLTRK control unit. It is not a user manual for the sonnen_system nor does it replace the user manual for the sonnen_system.

1.3 Symbols Used

The following hazard categories are used in this document.

DANGER!

The term Danger indicates a hazard which, if ignored, can lead to fatal injury

WARNING!

The term Warning indicates a hazard which, if ignored, can lead to serious injury or death.

CAUTION!

The term Caution indicates a hazard which, if ignored, can lead to injury.

ATTENTION!

The term Attention indicates a hazard which, if ignored, can lead to material damage

Other symbols

This symbol indicates a notice which, if ignored, will make the procedure or operation more difficult.

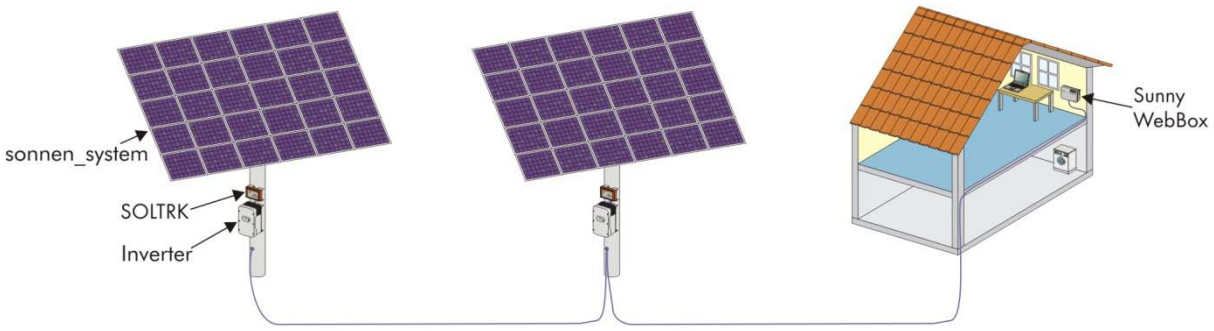
2 SOLTRK

2.1 Application and Function

SOLTRK is a control unit for PV tracking systems which determines the sun's position using astronomic calculations and automatically aligns the surface of the photovoltaic modules towards the sun. Tracking is performed in two axes, namely horizontal (X-axis = azimuth) and vertical (Y-axis = elevation).

The following parameters must be entered into the SOLTRK using an SMA "Sunny WebBox" data logger connected to the RS485 interface:

- longitude and latitude of the location
- current date and time



Up to 50 units (SOLTRK and inverters) can be managed by one Sunny WebBox. The travelling range of the tracking system can be restricted to prevent or reduce reciprocal shadowing of the sonnen_system installations (track-back).

The SOLTRK can be employed in locations at latitudes between 25 ° and 65 ° north. The longitude of the location can lie between –180 ° and +180 °.

2.2 Functions

SOLTRK functions

- Automatic tracking of the sonnen_system in the horizontal and vertical axes by calculating the position of the sun based on the longitude/latitude of the location, the date and the time.
- Controlling the elevation and azimuth drives and analysing the pulse signals from the rotary sensors.
- Error monitoring during setup and tracking operation.
- Optional connection of an "overdrive voltage" (overdrive), which enables the sonnen_system to move into a safe horizontal position, for example during a storm, independently of the SOLTRK control processor.
- Reduced reciprocal shadowing of the sonnen_systems by using the Sunny WebBox user interface to restrict the travelling range.

Operation

- Via the Sunny WebBox user interface or via manual control (only during commissioning and maintenance).

Indication of the operating modes

- The operating mode is indicated by the LEDs on the front of the SOLTRK.

Remote maintenance / remote operation

- The Sunny WebBox user interface can be used to configure, read and, if necessary, control or reset the SOLTRK. This allows efficient remote maintenance from any Internet connection, providing the Sunny WebBox is connected to the Internet. If an Internet connection is not available, direct Ethernet access to the Sunny WebBox is required in order to administrate the system.

Deployment location

- The SOLTRK can be deployed in locations situated between 25 ° and 65 ° latitude north and –180 ° to +180 ° longitude.

Power supply

- 24 V DC connection. (Maximum power consumption 5 A per sonnen_system).

RS485 communication

- To Sunny WebBox (software version 1.42 or higher) and inverter

2.3 Scope of Delivery

SOLTRK

2.4 Identification

2.4.1 Name Plate

You can identify the SOLTRK from its name plate (see figure to the right). The name plate is located on the right side of the SOLTRK housing.

Hardware version of the SOLTRK →

2.4.2 Firmware Version

The firmware version can be displayed on the Sunny WebBox once it has successfully detected the SOLTRK. The firmware version is displayed as a channel (see section 11.2 „Channel List“ on page 53).

3 Safety Instructions

SOLTRK is a single-channel system. This means that the SOLTRK could provoke involuntary movements if a hardware or software error occurs. Therefore, pay particular attention to the following safety instructions.

CAUTION!
Risk of injury or material damage.

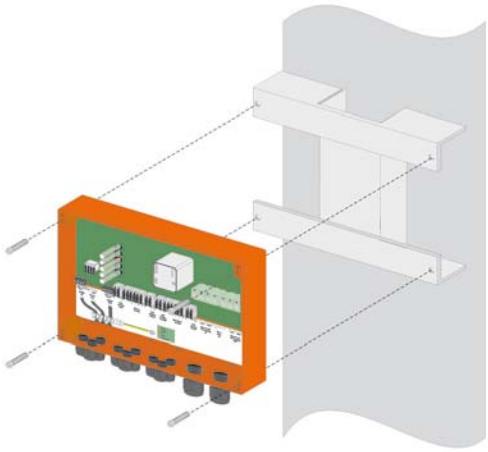
Unintended movements of the sonnen_system could result in injury or material damage.

- Remove all voltages from the SOLTRK before working on the sonnen_system.
- No persons or objects should be within the turning and tilting range of the sonnen_system. Ensure that this includes the entire range of travel, even beyond the position of the limit switch.
- During commissioning and maintenance, the SOLTRK may only be operated in manual mode and without the external overdrive fuse.
- Users are responsible for their own actions during manual operation.
- The user must verify that the control unit and system are working properly before changing to automatic operation.

4 Installation

This section describes the installation of the SOLTRK on the mounting plate of the sonnen_system.

1. Unscrew the cover on the SOLTRK.
2. Use the screws provided to attach the SOLTRK to the sonnen_system mounting plate, as shown in the figure to the right.

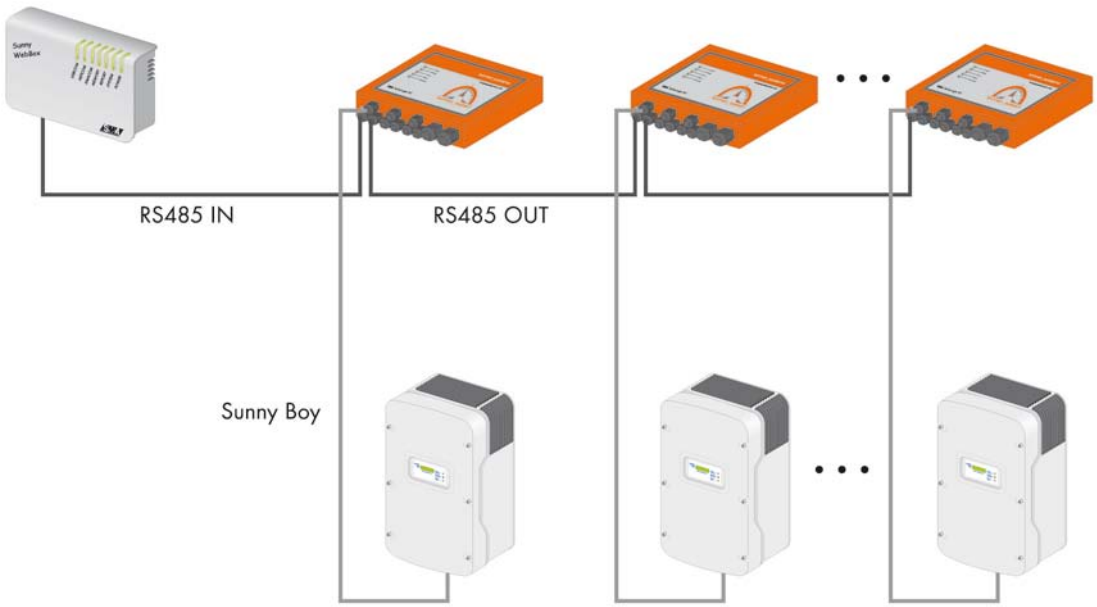


Please note that even if the cover has been correctly fitted, the SOLTRK housing only meets the specified protection degree (IP65) after all the cables have been installed. Complete the installation procedure to ensure that no humidity can enter the unit.

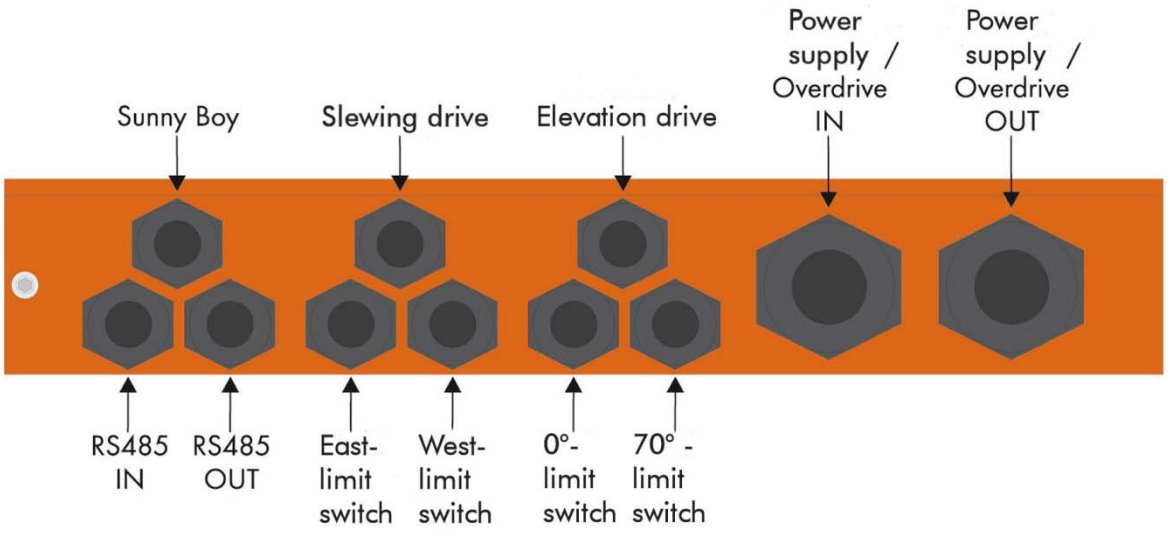
5 Connection

5.1 Wiring Diagram and Cable Feed-Throughs

Wiring diagram

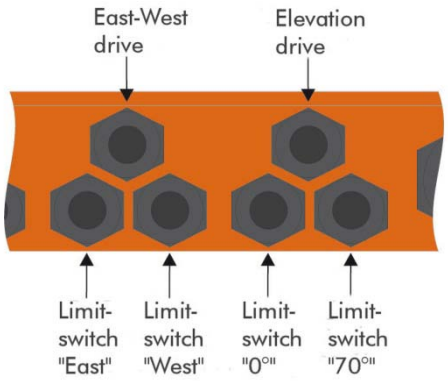


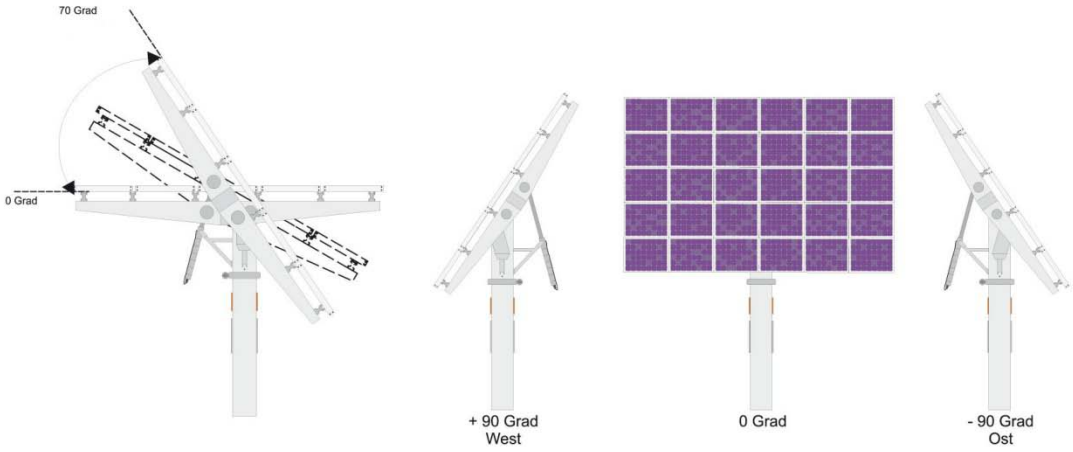
Front view of SOLTRK showing cable feed-throughs



5.2 Connecting the Limit Switches and Drives

1. Unscrew the appropriate cable screw connection to make the connection to the SOLTRK (see figure to the right).





2. Thread the cable through the respective cable feed-through.
3. Connect the numbered wires of the motor cables to the corresponding connections inside the SOLTRK (see figure below). The cables are connected 1:1. The polarity of the limit switch connections is arbitrary.

The motor will be damaged if the polarity of the motor connections is incorrect. Carefully check the connections.

4. Manually tighten the cable screw connections (1.8 Nm).

Inside view of SOLTRK, control and drive connections

- Azimuth drive = horizontal adjustment (X-axis)
- Elevation drive = vertical adjustment (Y-axis)

5.3 Connecting the Communication Device to the Inverter

Use the cables recommended in section 11.6 "Cabling Recommendations" on page 69.

5.3.1 Wiring Diagram (Inverter to SOLTRK)

WARNING!
Danger of electrocution!

High voltages are present inside the inverter which can lead to serious injury or even death if touched.

- All work on the inverters may only be performed by qualified electricians!
- Before making the connections, isolate the inverter as described in the inverter documentation.
- Follow all the safety instructions given in the inverter documentation.

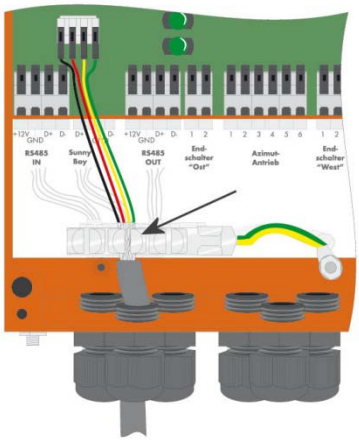
Connection in the Inverter

1. Open the inverter as described in the inverter documentation.
2. Remove all jumpers and termination resistors (depending on the type of inverter) for termination or signal bias which may be in the inverter. Refer to the instructions in the documentation on the RS485 communication interface on how to perform this procedure.
3. Connect the cable to the communication interface in the inverter as described in the documentation on the RS485 communication interface. Also refer to the poster "wiring principles RS485_sonnen_system".
4. Lay the cable securely, using suitable fastening materials.

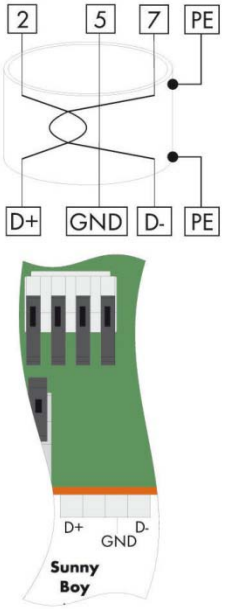
Connection in the SOLTRK

5. Unscrew the SOLTRK cable screw connection which is shaded in the figure below.

6. Pull the cable through the cable screw connection.
7. Strip the cable shield inside the SOLTRK and connect the shield to the SOLTRK terminal (see figure below).



8. Connect the wires inside the SOLTRK to the “Sunny Boy” connection (see figure below).



9. Shorten unnecessary conductors back to the cable sheath to prevent short circuits occurring.

10. Manually tighten the cable screw connection (1.8 Nm).

11. Lay the cable securely, using suitable fastening materials.

5.4 Connecting the communication to the Sunny WebBox

5.4.1 Cabling Notes

The cable length and quality can adversely affect the signal quality. To achieve good results, observe the instructions in section 11.6 "Cabling Recommendations" on page 69.

5.4.2 Jumper Functions

Termination

To ensure the signal quality of the RS485 communication bus, this must be terminated in the two devices at the end of the RS485 communication bus.

Refer to the documentation for the end device on how to configure the termination resistor.

Termination is limited to the two devices at the end of the RS485 communication bus. This is illustrated in the following figure:

The following devices can be found at each of the two ends of the RS485 data bus and must be terminated accordingly:

- SOLTRK + SOLTRK
- SOLTRK + Sunny WebBox
- SOLTRK + Sunny SensorBox
- Sunny WebBox + Sunny SensorBox

Also refer to the poster "wiring principles RS485_sonnen_system".

Signal biasing

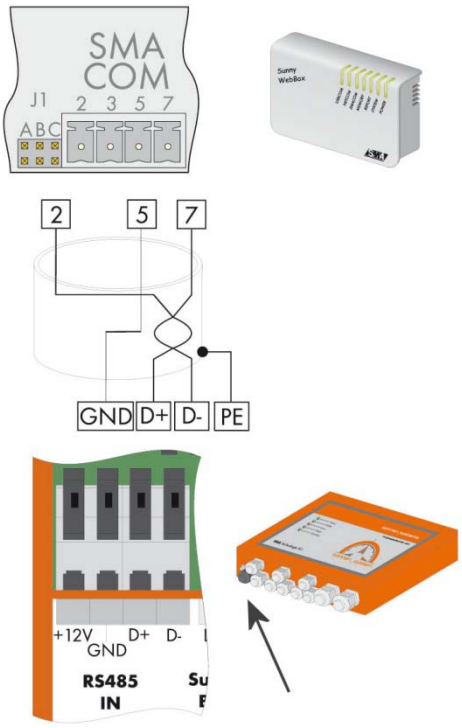
To ensure the signal quality of the RS485 communication bus, a maximum of one bias must be connected in the RS485 communication bus. We recommend doing this with the Sunny WebBox. Please refer to the Sunny WebBox documentation.

5.4.3 Wiring Diagram Sunny WebBox to SOLTRK

If an RS485 power injector is connected to your Sunny WebBox, refer to the details in section 5.4.4 "Wiring Diagram Sunny WebBox with RS485 Power Injector" on page 21.

Connections in the Sunny WebBox

1. Use the plug provided with the Sunny WebBox for the SMA-COM connection.
2. Connect the cable to the Sunny Web-Box, as shown in the figure to the right. Refer to the table for details on the twisted pair cables.



3. Take note of the conductors' colour coding:

WebBox "SMA COM"	Conductor colour	SOLTRK "RS485 IN"
*2		*D+
5		GND
*7		*D-

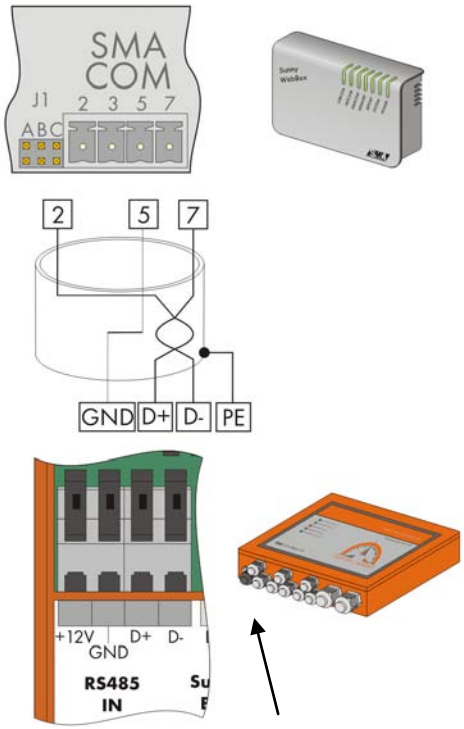
* The conductors 2 and 7 (D+ and D-) must be a twisted pair.

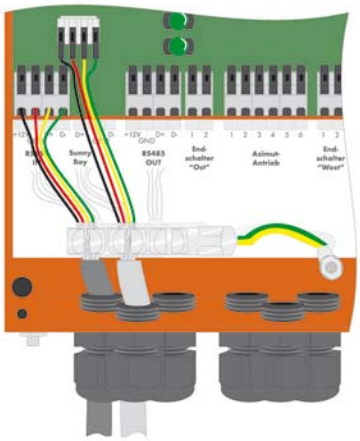
4. If the Sunny WebBox is one of the two end points of the RS485 data bus, check that jumper J1A is mounted.

5. Check that jumpers J1B and J1C are fitted to ensure signal biasing.

Connection in the SOLTRK

6. Unscrew the SOLTRK cable screw connection which is shaded in the figure to the right.
7. Pull the cable through the cable screw connection.
8. Strip the cable shield inside the SOLTRK and connect the shield to the SOLTRK terminal (see figure below).





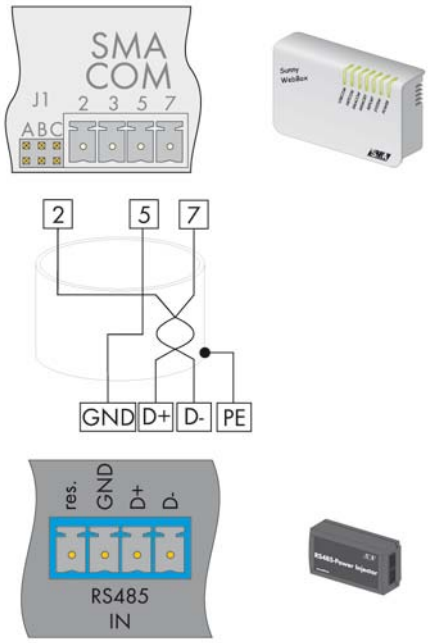
9. Connect the cable to the SOLTRK as shown in the figure above. Use the conductor colours you noted earlier.
10. Manually tighten the cable screw connection (1.8 Nm).

5.4.4 Wiring Diagram Sunny WebBox with RS485 Power Injector

If a Sunny SensorBox is used in conjunction with your Sunny WebBox and the RS485 power injector is directly connected to the Sunny WebBox, connect the cabling as follows.

Sunny WebBox to RS485 Power Injector

1. Pull out the RS485 Power Injector's power plug.
2. Use the plug provided with the Sunny WebBox for the SMA-COM connection.
3. Connect the RS485 Power Injector to the Sunny WebBox as shown in the figure to the right. Refer to the table for details on the twisted pair cables.



4. Take note of the conductors' colour coding.

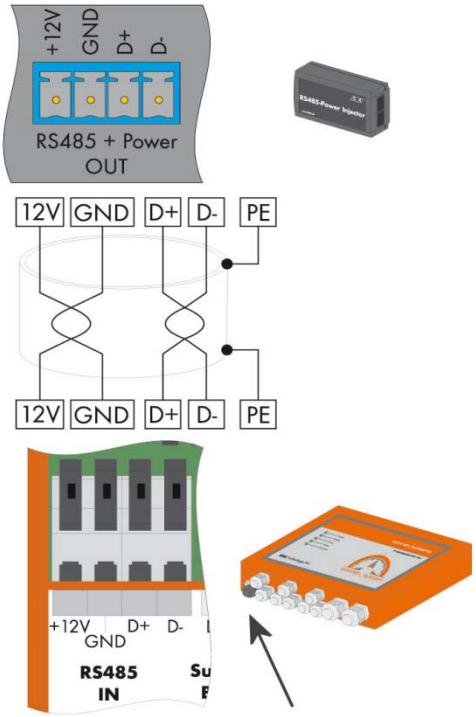
WebBox SMA-COM	Conductor colour	RS485 Power Injector RS485 IN
*2		*D+
5		GND
*7		*D-

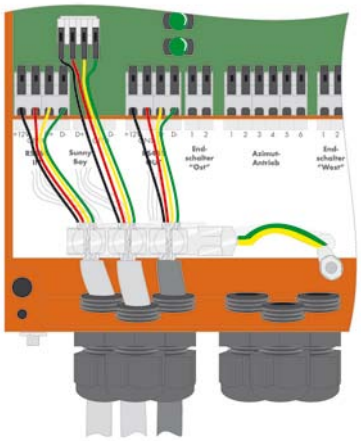
* The conductors 2 and 7 (D+ and D-) must be a twisted pair.

5. If the Sunny WebBox is one of the two end points of the RS485 data bus, check that jumper J1A is mounted.
6. Check that jumpers J1B and J1C are fitted to ensure signal biasing.

RS485 Power Injector to SOLTRK

7. Unscrew the SOLTRK cable screw connection which is shaded in the figure to the right.
8. Pull the cable through the cable screw connection.
9. Strip the cable shield inside the SOLTRK and connect the shield to the SOLTRK terminal (see figure below).





10. Connect the RS485 power injector to the SOLTRK as shown in the figure above. Refer to the table for details on the twisted pair cables.

11. Take note of the conductors' colour coding.

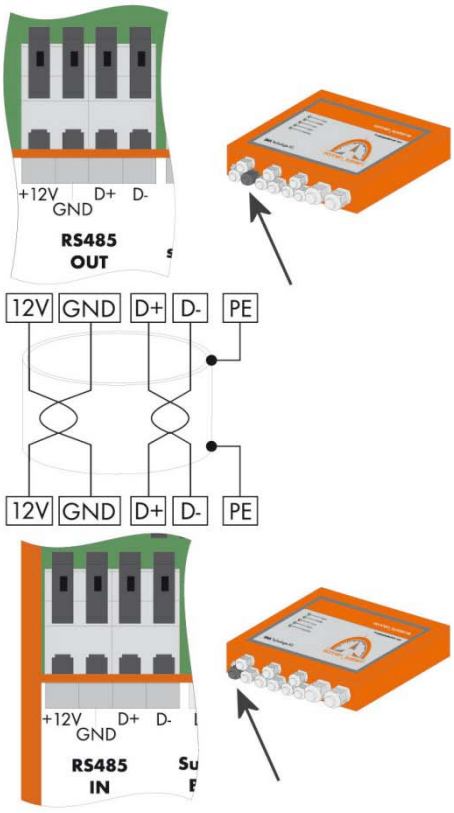
RS485 Power Injector RS485 + Power OUT	Conductor colour	SOLTRK RS485 IN
*+12 V		*+12 V
*GND		*GND
*D+		*D+
*D-		*D-

***The +12 V and GND conductors, as well as the D+ und D- conductors must both be twisted pairs.**

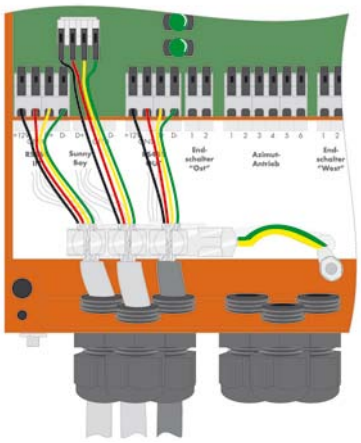
12. Manually tighten the cable screw connection (1.8 Nm).

5.5 Connecting another SOLTRK

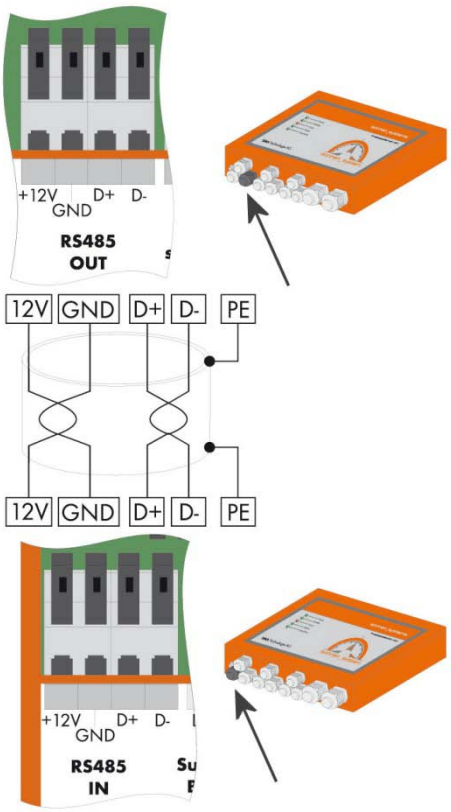
1. Remove the termination resistor on the "RS485 OUT" connection of the SOLTRK.
2. Unscrew the SOLTRK cable screw connection which is shaded in the figure to the right (next to figure RS485 OUT).
3. Pull the cable through the cable screw connection.



4. Strip the cable shield inside the SOLTRK and connect the shield to the SOLTRK terminal (see figure below).



5. Connect the wires to the "RS485 OUT" connection of the SOLTRK as shown in the figure to the right. Refer to the table for details on the twisted pair cables.



6. Take note of the conductors' colour coding:

SOLTRK "RS485 OUT"	Conductor colour	SOLTRK "RS485 IN"
*+12 V		*+12 V
*GND		*GND
*D+		*D+
*D-		*D-

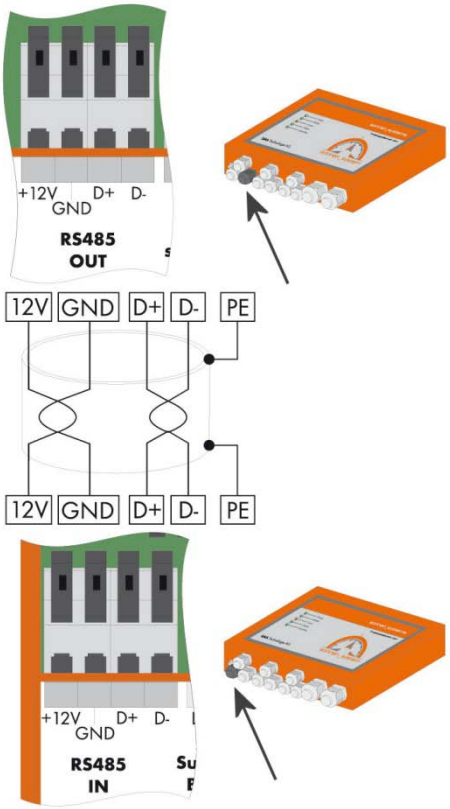
*** The +12 V and GND conductors, as well as the D+ und D- conductors must both be twisted pairs.**

7. Manually tighten the cable screw connection (1.8 Nm).

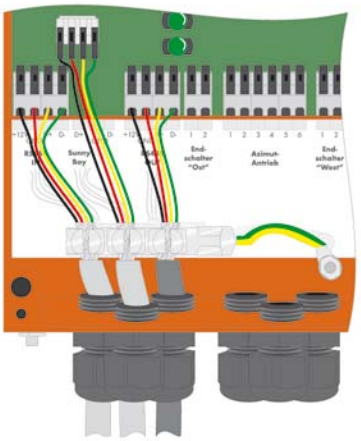
Additional SOLTRK

8. Unscrew the cable screw connection which is shaded in the figure to the right (figure next to RS485 IN) on the next SOLTRK.

9. Pull the cable through the cable screw connection.



10. Strip the cable shield inside the SOLTRK and connect the shield to the SOLTRK terminal (see figure below).



11. Connect the wires to the "RS485 IN" connection on the other SOLTRK as shown in the figure above. Use the conductor colours you noted earlier.

12. Manually tighten the cable screw connection (1.8 Nm).

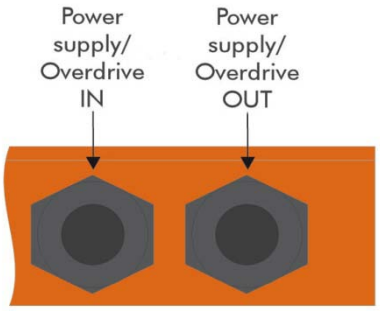
13. Several SOLTRK can be connected together in the same manner. The termination resistor remains plugged into the RS485 data bus of the last SOLTRK ("RS485 OUT" connection).

14. Lay the cables securely, using suitable fastening materials.

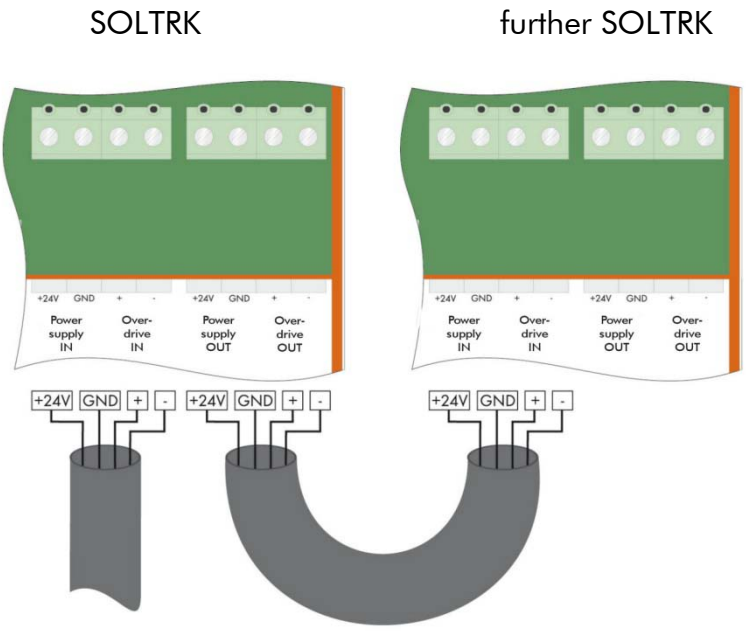
5.6 Connecting the Power Supply and Overdrive Line

Connect the power supply (24 V DC) and overdrive as follows:

1. Unscrew the appropriate cable screw connection to make the connection (see figure to the right, view of SOLTRK cable screw connections).
2. Pull the cable through the cable screw connection.



3. Connect the power supply and overdrive line inside the SOLTRK as shown in the figure below.



4. Take note of the conductors' colour coding:

	Connection	Conductor colour
Power supply	+24 V	
	GND	
Overdrive	+	
	-	

5. Manually tighten the cable screw connections (3.5 Nm).

5.7 Grounding Connection

1. Fit a suitable ring cable lug to the earthing connection (see figure to the right) on the SOLTRK.
2. Ground the SOLTRK to a suitable earthing star point.

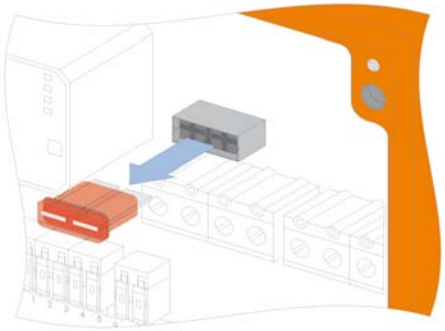
6 Commissioning

Commissioning of the SOLTRK occurs in five steps:

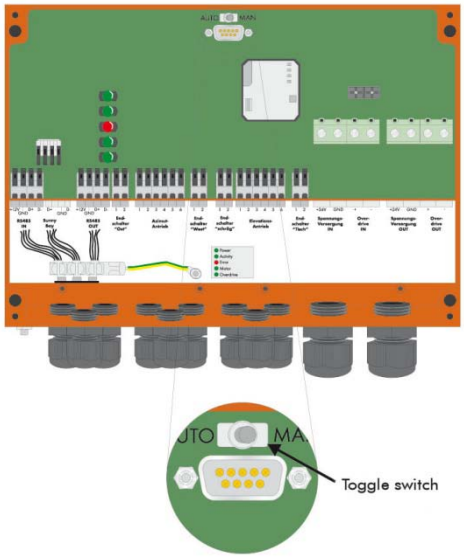
- Switching on the power supply
- System test in manual mode
- Configuring the SOLTRK parameters
- Calibrating the travelling range
- Activating the automatic tracking function

6.1 Switching on the Power Supply

1. Unscrew the cover on the SOLTRK.
2. Remove the overdrive fuse (see figure to the right) to prevent any accidental movement of the sonnen_system.

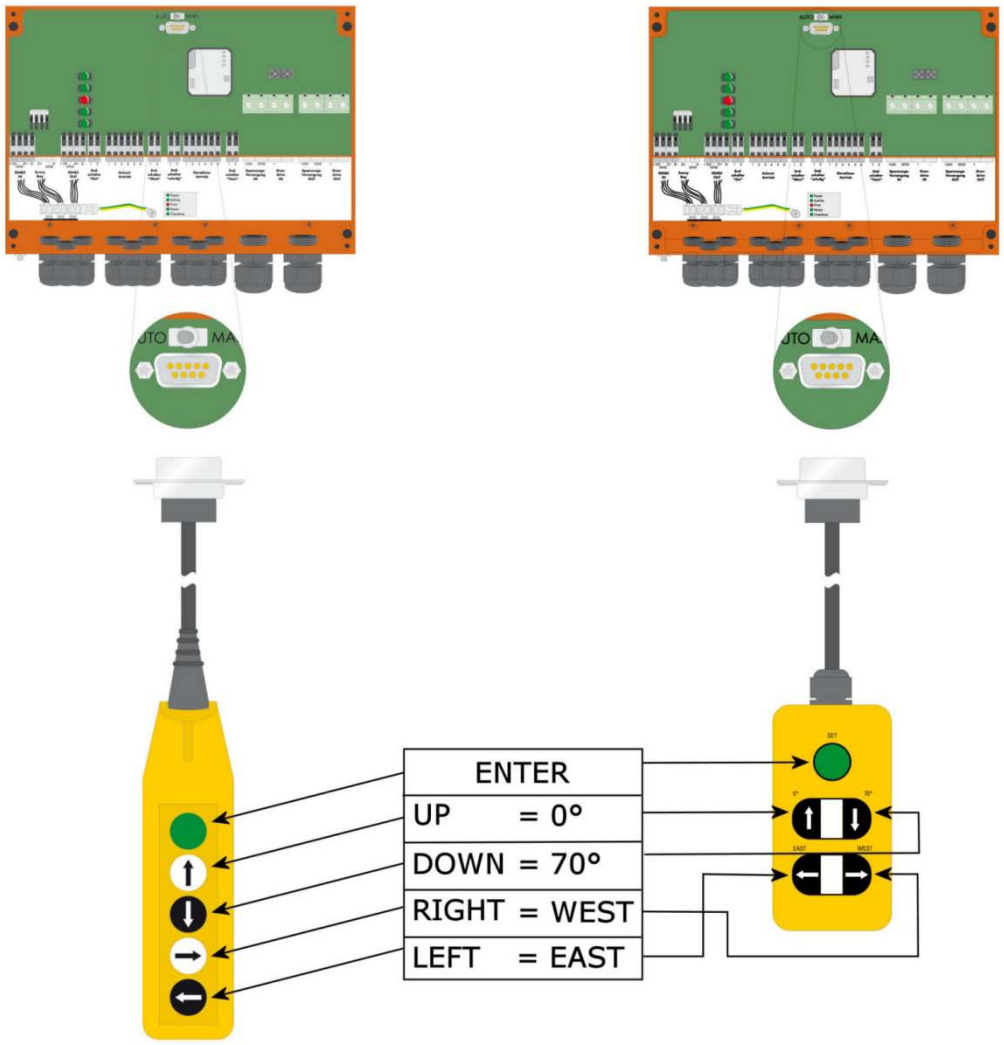


3. Set the toggle switch in the SOLTRK to "MANUAL" (see figure to right). The SOLTRK switches to manual operation.
4. Switch on the power supply.
5. Check the LEDs on the SOLTRK:
   - The Power LED must glow green.
   - The Error LED must be off.
   - The Overdrive LED must flash (manual operation).



Connecting the manual control unit

6. Attach the plug from the manual control unit into the corresponding connector on the SOLTRK (see figure below) and screw tight. Refer to these two figures to determine which manual control unit matches the one you have.



A description of the keypad functions is given in section 11.5.1 “Summary of Manual Control Unit Commands” on page 68.

6.2 System Test in Manual Mode

Users are responsible for their own actions during manual operation.

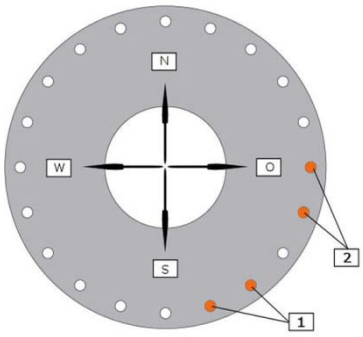
6.2.1 Checking the Installation

The procedure for checking the installation using the manual control unit is described below.

Check direction of travel for X and east-west limit switches

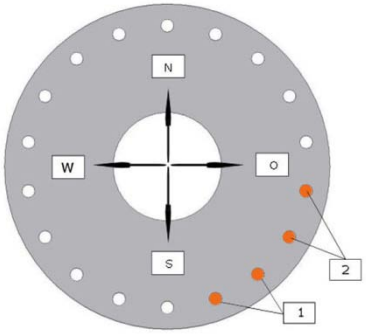
The figures to the right below show the position of the limit switches on the two sonnen_systems 3_30 and 3_40/3_60.

1. Press the EAST key ⊂ and keep it held down. The X-motor should move the sonnen_system in an easterly direction.
2. Operate the east-limit switch (see figure to the right, position 1). The motor should stop.



sonnen_system 3_40/3_60

3. Release the East key ⊂ before releasing the east-limit switch.
4. Press the WEST key ⊃ and keep it held down. The X-motor should move the sonnen_system in a westerly direction.
5. Operate the west-limit switch (see figure to the right, position 2). The X-motor should stop.
6. Release the WEST key ⊃ before releasing the west-limit switch.

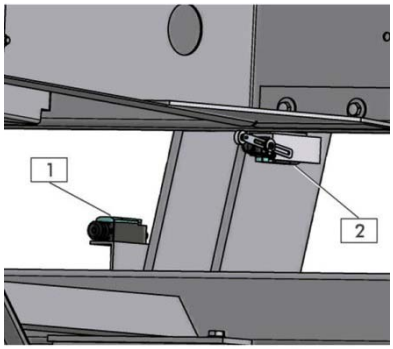


sonnen_system 3_30

Check direction of travel for Y and elevation-limit switches

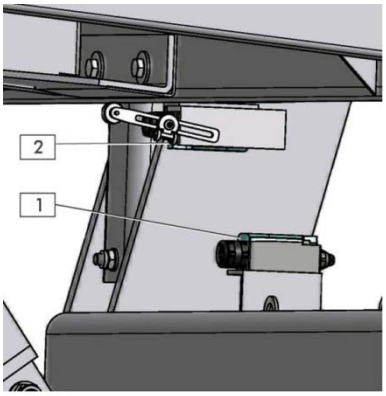
The figures to the right below show the position of the limit switches on the two sonnen_systems 3_30 and 3_40/3_60.

1. Press the DOWN (70°) key and keep it held down. The Y-motor should move the sonnen_system towards the 70° position.
2. Operate the 70°-limit switch (see figure to the right, position 1). The Y-motor should stop.
3. Release the DOWN (70°) key before releasing the 70°-limit switch.



sonnen_system 3_40/3_60

4. Press the UP (0°) key and keep it held down. The Y-motor should move the sonnen_system toward the 0° position.
5. Operate the 0°-limit switch (see figure to the right, position 2). The Y-motor should stop.
6. Release the UP (0°) key before releasing the 0°-limit switch.



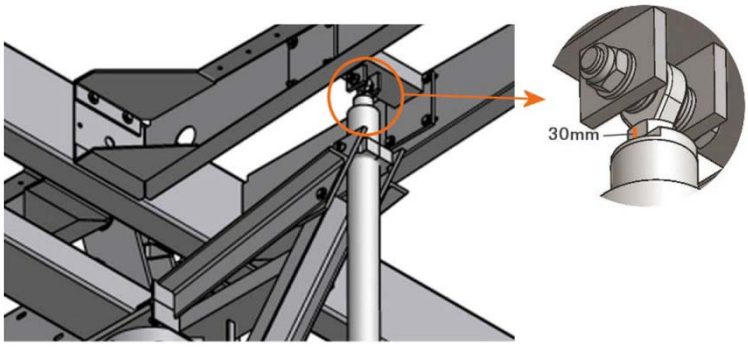
sonnen_system 3_30

Adjusting the 0°-limit switch

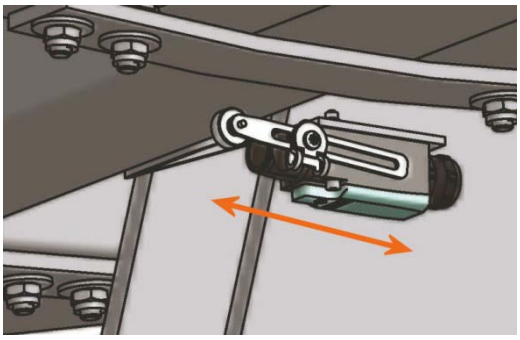
1. Loosen the bolt on the length-adjustable twist lever and push it in completely.

ATTENTION!

A minimum of 30 mm of the piston rod of the elevation drive must remain visible at all times while performing the following steps. See the figure below. If the piston rod is not minimum 30 mm visible, the elevation drive will be damaged.



2. Press the UP (0°) key ↑ and keep it held down until the central beam of the sonnen_system is right angled to its main beam.



3. Push the twist lever under the central beam until the 0°-limit switch audibly switches over.
4. Tighten the bolt on the length-adjustable twist lever to 0.8 to 1 Nm.

5. Press the DOWN (70°) key and keep it held down until the twist lever no longer touches the central beam.
6. Press the UP (0°) key and keep it held down.
7. The Y-motor should stop when the 0°-limit switch switches over. Check the angularity of the central beam to the main beam again.

6.3 Configuring the Sunny WebBox and SOLTRK Parameters

6.3.1 Setting the Time, Date, Time Zone and Synchronisation

1. Commission the Sunny WebBox as described in the Sunny WebBox user manual.
2. Log on via the Sunny WebBox user interface.
3. Set the time zone of your location as described in the Sunny WebBox user manual.
4. If the Sunny WebBox can access the internet, set “Automatic Time Synchronisation” function to “Yes”.

It is imperative that the time and date on the Sunny WebBox is correctly set. To ensure the time and date are accurate, select “Automatic Time Synchronisation” (only possible if the Sunny WebBox can access the internet).

5. Set automatic summer/winter changeover to “Yes”.
6. Set the time and the date. It is not necessary to manually set the time if you are using the "Automatic Time Synchronisation" function.
7. Save the settings.

6.3.2 Detecting the SOLTRK using the Sunny WebBox

1. Configure the following on the Sunny WebBox user interface:
   - Set the interface to "SMA-COM".
   - Set the transfer protocol to "SMA-NET".
   - Set the baud rate to “1200”.

2. Start detection as described in the Sunny WebBox user manual.

6.3.3 Assigning the detected SOLTRK devices

The device type and serial number of the detected SOLTRK devices are displayed on the Sunny WebBox user interface. The displayed serial numbers can be compared with those printed on the name plates of the SOLTRK devices and assigned accordingly. It is also recommended that you make a note of the assignment between the SOLTRK and the Sunny Boy so that the data can later be displayed accordingly, e.g. on the Sunny Portal.

6.3.4 Determining and Setting the Geographic Location Data

The longitude and latitude coordinates of your location must be entered into the SOLTRK to enable it to make the tracking calculations.

The degrees longitude and latitude (WGS84) for your location may be determined using the "Google Earth" program at http://earth.google.de or by means of a GPS receiver.

1. Log onto the Sunny WebBox user interface as an installer by entering the appropriate password.
2. Open the SOLTRK parameter list.
3. Enter the longitude coordinate for your location using the "LocCoordLong" parameter. The value in degrees can lie in the range –180 ° (to the west of Greenwich) to +180 ° (to the east of Greenwich) with two decimal places.
4. Enter the latitude coordinate for your location using the "LocCoordLat" parameter. The value in degrees can lie in the range 25 ° to 65 ° with two decimal places.

The values are entered in degrees. The two decimal places therefore correspond to 1/100 degree (and not minutes).

If the data is only available in degrees/minutes/seconds notation, the decimal places can be calculated as follows:

- (minutes/60) + (seconds/ 3600)

Example: Location Niestetal 51 °19´52 corresponds to 51 + (19/60) + (52/3600), which equates to 51.3172 degrees (enter the next rounded value, i.e. 51.32).

Take care to ensure that the data relates to the WGS84 coordinate system.

Standard settings for further parameters

5. Enter the values given in the column 'setting' in the table of parameters below.

Channel	Setting
3 ElevationLimit	65°
5 LocCoordLat	Enter location coordinates: Latitude
6 LocCoordLong	Enter location coordinates: Longitude
9 RefErrMax	Set to 2
10 ReftimeMax	Set to 7
11 Remote	Control command and error acknowledgement (see section 7.2 "Operation using Remote Operating Commands" on page 46.
14 SensBackY	Set to 2500

Channel	Setting
17. TrkDiffMin	3° when using the IMO slewing drive, otherwise 0.50°
18. TypeSelect	Value depends on the used slewing drive and sonnen_system: 1: sonnen_system 3_40/3_60; IMO WD-L 0419 2: sonnen_system 3_30; KMI SE1 4C-85M 3: sonnen_system 3_40/3_60; KMI SE17B-102M

6. Save for all devices of the device type.

Further parameters are described in section 11.2.2 "Parameters" on page 57.

6.4 Calibrating the Travelling Range using the Manual Control Unit

The control unit requires exact reference data to ensure precise tracking. Since the sonnen_system can never be perfectly aligned mechanically during installation, the control unit requires a reference value for the azimuth position. The reference value is determined once for each sonnen_system. This is value is permanently stored in the control unit.

6.4.1 Selecting the Calibration Mode

Calibration is a sub-function of manual operation. Three calibration modes are available: "sun calibration", "south calibration" and "quick calibration".

In the case of sun calibration, the module surface is aligned as precisely as possible towards the sun; in the case of south calibration it is aligned towards the south. Quick calibration uses a faster calibration process and can only be used if the position of the X-motor is already known.

Tracking quality is therefore dependent on the accuracy of alignment to the south or the sun.

South calibration

South calibration requires a very accurate compass and the current declination (deviation between magnetic north and true north) for your location. The declination angle can be determined from topographical maps for your location or calculated on the Internet.

http://www.ngdc.noaa.gov/seg/geomag/jsp/struts/calcDeclination

We recommend the following compass:

RECTA DP 65

When determining the direction, take care to ensure that the compass is not placed in the magnetic interference field produced by the steel structure, DC cables or the inverter.

Sun calibration

Sun calibration can only be used when the following prerequisites are fulfilled:

- The sun is shining,
- The SOLTRK has been detected using the Sunny WebBox
- The time zone, time and longitude/latitude coordinates for your location have been entered in the Sunny WebBox user interface.

Quick calibration

Quick calibration can only be used if either a south or a sun calibration has been performed. This means the position of the X-motor is already known from earlier referencing. This saves significant time during calibration, particularly when readjusting the systems.

6.4.2 Performing South Calibration

Stop calibration = Press arrow key

If a problem occurs, the calibration process can always be stopped by pressing any KEY on the manual control unit. The calibration process must then be repeated.

1. Check and (if necessary) correct the following:
   - Has the fuse for the overdrive circuit been removed?
   - Toggle switch set to "MAN"?
   - Manual control unit plugged in?
2. Align the module surface in the X-direction as close as possible to south by pressing the arrow keys on the manual control unit.
3. Next press the keys "ENTER, UP (0°) ↑ and EAST ↻" at the same time.
   The calibration run of the sonnen_system starts after 3 seconds. Wait for the calibration run to complete.
   - SOLTRK drives to the east- limit switch, determines its position and stores this value internally.

– During the calibration run, the motor LED glows once the X-position is known or flashes if the X-position value is invalid.

4. Check whether the calibration run has been successful.

– Calibration successful: Motor LED and Error LED are off.

– Calibration unsuccessful: The Error LED flashes if referencing at the limit switch was not performed correctly. The Error LED glows if the determined limit switch position does not lie between –135 ° and –160 °. One possible cause of the error is that the sonnen_system was not properly orientated to the south or that the east-limit switch is not in the correct position. If necessary, adjust the east-limit switch.

– Repeat the calibration process.

6.4.3 Performing Sun Calibration

Stop calibration = Press arrow key

If a problem occurs, the calibration process can always be stopped by pressing any KEY on the manual control unit. The calibration process must then be repeated.

1. Check and (if necessary) correct the following:

– Has the fuse for the overdrive circuit been removed?

– Toggle switch set to "MAN"?

– Manual control unit plugged in?

2. Orientate the module surface in the X-direction as closely as possible towards the sun by pressing the arrow keys on the manual control unit. If there is a gap in the centre of the module surface, align the module array so that the light cast through the gap shines onto the centre of the mast or the rotating head.

3. Next press the keys ENTER, DOWN 🡻 and WEST 🡺 at the same time. The calibration run of the sonnen_system starts after 3 seconds. Wait for the calibration run to complete.

   – SOLTRK drives to the east-limit switch, determines its position and stores this value internally.

   – During the calibration run, the motor LED glows once the X-position is known or flashes if the X-position value is invalid.

4. Check whether the calibration run has been successful.

   – Calibration successful: Motor LED and Error LED are off.

   – Calibration unsuccessful: The Error LED flashes if referencing at the limit switch was not performed correctly. The Error LED glows if the determined limit switch position does not lie between –135 ° and –160 °. One possible cause of the error is that the sonnen_system was not properly orientated towards the sun.

   – Repeat the calibration process.

6.4.4 Performing Quick Calibration

Quick calibration can only be performed if a south or a sun calibration has been successful. This means that calibration is started from a known position (from an earlier reference). This saves significant time during sonnen_system calibration and readjustment.

1. At the same time, press the keys ENTER, DOWN (70°) 🡻 and WEST 🡺. The calibration run of the sonnen_system starts after 3 seconds.

Calibration can be terminated as soon as the LED glows permanently.

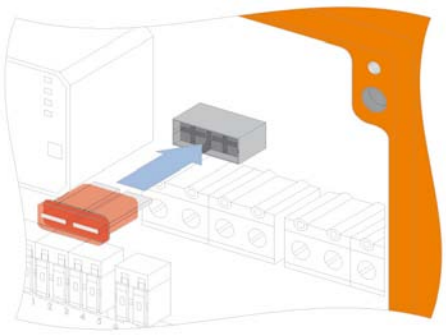
If the position of the X-motor is known when starting the calibration procedure, SOLTRK uses it to calculate and store internally the new position of the limit switch. If this results in a value outside the valid range from –160 ° to –135 °, the limit switch position is set to –145 ° and the X-position to unknown (the MOTOR LED will flash during the subsequent run).

Premature termination of a calibration run when the Motor LED is flashing will result in the SOLTRK setting the limit switch position to –145 ° and the X-position to unknown.

6.5 Starting Automatic Operation and Overdrive Function Test

To activate automatic operation, proceed as follows:

1. Press the DOWN (70°) key and keep it held down until the module surface is in an inclined position.
2. Detach the manual control unit.
3. Insert the fuse in the SOLTRK (see figure to right).

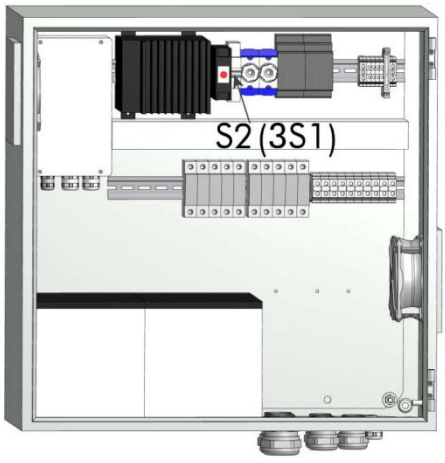


CAUTION!
Risk of injury or material damage!

The sonnen_system travel in overdrive mode can cause injuries and material damage.

When one or more sonnen_systems are installed, only start the overdrive test as described under steps 4 and 5 after all SOLTRK units have been set up and nobody is working on the sonnen_systems any longer.

4. Operate the overdrive switch S2 (3S1) in the DC power supply safeguard. (See figure to the right). The module surface must travel to 0° position.
5. Operate the overdrive switch in the DC power supply safeguard again.
6. Set the toggle switch in the SOLTRK to "AUTO". The SOLTRK switches to automatic operation. The Sunny WebBox user interface then displays at spot value "(Mode)" the value "Auto" for automatic operation.

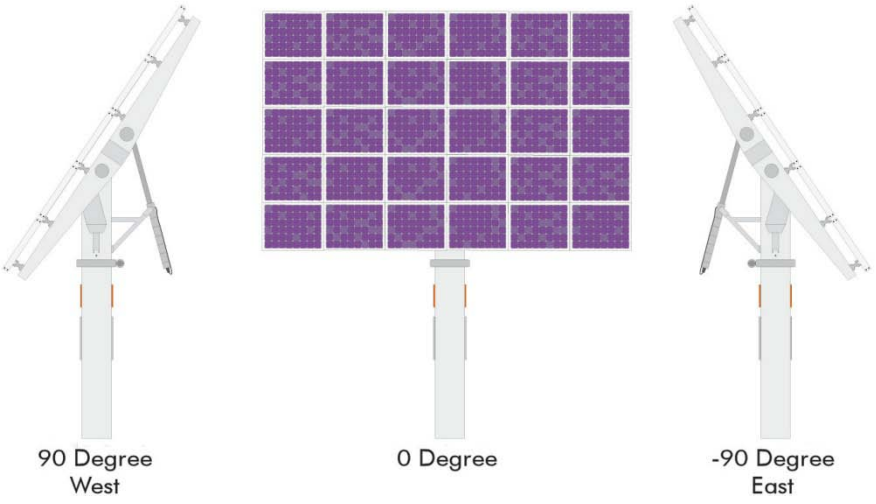


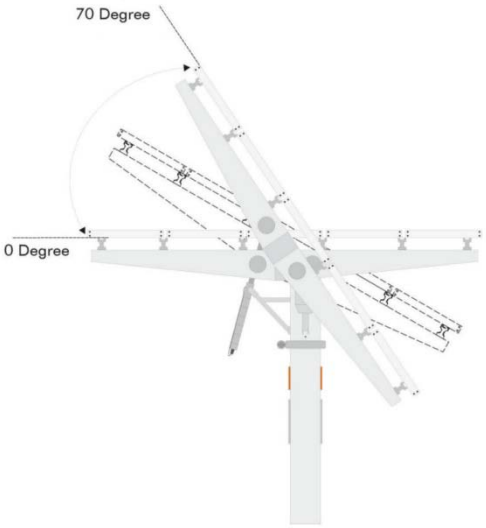
7. Screw the cover back onto the SOLTRK. Ensure that the cover fits correctly to ensure a tight seal.

7 Tracking Function

This section describes the travel characteristics of the sonnen_system. The following general definitions apply:

- The horizontal value is the rotation of the module surface from the southerly position. South is designated as 0 °. Adjustments to the east and west are negative and positive respectively. East is therefore –90 ° and west +90 °.
- The vertical value is the tilt angle between the module surface and the horizontal position. The 0°-position (level surface) is therefore 0 degrees; the vertical position of the module surface corresponds to 90 degrees. The mechanism allows a Y-adjustment between 0 ° and 70 °.





7.1 Movement of the Module Surface in "Auto" Operating Mode

The movements of the module surface are described below:

- Motor test
- Reference run
- Standby
- Tracking (module surface follows the sun)
  - Standby (02.00 until sunrise)
  - Tracking (sunrise to sunset)
  - Standby (sunset until 22.00)
  - Return (after 22.00, before 02.00)
  - Sleep (after return and until 02.00)

7.1.1 Motor Test

The motor test is executed when a test command is received. This command is generated at the start of automatic operation as well as at sunrise.

During the execution of the test, the Motor LED is glowing (during certain phases). If the Motor LED flashes (unknown position), a reference run is subsequently performed on the motor in question.

An unsuccessful motor test will result in a permanent or temporary error (see section 11.4 "Errors" on page 60). The test command is only reset after the test has been successfully executed.

7.1.2 Reference Run

A reference run is performed after the return at night. The reference run can be interrupted for a certain number of nights using the parameter RefTimeMax.

An unsuccessful reference run will result in a temporary error and, in the case of numerous consecutive errors, a permanent error (see section 11.4 "Errors" on page 60). The reference run command is only reset after referencing has been successfully executed.

7.1.3 Standby

The sonnen_system will remain in its initial position as long as the SOLTRK does not receive a valid time signal from the Sunny WebBox. If no time signal is received within approx. 15 minutes, it moves into the 0°-position.

7.1.4 Tracking

Unless any of the above conditions are taken in up normal operation, the system switches to tracking mode. The system will switch to the following states during the course of the day. The stated times are local times (UTC + latitude degrees * 4 minutes).

- Standby (2 a.m. until sunrise)
- The Standby state ends at sunrise. Sunrise is defined as half an hour prior to the calculated elevation angle of the sun being less than 91 °. At this point, the Y-target value suddenly changes from 5 ° to 70 ° and the X-target value from –130 ° to the azimuth angle at sunrise.

Tracking (sunrise to sunset)

A motor test is performed before tracking begins.

X and Y then track the sun's position as soon as the deviation between the set position and the target position exceeds 0.25 to 3 degrees (or parameter value). In this case, the X-position is limited between –135 ° and +135 ° and the Y-position between 0 ° and 70 ° (or the set parameter value).

During tracking, the engine speed is reduced from 2,400 rpm to 1,200 rpm within the last 2 ° (X-motor) or 0.5 ° (Y-motor) of movement.

If the travelling movement is interrupted (when actuating the limit switch) or prevented, the adjustment is completed immediately afterwards. A (temporary) error is signalled if the actual position deviates by more than 5 ° from the target value for longer than 15 minutes.

Tracking ends at sunset. Sunset is defined as half an hour after the calculated elevation angle of the sun being greater than 90 °. At this point, the Y-target value suddenly changes from 70 ° to 5 ° (or the set parameter value) and the X-target value remains unchanged (azimuth angle for sunset position).

Standby (sunset until 10 pm)

Sleep position (Y-position = 5 °) is maintained, the X-position remains unchanged (even after manual adjustment). The Standby state ends at 10 a.m.

Return motion (after 10 p.m., before 2 a.m.)

During a normal daily cycle, the return motion starts at exactly 10 p.m. However, if tracking is interrupted between 10 p.m. and 2 a.m. (overdrive, manual operation, error, restart), the Sleep state is reached by first passing through the Return motion state.

The Y-motor is driven to a position of 5 ° (this is already the case if previously in Standby). If an interruption has occurred (e.g. when actuating the limit switch), the movement is completed immediately afterwards.

Depending on the value of the parameter RefTimeMax, Y-referencing is performed at the 0° limit switch.

The X-motor is driven to a position of –130 degrees. If an interruption has occurred (e.g. when actuating the limit switch), the movement is completed immediately afterwards.

Depending on the value of the parameter RefTimeMax, X-referencing is performed at the east-limit switch.

Sleep (after return motion and until 2 a.m.)

A Y-position of 5 ° and an X-position of -130 ° are maintained. Travelling movements only occur if adjustments are made (overdrive in case of wind, manual operation). This also applies if the sun sets during this period.

7.2 Operation using Remote Operating Commands

Remote operating commands are used to remotely control the SOLTRK from the Sunny WebBox. A description of the remote operating commands and their functions are given in the appendix, section 11.3 “Remote Control Mode (Remote Operation)” on page 58.

7.3 track_back: Special Function to Prevent Shadowing Effects

In order to prevent reciprocal shadowing of the sonnen_systems (for example if the sun is low in the East or West), the maximum inclination of the module surface can be limited by means of parameters set on the Sunny WebBox interface.

1. Log onto the Sunny WebBox user interface as an installer by entering the appropriate password (SMA).
2. Open the SOLTRK parameter list.
3. Enter the maximum inclination in degrees as the "ElevationLimit" parameter. The value in degrees can lie in the range 0 ° to 70 ° with two decimal places. This value is preset to 70 °, i.e. no restriction other than the maximum possible mechanical inclination.
4. Save the settings.

8 Maintenance and Cleaning

8.1 Maintenance

If automatic time synchronisation with the Sunny Portal has not been activated on the Sunny WebBox user interface, check and (if necessary) correct the time on the Sunny WebBox user interface every 3 months.

Check the fuse in the overdrive circuit every six months. This is simply done by activating the overdrive function. A faulty fuse is indicated by the Error LED and the error number 1 (ERR_FUSE) is displayed on the Sunny WebBox user interface. Please refer to the error list in section 11.4 “Errors” on page 60.

8.2 Cleaning

Do not clean the SOLTRK using a pressure washer otherwise water may enter the SOLTRK.

Use a scratch-free cloth moistened only with water to avoid damaging the surface of the SOLTRK.

9 Decommissioning

9.1 Disassembly

1. Disconnect the SOLTRK from the supply voltage.
2. Unscrew the cover on the SOLTRK.
3. Remove the cables connected inside the SOLTRK.
4. Unscrew the SOLTRK from the sonnen_system mounting plate.
5. Screw the cover back on the SOLTRK.

9.2 Packaging for Shipment

When returning the device to us, be sure to use packaging which adequately protects the device from damage during transport (if possible, the original packaging).

9.3 Disposal

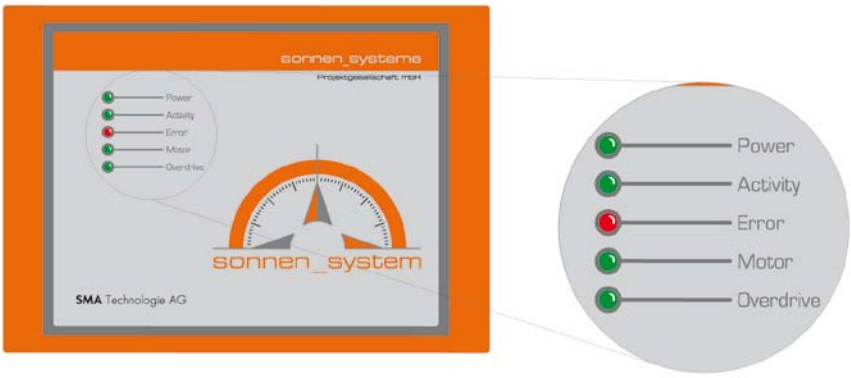
Dispose of the SOLTRK at an authorised disposal company.

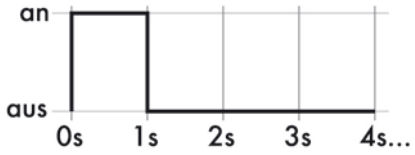
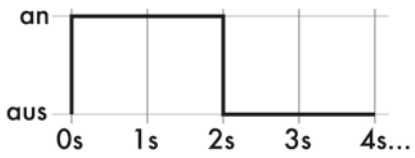
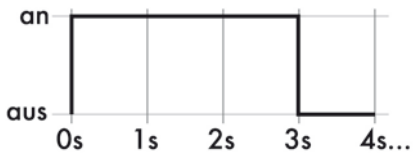
10 Technical Data

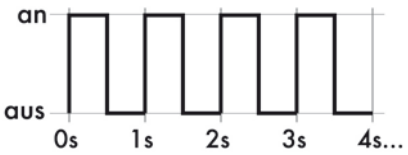
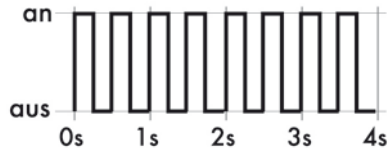
Environmental conditions for operation	
Ambient temperature	-20 °C to +55 °C
Height	0 m to 2000 m above mean sea level (AMSL)
EMC interference stability	according to EN61000-6-2:2001 (interference stability for industrial sector, also fulfils requirements for residential areas)
EMC interference	according to EN61000-6-3:2001 (interference emissions in residential areas,also fulfils requirements for industrial areas)
Protection rating	IP65 (suitable for outdoor installation)
Dimensions	
Size	280 mm x 240 mm x 70 mm (width x height x depth)
Weight excl. packaging	approx. 2000 g
Power supply	
Operational voltage	24 Volt DC, ± 20%, 150 mA (motor off) max. 20 A (motor on)
Power consumption	< 3.6 W (motor has stopped)
Interfaces	
Communication interface	RS485
Inverter interface	RS485
Motor interface X and Y	motor control 0 V to 24 V and rotary sensor inputs
Limit switches	digital input, motor control
Manual control	digital TTL inputs
Overdrive	24 V DC, max. 7,5 A (fused)

11 Appendix

11.1 LEDs



LED	Status	Function
Power	glows green	Power supply is present.
	off	No power supply.
Activity	flashes green	No communication, no operation:  Communication running (normal operation):  No communication, autonomous operation: 
	off/glowing	Malfunction

LED	Status	Function
Error	flashes red	A self-correcting device error has occurred. These errors are automatically cleared after 30 minutes.
	glows red	A permanent device error has occurred. These errors are not cleared automatically. Maintenance action is required. See section 11.4 “Errors” on page 60.
	off	No error present.
Motor	glows green	At least one motor is being actuated. The positions of all actuated motors are known.
	flashes green	At least one motor is being actuated. The position of at least one actuated motor is known.
	off	No motor is being actuated.
Overdrive	glows green	External overdrive is active.
	flashes green	Manual operation is active:  Remote operation is active: 
	off	Automatic operation is switched on, external over-drive is inactive.

11.2 Channel List

11.2.1 Spot Values

Channel	Read	Explanation
1 CurrAzimuth	all	Current azimuth angle of the sonnen_system. Unit: degrees
2 CurrElevation	all	Current tilt angle of the sonnen_system. Unit: degrees

Channel	Read	Explanation
3 Error	all	Current overall tracking status 1: ERR_FUSE (fuse damaged) 2: ERR_RELAIS (overdrive relay damaged) 3: ERR_X_DIR (error in azimuth direction) 4: ERR_Y_DIR (error in elevation direction) 5: ERR_TIMEOUT (25 min. timeout when command is being processed) 6: ERR_PULSCNT (Error of encoder system measuring) 7: ERR_X_RANGE (X pos<-170 or X pos>+170°) 8: ERR_SENS_POS (limit switch outside range -135 ..+160°, only possible in calibration mode!) 9: ERR_REFCNT (excessive amount of faulty reference runs) 10: ERR_RPCHALT (forced remote error command) 11: ERR_I_MAX (overcurrent) 12: ERR_I_STOP (motor stops without 0 current-> blocked state) 13: ERR_INV_XREF (error in azimuth reference) 14: ERR_INV_YREF (error in elevation reference) 15: ERR_X_MOV (motor test: minimum number of X-steps/ time unit not reached, azimuth) 16: ERR_Y_MOV (motor test: minimum number of Y-steps/ time unit not reached, elevation) 17: ERR_TEST (motor test: general power error, current properties) 18: ERR_Y_RANGE (elevation range exceeded) 19: ERR_X_DELAY (tracking mode: longer than 15 Min. >5 deviation from target position, azimuth) 20: ERR_Y_DELAY (tracking mode: longer than 15 Min. >5 deviation from target position, elevation) 21: ERR_U24_LOW battery undervoltage (firmware version. 1.6 and higher)
4 Firmware	all	Firmware version

Channel	Read	Explanation
5 h-On	all	Total number of operating hours. Unit: h
6 HwVer	all	Hardware version
7 I-Azi- Act	all	Momentary current of the azimuth motor
8 I-Elev- Act	all	Momentary current of the elevation motor
9 IMaxAziMot	all	Maximum current of the azimuth motor (reset at night). Unit: mA
10 IMaxElevMot	all	Maximum current of the elevation motor (reset at night). Unit: mA
11 LastOverride	all	Local time at which last overdrive took place.
12 LastSync	all	Time of last valid time synchronisation by Sunny WebBox (UTC)
13 Mode	all	Summary of operating modes N/V: Invalid mode MANUAL: Manual mode AUTOMATIC: Automatic mode = Tracking ERROR: Permanent error DISTURBANCE: Disturbance WARNING: Warning

Channel	Read	Explanation
14 OperMode	all	Display the current operating mode of the SOLTRK. 0: ManualMode 1: OVERDRIVE (overdrive activated) 2: ERROR TEMP (temporary error – 30 min) 3: ERROR PERM (permanent error) 4: MOTOR TEST (motor test activated) 5: REFERENCING (reference run activated) 6: WAIT TIME (wait for change to time counter) 7: SAFE STATE (safe state after 15 min. without valid time change) 8: STANDBY (sun has set outside NIGHT MODE) 9: TRACKING (tracking mode) 10: RETURN EAST (return to east end switch) 11: NIGHT MODE (10 p.m. until 2 a.m.) 12: REMOTE OP (remote operation activated, via Webbox) 13: BOOT MODE (initial startup procedure)
15 OverrideCnt	all	Number of overdrives performed manually (driving to 0°-position).
16 ResetCnt	all	Indicates the total number of resets performed.
17 TargetAzi	all	Target value of azimuth angle Unit: degrees
18 TargetElev	all	Target value of tilt angle Unit: degrees
19 Voltage 24	all	Current battery voltage

11.2.2 Parameters

Channel	Read	Write	Explanation
1 Device Number	All	Inst	Nr. Of the Board for correlation between inverter and SOLTRK (firmware version 1.28 and higher)
2 Device Reset	Inst	Inst-	Reset device (1)
3 ElevationLimit	All	Inst	Maximal elevation angle to avoid reciprocal shadowing. Unit: Degree
4 Elevation Offset	Inst	Inst	Offset in elevation direction (-35°…+35°) (firmware version 1.6 and higher)
5 LocCoordLat	All	Inst	Location coordinate latitude. Unit: Degree with 2 decimal places
6 LocCoordLong	All	Inst	Location coordinate longitude. Unit: Degree with 2 decimal places
7 Night Elevation	All	Inst	Night position of module surface in elevation direction
8 Password	Inst	Inst	Password for special function
9 RefErrMax	Inst	Inst	Max. allowed reference errors until permanent error
10 RefTimeMax	Inst	Inst	The number of nights in which no referencing is performed. If this parameter is changed or if the SOLTRK is restarted, referencing is always performed the following night.
11 Remote	Inst	Inst	Adjusting command and error acknowledgment (see section 7.2“Operation using Remote Operating Commands“ on page 46
12 RemoteStep	Inst	Inst	Number of degrees ‘driven’ at remote command UP /DOWN /EAST /WEST. RemoteStep = 0: unlimited driving (as far as limit stop or another remote command) (firmware version 1.6 and higher)
13 SensBackX	Inst	Inst	Travelling distance at east-limit switch limit switch test
14 SensBackY	Inst	Inst	Travelling distance at 0°-limit switch limit switch test

Channel	Read	Write	Explanation
15 Serial Number	All	Inst	SOLTRK serial number
16 StartDelay	All	Inst	Delay in seconds at change-over from standby to tracking at sunrise (StartDelay = 0: Value between 0-300 sec. depending on serial number) (firmware version 1.6 and higher)
17 TrkDiffMin	Inst	Inst	Min. deviation to start tracking in 1/ 100 degree
18 TypeSelect	All	Inst	1-sosy 3_40/60 IMO; 2-sosy 3_30 KMI; 3-sosy 3_40/60 KMI

11.3 Remote Control Mode (Remote Operation)

In remote control mode (remote operation), the sonnen_system can be operated via a data interface.

CAUTION!
Risk of injury or material damage!

Various safety functions are disabled in remote control mode.

- Only activate remote control mode when the sonnen_system can be visually monitored.

The remote control commands can be entered using the installer account on the Sunny WebBox user interface; the "**Remote**" parameter is used for this purpose (see section 11.2 "Channel List" on page 53). Remote operation is activated as soon as a command is entered. Remote operation then remains active for 30 minutes after which the system returns to automatic operation. To extend this time, enter any command within 30 minutes (e.g. NOP). QUIT exits remote operation.

Command code for parameter "Remote"	CODE prior (until firmware)	Action
0: None		
1: REFRESH_30s	9522501	30 minute timeout refresh for remote operation
2: STOP_ACT_CMD	9522502	Stop the current remote command
3: UP_EAST	9522503	Drive to 0°- position and East end position
4: UP	9522504	Drive to 0°- position (or parameter value RemoteStep)
5: DOWN	9522505	Drive to 70° position (or parameter value RemoteStep)
6: EAST	9522506	Drive to east limit stop (or parameter value RemoteStep)
7: WEST	9522507	Drive to west limit stop (or parameter value RemoteStep)
8: OVDRV_UP	9522508	Drive with max. velocity to the 0° position (emergency operation)
9: OVDRV_DOWN	9522509	Drive with max. velocity to 70°
10: WEST_90	9522510	Drive to 90° (alignment to West)
11: SOUTH	9522511	Drive to 0 (alignment to South)
12: EAST_90	9522512	Drive to 90 (alignment to East)
13: ELEV_35	9522513	Drive to 35° elevation
14: ERR_CLR	9522514	Delete all remote operating errors
15: FORCE_ERR	9522515	Set a permanent error
16: QUIT_REMOTE	9522516	Quit remote operation
17: MOT_TEST	9522517	Start the motor test
18: REF_SOUTH	9522518	Start the south referencing
19:REF_ASTRO	9522519	Start the Astronomical referencing
20: RPC_BUSY	9522520	Feedback command enable
21:RPC_MAX	9522521	n/a

11.4 Errors

If an error occurs, the SOLTRK stops tracking mode and drives to the 0°-position (if possible). Errors are displayed in the parameter list on the Sunny WebBox and indicated by the Error LED on the SOLTRK housing.

The Error LED can indicate two types of errors.

- Error LED flashes red:
  - Self-correcting device error. These errors are automatically cleared after 30 minutes (number 11-21).
- Error LED glows red:
  - A permanent device error has occurred (number 1-10, 21). These errors are not cleared automatically. Maintenance action is required. The Sunny WebBox indicates the tracking status and any errors by means of an error code for the "DriveError" parameter in the parameter list. A description of the error codes is given in section 11.2 "Channel List" starting on page 53. The corrective actions for the indicated errors are given in the following table.

No.	Errors	Causes and eliminating errors
1.	ERR_FUSE	• The fuse is faulty. This error can only occur during overdrive operation. This error is only cleared when the fuse in overdrive operation is detected as “OK”. 1. Replace the fuse inside the SOLTRK. 2. Initiate overdrive to clear the error.
2.	ERR_RELAIS	• The change-over relay is defective. This error can only occur during the motor test. 1. Change the control unit.
3.	ERR_INV_XDIR	• The X-motor turns in the wrong direction. This error can only occur during the motor test. SOLTRK cannot determine if both the X-power terminals and X-sensor signals are reversed. The driving direction should therefore be checked using the manual control unit. 1. Reverse the signals for the X-rotary sensor. 2. Check the driving direction using the manual control unit. The sonnen_system should drive to the left when pressing the “LEFT” arrow key on the manual control unit. The sonnen_system should drive to the right when pressing the “RIGHT” arrow key on the manual control unit.

No.	Errors	Causes and eliminating errors
4.	ERR_INV_YDIR	• The Y-motor turns in the wrong direction. This error can only occur during the motor test. SOLTRK cannot determine if both the Y-power terminals and Y-sensor signals are reversed. The driving direction should therefore be checked using the manual control unit. 1. Reverse the signals for the Y-rotary sensor. 2. Check the driving direction using the manual control unit. The sonnen_system should drive to the table position when pressing the "UP (0°) ↑" arrow key on the manual control unit. The sonnen_system should drive to the wash position when pressing the "DOWN (70°) ↓" arrow key on the manual control unit.
5.	ERR_TIMEOUT	• A driving command has exceeded its maximum duration (25 minutes), even though the power to the motor has not been disconnected, the motor is not standing still and an overcurrent has not occurred. The motor is probably turning without being coupled to the mechanism or is moving with difficulty. 1. Check the mechanism, the driving behaviour and the limit switches.
6.	ERR_PULSCNT	• A driving command has exceeded its maximum number of motor revolutions (X: 39288, Y: 35154), even though the power to the motor has not been disconnected, the motor is not standing still and an overcurrent has not occurred. The motor is probably turning without being coupled to the mechanism. 1. Check the mechanism, the driving behaviour and the limit switches.

No.	Errors	Causes and eliminating errors
7.	ERR_XRANGE	• The X-motor has exceeded the permitted range from –170 ° to +170 °. A limit switch is probably defective. 1. Check the east-west limit switches. 2. Perform a reference run.
8.	ERR_SENSPOS	• The determined position of the X-limit switch East does not lie in the permitted range from –160 ° to –135 °. This error can only occur during manual operation or after calibration. If the determined position of the limit switch is less than –165 °, it is internally set to -165 °. If it is greater than –135 °, it is set to –135 °. This internal value remains unchanged when subsequently changing to automatic operation, i.e. it is accepted by the user. This results in positional discrepancies during subsequent operation. 1. Change the position of the limit switch. 2. Precisely align the sonnen_system to the south or the sun. 3. Repeat the calibration process.
9.	ERR_REFCNT	• The maximum permitted number of failed referencing attempts has been exceeded. This error can only occur during automatic operation. The 0°-limit switch is probably defective. 1. Check the limit switches. 2. Perform manual referencing.

No.	Errors	Causes and eliminating errors
10.	ERR_RPCHLT	• SOLTRK has been shut down by remote command. This error can only occur during automatic operation. 1. Clear the error using a remote command or switch the SOLTRK to manual operation.
11.	ERR_IMAX	• An overcurrent has occurred in either the X- or Y-motor. It is probably mechanically blocked
12.	ERR_I_STOP	• The motor has stopped but the current has not fallen to zero. One possible cause could be missing rotary pulses.
13.	ERR_INV_XREF	• Error during X-referencing at limit switch East. During the second approach of the sensor (verification run) the motor did not stop in the range of the sensor. For example, this error can occur if the sensor is manually actuated and held during a reference run and then released prior to the verification run.
14.	ERR_INV_YREF	• Error during Y-referencing at 0° limit switch. During the second approach of the sensor (verification run) the motor did not stop in the range of the sensor. For example, this error can occur if the sensor is manually actuated and held during a reference run and then released prior to the verification run.
15.	ERR_X_MOV	• Error during X-referencing at limit switch East. When driving back from the sensor (return motion), the motor did not reach the required number of revolutions. For example, this error can occur if the West-limit switch is manually held during a reference run.

No.	Errors	Causes and eliminating errors
16.	ERR_Y_MOV	• Error during Y-referencing at 0°-limit switch. When driving back from the sensor (return motion), the motor did not reach the required number of revolutions. For example, this error can occur if the 70°-limit switch is manually held during a reference run.
17.	ERR_TEST	• An error has occurred during motor test X or Y.
18.	ERR_Y_RANGE	• The Y-motor has exceeded the permitted range from –10 ° to +80 °. A Y-reference run is performed after the error is cleared.
19.	ERR_X_DELAY	• The X-target value and X-actual value differ by more than 5 ° for longer than 15 minutes. This error can only occur during tracking mode. For example, there could be a error in the power connections or the rotary pulses received from the X-motor.
20.	ERR_Y_DELAY	• The Y-target value and Y-actual value differ by more than 5 ° for longer than 15 minutes. This error can only occur during tracking mode. For example, there could be an error in the power connections or the rotary pulses received from the Y-motor.
21.	ERR_U24_LOW under-voltage detection	• A temporary error is displayed at $U_{BATT} \leq$ 19 V (± 1 V). This error is automatically deleted within half an hour if $U_{BATT} >$ 21 V (± 1 V). In the case of three consecutive errors, it becomes a permanent error.

11.4.1 Clearing Permanent Errors (LED)

ATTENTION!
Possible damage or impairment to sonnen_system

Clearing errors without correcting the cause can damage or impair the function of the sonnen_system.

- Ensure the cause of the error is corrected properly.
- Before restarting automatic operation, verify the correct function of the system controls in manual operation.

After the errors have been corrected, clear all permanent errors (Error LED glows permanently red) as follows to extinguish the Error LED.

Set the toggle switch in the SOLTRK to "MANUAL" operation.

If the manual control unit has already been connected, permanent errors can be cleared by pressing any key on the manual control unit.

If the error ERR_FUSE is displayed, this can be cleared by initiating overdrive providing the fuse is intact.

All errors are cleared when switching to manual operation. Errors in manual operation are cleared by pressing any key. All errors are cleared when switching to automatic operation.

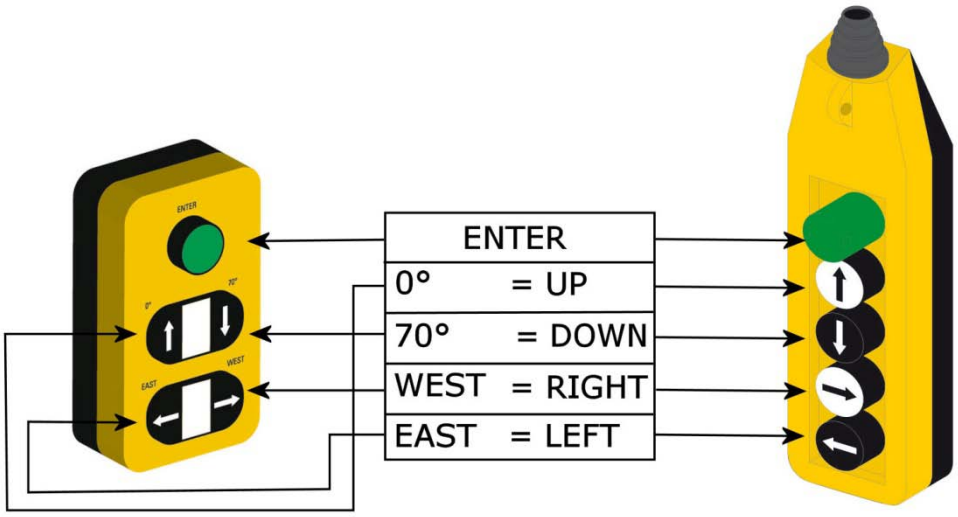
Errors can also be cleared via remote command, see section 11.3 "Remote Control Mode (Remote Operation)" on page 58.

11.5 Using the Manual Control Unit

The sonnen_system is calibrated using the manual control unit in "MANUAL" operating mode; this is set using the toggle switch inside the SOLTRK. The toggle switch is above the connection for the manual control unit.

In "MANUAL" operating mode, the SOLTRK does not perform any tasks itself, instead it only responds to the keys pressed on the manual control unit. The X- and Y-drives can be fully controlled using the manual control unit. The user is fully responsible for operation using the manual control unit since the position monitoring function of the SOLTRK is not active in "MANUAL" operating mode.

The manual control unit has four arrow keys and an Enter key.



11.5.1 Summary of Manual Control Unit Commands

Non-permanent commands (active as long as key is pressed)	
Up (0°)	Y-travel towards table position
Down (70°)	Y-travel towards wash position
WEST	X-travel towards West
EAST	X-travel towards East

Permanent commands (continuous travel after 3 seconds)	
Enter	X-travel East, Y-travel 0°-position (simultaneous)
Enter + Up (0°)	Y-travel towards 0°- position
Enter + Down (70°)	Y-travel towards 70°- position
Enter + WEST	X-travel towards West
Enter + EAST	X-travel towards East
Enter + Down (70°) + WEST	Sun calibration
Enter + Up (0°) + EAST	South calibration
Enter + Up (0°) + WEST	Perform a motor test. For example, a motor test can be performed following installation to test the correct functioning of the motor. The motor test is simultaneously performed for X and Y. If the test is successful, the Error LED remains off. See section 7.1.1 “Motor Test” on page 44.
Enter + Down (70°) + EAST	Perform X- and Y-referencing (even after changing to automatic operation). The limit switches (East and 0°) are approached. See section 7.1.2 “Reference Run” on page 44.

11.6 Cabling Recommendations

11.6.1 Communication

Outdoors

For outdoor use, use a cable with the following basic properties:

- Cross-section: min. 2 x 2 x 0.22 mm^2, min. 2 x 2 x AWG 24
- External cable diameter: min. 5 mm, max. 10 mm
- Shielded
- Twisted pair conductors
- UV resistant
- The maximum cable length of the entire RS485 bus (from the Sunny WebBox to the final SOLTRK) is 1200 m.

We recommend the use of the following cable types for outdoors:

- Lapp cable: UNITRONIC Li2YCYv 2 x 2 x 0.22 mm^2, order no.: 0031 350
- SMA cable: COMCAB-OUTxxx* (available in lengths 100 m / 200 m / 500 m / 1000 m)

Indoors or routed in a cable channel

If you protect the cable from UV radiation outdoors by means of a suitable cable channel, you can use a non-UV-resistant cable for indoors with the basic properties mentioned above.

We recommend the use of the following cable types for indoors:

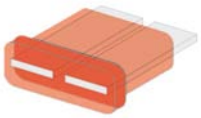
- Lapp cable: UNITRONIC Li2YCY (TP) 2 x 2 x 0.22 mm2, order no.: 0031 320
- Helu cable: PAAR TRONIC-Li-2Y CY 2 x 2 x 0.22 m^2, order no.: 2111
- SMA cable: COMCAB-INxxx* (available in lengths 100 m / 200 m / 500 m / 1000 m)

11.6.2 Power supply

For outdoor use, use a cable with the following basic properties:

- Cross-section: min. 4 x 4 mm^2, min. 4 x AWG 11
- External cable diameter: max. 18 mm
- UV resistant
- Ensure that the voltage drop does not exceed (5A) 4V/DC when under load.

12 Accessories



- Flat car fuse 5 A beige, Eska 340.024
- Flat car fuse 7.5 A, Eska 340.025

13 Contact

If you have any questions or queries, please contact us. A team of qualified engineers and technicians is at your disposal.

Help us to help you by having the following information ready when you call us:

- Inverter model and serial number
- Sunny WebBox serial number and firmware version
- SOLTRK serial number and firmware

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