

## User Manual:

# ST-5 Automated Sun Tracker



## User information

Spectrafy strongly recommends reading this instruction manual prior to installation and operation of your ST-5 automated sun tracker.

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Spectrafy reserves the right to make changes to this user manual without prior notice.

## Warranty and liability

Spectrafy guarantees that the ST-5 sun tracker has been thoroughly tested to ensure that it meets all of the stated specifications. A one year warranty is provided from date of invoice, subject to correct installation and operation. Spectrafy accepts no liability for any loss or damages arising from improper usage of this product.

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## Introduction

Dear customer, thank you for purchasing the ST-5 Sun Tracker. Please familiarize yourself with this instruction manual for a complete understanding of your device.

By employing the latest advances in tracker technology, the ST-5 achieves a breakthrough in the cost of accurate, reliable solar tracking.

The ST-5's compact size and weight make transport, installation and maintenance refreshingly simple and affordable. With a payload limit of 5 kg, the ST-5 can be configured to hold up to four direct or global SolarSIMs, or an equivalent mass of non-Spectrafy instruments.

The ST-5's automated control box employs a highly accurate and efficient solar positioning algorithm to determine the sun's location, while the precision engineered hardware ensures pointing accuracy of  $\pm 0.1^\circ$ . For custom uses, optional PC-based software allows precise manual control.

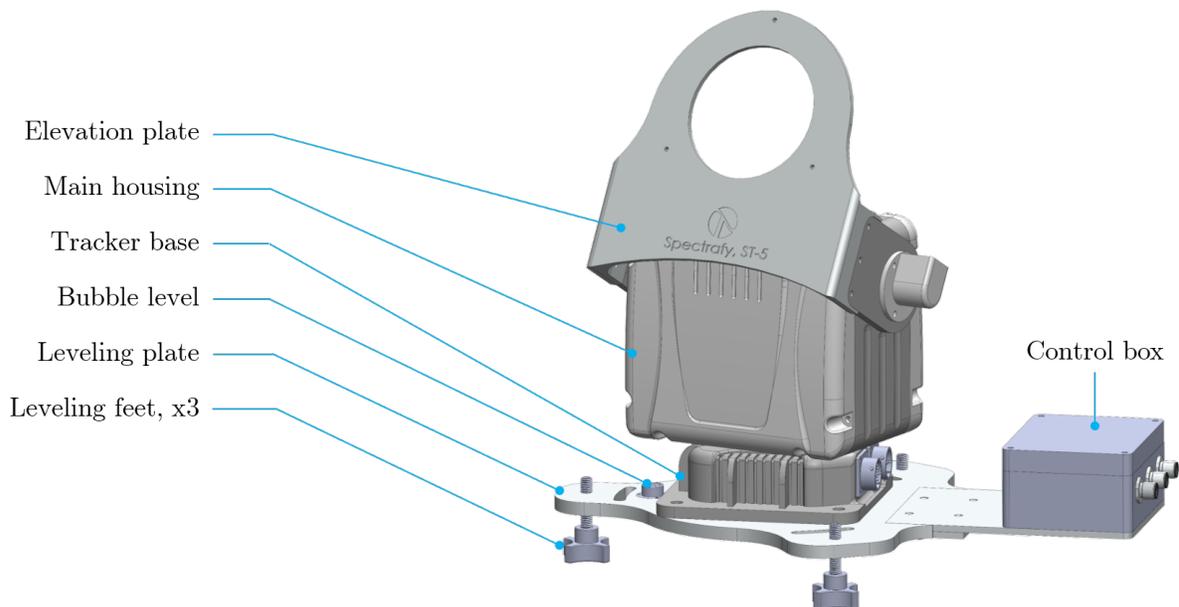
The on-board GPS automatically configures time and location upon start-up and eliminates internal clock drift, while the ST-5's integrated leveling feet, azimuth adjustment and tie-down bolts enable swift and easy installation via the integrated bubble level.

If you have any questions, please feel free to contact us by e-mail at [info@spectrafy.com](mailto:info@spectrafy.com)

## 1 Main components

The main components of the ST-5 Sun Tracker are shown in Figure 1, which include:

- a main housing
- a tracker base,
- an elevation plate
- a leveling plate,
- a bubble level,
- leveling feet, and
- a control box.



**Figure 1:** Main components of the ST-5 Sun Tracker.

## **1.1 Main housing**

The main housing contains the ST-5's mechanical and electrical assemblies.

## **1.2 Tracker base**

The tracker base supports the main housing, while also providing the communication and power interfaces through two external connectors.

## **1.3 Elevation plate**

The elevation plate secures the irradiance sensor to the sun tracker. The mounting plate for the SolarSIM-D2 is shown in Figure 1. Mounting assemblies are also available for a range of third-party radiometers.

## **1.4 Leveling plate**

The leveling plate enables the user to level the ST-5 Sun Tracker and to secure it to the user's mounting platform.

## **1.5 Bubble level**

The high-accuracy bubble level shows the user how level the ST-5 is.

## **1.6 Leveling feet**

The three leveling feet can be adjusted to move the bubble level into its central circle, thereby levelling the tracker.

## **1.7 Control box**

The control box houses a micro-controller and on-board GPS module to automatically orient the tracker to face the sun, anywhere in the world. DC power and optional communication to both the tracker and/or the SolarSIM-D2 are routed through three external M12 connectors on the front of the control box.

## 2 Installation

### 2.1 Contents of delivery

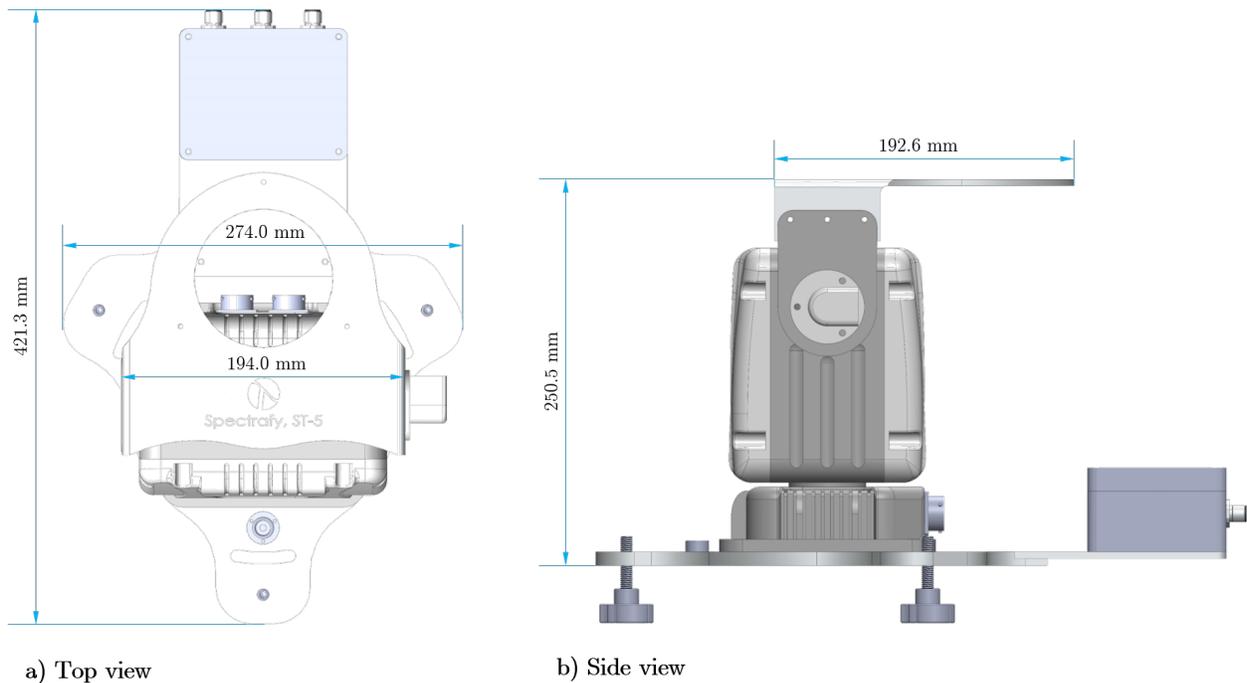
Each ST-5 Sun Tracker product package contains:

- 1 × ST-5 Sun Tracker and control box,
- 1 × 10m power cable,
- 1 × control cable,
- 3 × leveling feet, and
- 1 × SolarSIM-D2 communication cable (optional).

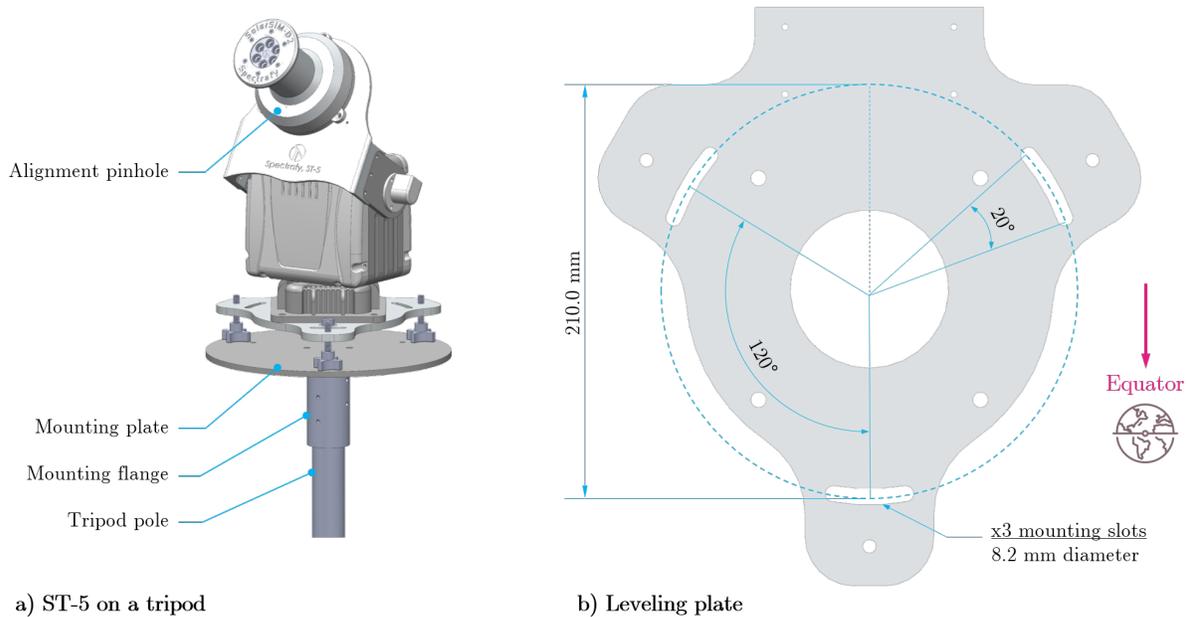
Please check the contents of the package and note if any damage has occurred during shipment. Please contact Spectrafy at [info@spectrafy.com](mailto:info@spectrafy.com) to facilitate the repair or replacement of any damaged components.

### 2.2 Overall dimensions

Figure 2 shows the dimensions of the ST-5 Sun Tracker that can be helpful during installation.



**Figure 2:** Dimensions of the ST-5 Sun Tracker as viewed from the a) top and b) side.

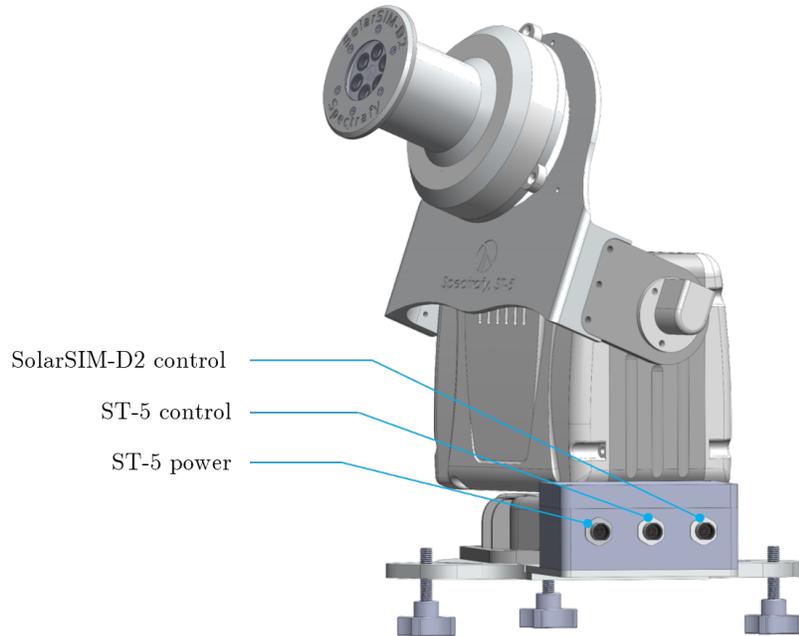


**Figure 3:** a) The ST-5 mounted on the TMP-ST5 tripod mounting platform. b) Dimensions of the ST-5 leveling plate. Three 8.2 mm mounting slots with a 20° range are radially positioned 120° apart on a 210 mm diameter circle. Please note the required orientation of the leveling plate with respect to the equator.

## 2.3 Installation

Installation of the ST-5 Sun Tracker should be performed on a sunny day to ensure optimal azimuthal alignment. The step-by-step installation procedure is described as follows:

1. Attach the ST-5 Sun Tracker to the levelling plate with the supplied screws. Ensure the connectors on the tracker base point towards the control box, as per Figure 3
2. Attach the elevation plate to the ST-5 Sun Tracker with the supplied screws.
3. Place the ST-5 Sun Tracker on the mounting plate, or other appropriate platform, with the leveling plate facing roughly towards the equator, as per Figure 3, i.e. in the Northern hemisphere the leveling plate would point South.
4. Mount the SolarSIM-D2 to the ST-5's elevation plate via the three mounting springs and M4-0.7 screws (shipped with the D2). Ensure each screw is tightened to the same depth. Perform a similar procedure with other radiometers, if applicable.
5. Adjust the ST-5's leveling feet until the bubble level is centered within its circle.
6. Connect the connector-end of the single-ended ST-5 power cable to the control box's ST-5 power connector, as per Figure 4. Similarly, connect the SolarSIM-D2



**Figure 4:** Connector functions of the ST-5’s control box.

communication cable and the ST-5 control cable to the control box, if applicable. Note that connecting the ST-5 control cable is only required if the user has purchased the ST-5’s custom control option.

7. Connect the other end of the power cable to a 12 VDC power source, capable of supplying at least 3A (refer to Table 1 for wiring instructions). The tracker will now automatically begin the power-up initialization process by testing its range of motion in azimuth and elevation.

8. After initialization, the ST-5 will automatically acquire a GPS signal and determine its geographical coordinates and the local time. This may take up to 15 minutes, depending on the location.

9. Once a GPS connection is established, the ST-5 will rotate into position and start tracking the sun, with a frequency of 0.2 Hz.

**Table 1:** Wiring guide for the ST-5 control box’s power connector.

Colour	Label	Function
Blue	$V_{in}$	Input voltage (+12 VDC)
White	GND	Common ground

10. Rotate the leveling plate and the tracker such that the sun spot is aligned in azimuth with the SolarSIM-D2's pinhole. If required, adjust the SolarSIM-D2's mounting screws to align the D2's pinhole in elevation. Similarly for third-party DNI sensors, perform the azimuthal alignment step.

11. Adjust the ST-5's levelling feet to relevel the tracker, if required. Secure the leveling plate to the mounting plate/platform via the three M8-1 screws provided.

12. Double-check the levelling of the ST-5 and the alignment of the SolarSIM-D2. Adjust the D2's mounting screws if necessary to centre the light spot on the pinhole.

### 3 Maintenance

The ST-5 requires minimal maintenance. The user should check the following items during every visit:

1. Regularly check the condition of all cables and connectors.
2. Make sure the bubble level is within its circle.
3. On a sunny day verify the alignment of the SolarSIM-D2 or other DNI sensor via the light spot on their pinholes.

The ST-5 does not require re-calibration, but the mounted irradiance sensors do. It is recommended that the SolarSIM-D2 undergoes recalibration every two years. For third-party radiometers, please consult the manufacturer.

## 4 Specifications

Table 2 lists the main specifications of the ST-5 Sun Tracker.

**Table 2:** ST-5 specifications

<b>Performance</b>	<b>ST-5</b>
Pointing accuracy	$\pm 0.1^\circ$
Payload	5 kg
Elevation range	$0^\circ$ to $125^\circ$
Azimuth range	$0^\circ$ to $360^\circ$
Over-rotation protection	Physical limit stops
Tracking mode	SPA-based (open loop)
Control	Automated control box with GPS
<b>General</b>	<b>ST-5</b>
Weight	6 kg
Dimensions (W x D x H)	274 mm x 421 mm x 275 mm
Power supply and usage	12 VDC, 34 W in motion, 4 W when idle
Operating temperature range	$-30^\circ\text{C}$ to $+55^\circ\text{C}$
Humidity range	0% to 100% RH
Environmental protection	IP66
Standard cable length	10 m