Instruction Manual
Solarbrain
DegerHellas LTD

Manual Name	:	Solarbrain
Version	:	V5. 2025-05

Edited by	:	DegerHellas Engineering Team
Approved by	:	Mr. H.Korkmaz,CEO, Degerenergie GmbH & Co. KG Dr. Markopoulos Ioannis, Mechanical Engineer, DegerHellas LTD

Table of contents

1. Notes on this Manual

1.1 Scope of validity

This manual describes capabilities of the product and the procedure for its installation.
Store this manual where it will be accessible at all times.

1.1.1 Instruction manual

The Manual should be stored with care and must accompany the machine during its lifetime.

- All pages are important and must not be removed, teared-up or modified.
- The manufacturer, at the request of the User, may provide additional copies of the Manual of the machine.
- The manufacturer reserves the right to modify the product and make improvements to the machine without informing the customer, and without updating the Handbook already delivered to the user.

1.2 Recipients

This manual is for the use of Installer, Operator and Service Personnel. The tasks described in this manual may be performed **only** by trained technician/electrician able mentally to understand and operate the specific type of equipment.

"OPERATOR" means the staff responsible for operating, adjusting, cleaning, performing maintenance on the machine.

"TECHNICIAN" means a person who, according to their professional training and experience, possesses sufficient technical knowledge related to the operation mode of the described board and is able to plan and coordinate any installation and maintenance. Technician is well versed on procedures of work safety and accident prevention.

1.3 Glossary and Symbols

The following explains the abbreviations used, and the meaning of the symbols to indicate the operator status and the state of the machine. Their use allows to provide information necessary for the proper use of the machine in conditions of safety rapidly and unequivocally.

1.3.1 Glossary

OPERATOR: Person in charge of installing, operating, adjusting, maintaining, cleaning, repairing or transporting the machine (Annex I, 1.1.1 Directive 2006/42/EC)

STATE OF THE MACHINE: The state of the machine includes the operating mode, for example, automatic gear, maintained action control (jog), shutdown, etc..the condition of safety devices on the machine like protectors included, excluded patrons, etc..

RESIDUAL RISK: Risk that could not be eliminated or sufficiently reduced by design, against which the guards are not (or are not totally) effective, the user is given the information of its existence and the instructions and warnings to allow exceeded (see, respectively, 5.4 and 6.5.1 of the European standards EN 12100-1 and EN121000-2);

COMPONENT OF SAFETY: It means a component used to provide a safety function and whose failure or malfunctioning endangers the safety and / or health of persons exposed (eg. lifting tool; fixed, mobile, adjustable protector, etc.., electrical device, electronic, optical pneumatic, hydraulic, that enslaves, ie interlocks, a protector, etc..).

PERSONAL PROTECTIVE EQUIPMENT (P.P.E.): Euipment designed and manufactured to be worn or held by a person for protection against one or more risks to that person's health or safety.

1.3.2 Symbols

Dangerous voltage

Do not remove the safety devices?

In case of fire do not extinguish with water

Gloves for protection against electrical hazards required

Safety goggles required

1.4 General Information

1.4.1 Manufacturer & Operational Approval

Manufacturer

DegerHellas LTD
Energy Systems
169 Great Alexander Str. 13562
Agioi Anargyroi, Athens, Greece
T: +302110127290
E: info@degerhellas.gr

Approval

DEGERenergie GmbH & Co. KG
Solar Tracking Systems
Hafnerstraße 50
72131 Ofterdingen, Germany
T:+4974737021841
E: info@degerenergie.com

2 Scope of delivery

Check the delivery for completeness and for any visible external damage. Contact us as soon as possible if anything is damaged or missing.

Qty	Description
1	Solarbrain
1	P.S.U. (Power Supply Unit)
1	CAN Bus 2 CTC cable
1	CAN Bus 2 EK-S1 cable

3 Solarbrain & the Backtracking Function

It is well known that the efficiency of the solar PV installations is being affected by shadows. These shadows may occur due to the existence of trees or buildings around the PV Plant or because of other trackers. Especially in the morning and late afternoon, these shadows grow bigger, so that the efficiency of the whole PV Plant is being decreased.

At this crucial point, a new technology comes to bring the solution! The backtracking technology drives the tracker in the position where there is no shadow and by using the MLD sensor we can achieve the highest power!

DegerHellas designs and manufactures the **Solarbrain** for HSAT (Horizontal Single Axis Trackers), a device which is connected with the Deger Trackers S series and by using its backtracking algorithm determines the optimized tilt of the tracker in order to achieve the maximum efficiency. Moreover, each of the 1axis tracker is not casting any shadow to the neighbor tracker (in west or east) at any time as it´s shown on Error: Reference source not found!

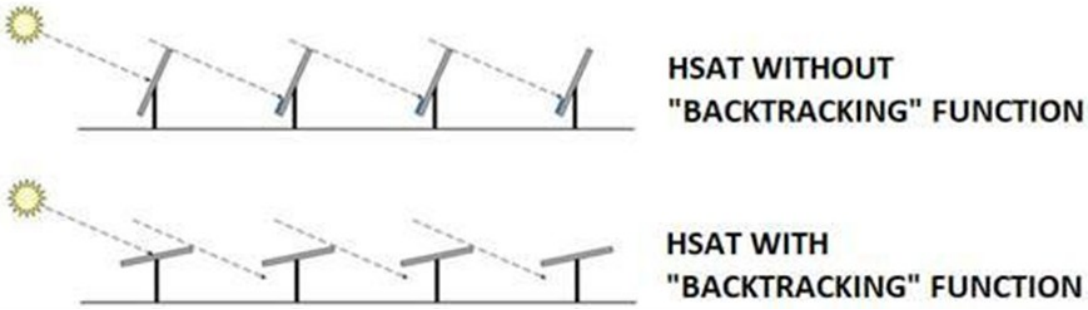


Figure 1: Backtracking benefits on HSAT systems.

4 Installation

4.1 Safety

If the Solarbrain is going to be mounted on a wall, use the appropriate tools and wear all the needed P.P.E. (Personal Protective Equipment).

4.2 Main Parts

The dimensions of the Solarbrain device Figure 2, 3 are 220mmX140mmX60mm and it weights approximately 700 gr.

Photos of the As-built device and its peripherals are shown below:

Figure 2: Solarbrain Main Device (Front panel).

Figure 3: Solarbrain Main Device (Back panel).

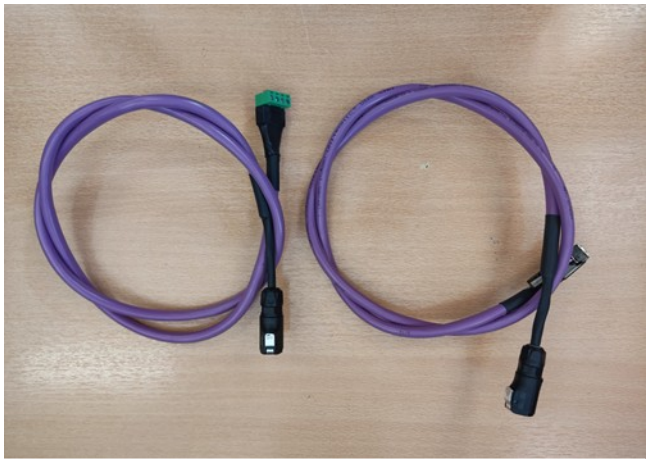


Figure 4: CAN Bus 2 cables.

Figure 5: CAN Bus 2 CTC cable (Circular connectors & PC connector via the CAN Bus adaptor).

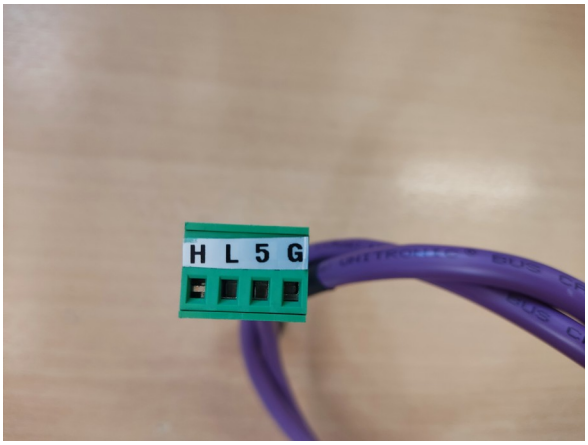


Figure 6: CAN Bus 2 EK-S1 cable (EK-S1 connector).

Figure 7: Solarbrain Power Supply Unit.

Figure 8: CAN Bus Adaptor ***(Not included with the Solarbrain set).***

5 Electrical Connections

The Solarbrain has four ports in total, from which three are placed in the front panel Figure 9 and one in the back Figure 10. On the left side of the front panel, there are two identical round/ circular inlets that are connected with the CAN Bus 2 cables Figure 4, 6 and 12. In the center, there is a RJ-45 plug used for Ethernet connection with a router or a network switch. At the back panel on the right side is placed the DC power plug and next to it, is the fuse of the device Figure 11.

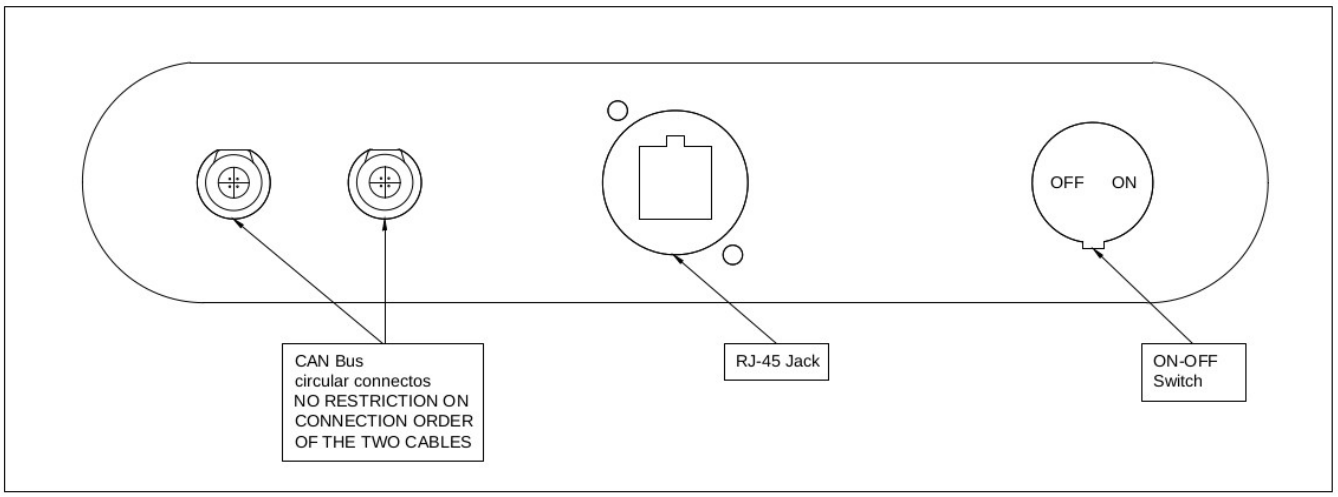


Figure 9: Solarbrain diagram (Front panel Circular connectors & RJ-45 Plug).

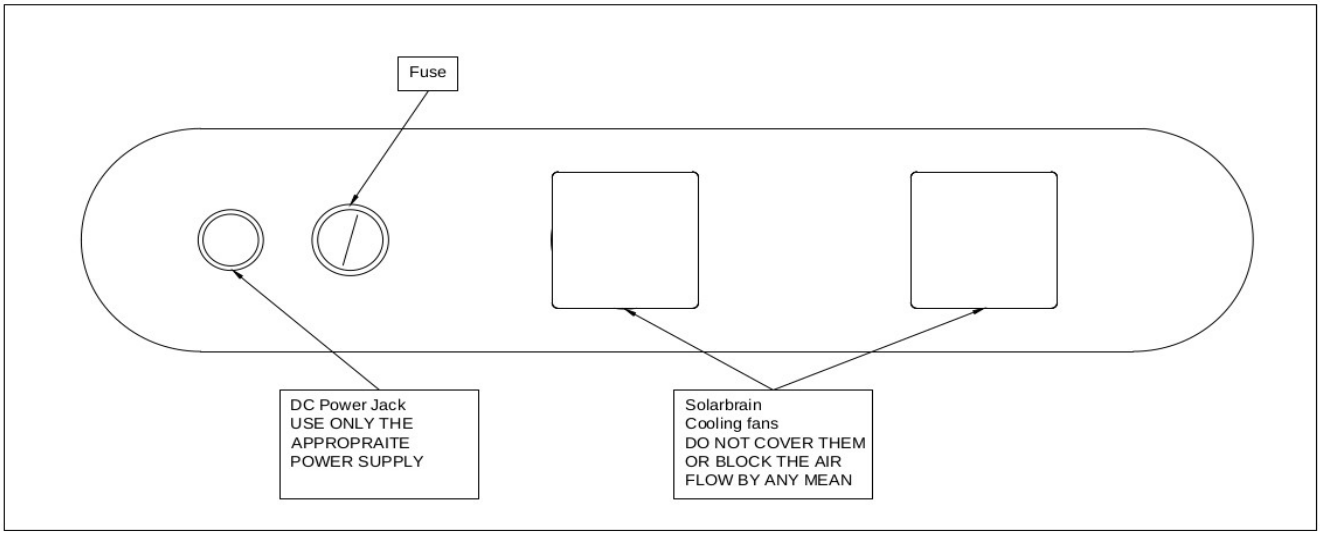


Figure 10: Solarbrain diagram (Back panel DC Power Plug).

Figure 11: Solarbrain back panel connections.

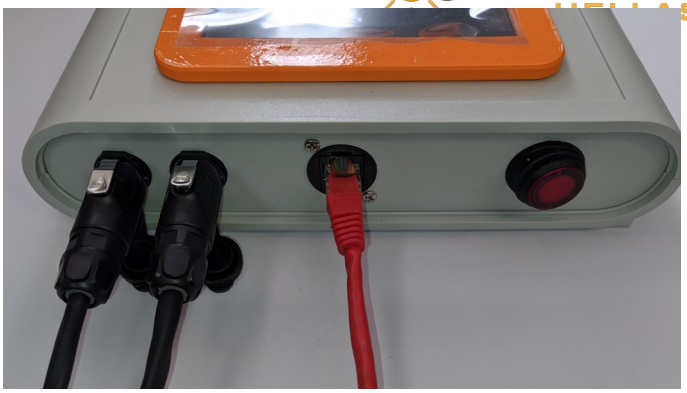


Figure 12: Solarbrain front panel connections.

The systems that are connected with the Solarbrain can be distinguished into 3 categories:

- **Power connection**
  Use the power supply as shown on Figure 11

- **Internet connection**
  Use an Ethernet cable for the connection between your router and the Solarbrain Figure 12

- **Trackers connection through EK-S1 (CAN Bus connection)**
  Use the Solarbrain CAN Bus 2 cable set (**there is no *restriction on the order or place that the* two *identical connectors will be connected***) Figure 4 and 6 For the connection of the Solarbrain with the rest of the PV plant you follow the same principal as when you connect with the CTC software. This principal is illustrated in the following diagram Error: Reference source not found and Error: Reference source not found :

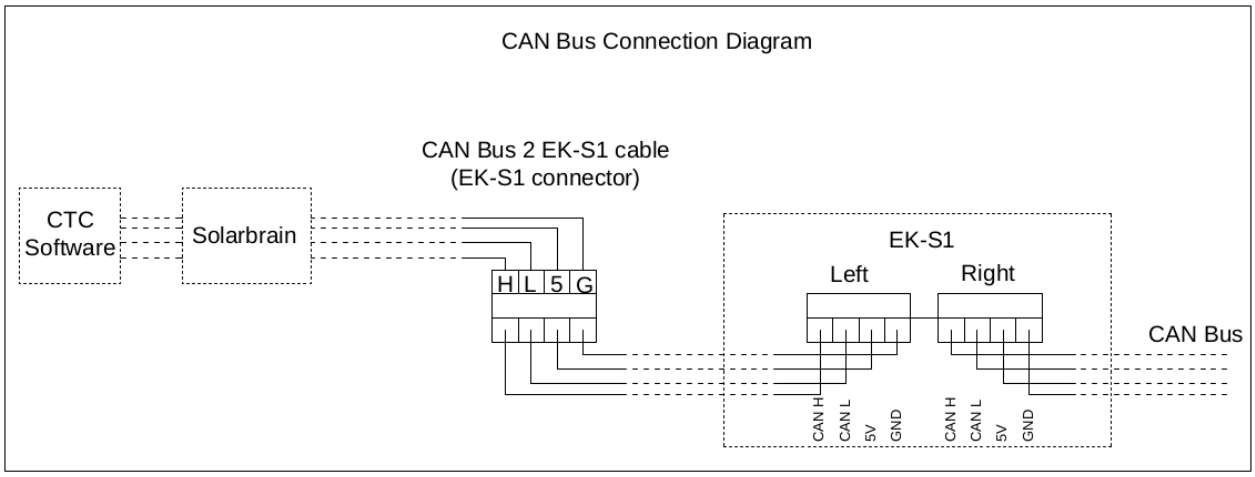


Figure 13: CAN Bus connection diagram with Solarbrain & CTC Software.

As shown bellow through the diagram the Solar Brain is actually connected/ integrated in the CAN Bus path and in that way it can communicate with the rest of the system without interference.

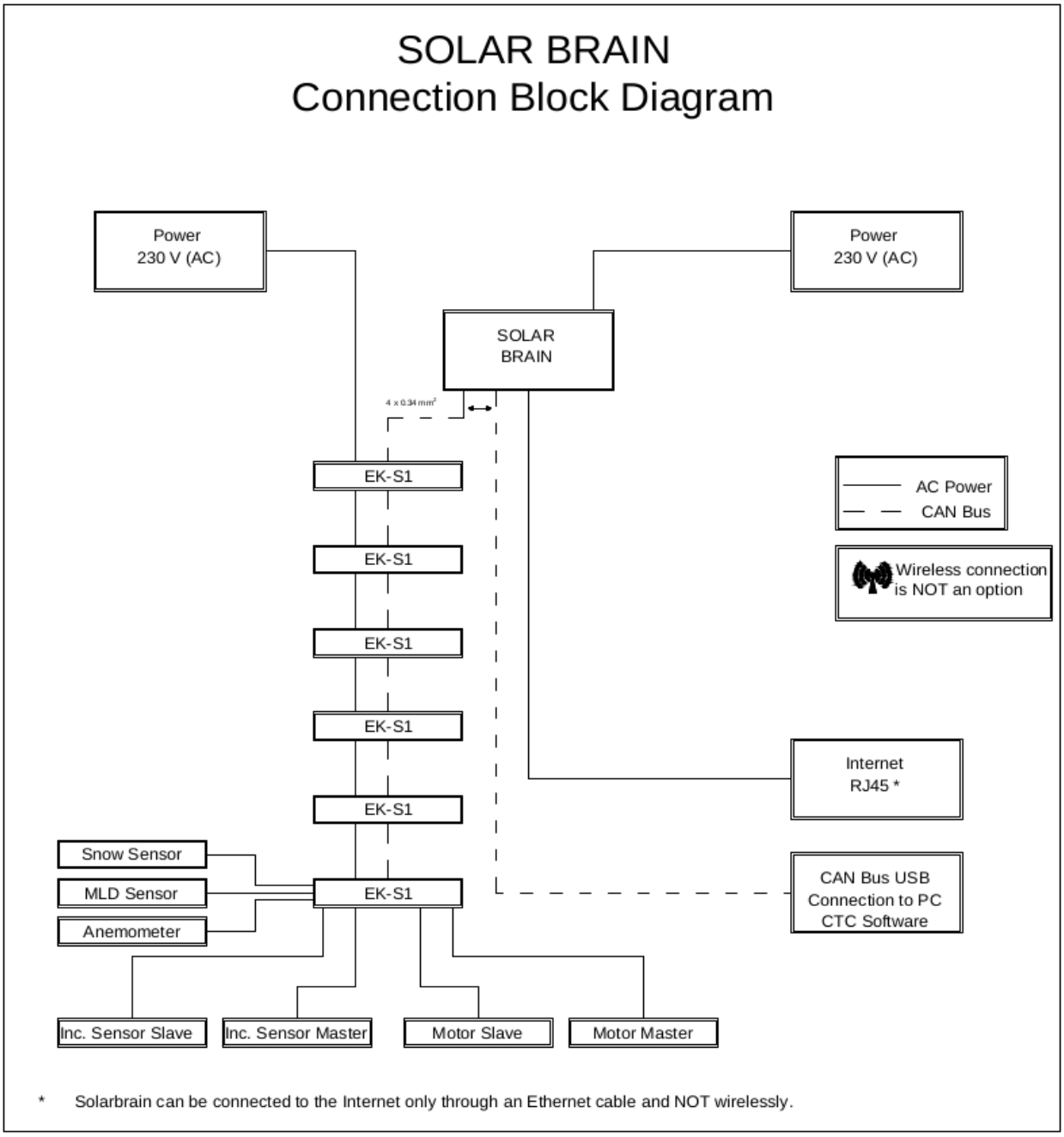


Figure 14: Solarbrain Connection Block Diagram.

Please bear in mind that there is no restriction on the order or place that the tow identical connectors will be connected.
Please bear in mind that the Solarbrain is not a wireless device. Thus for its connection with Internet there must be a physical alliance through an Ethernet cable.

6 Parts

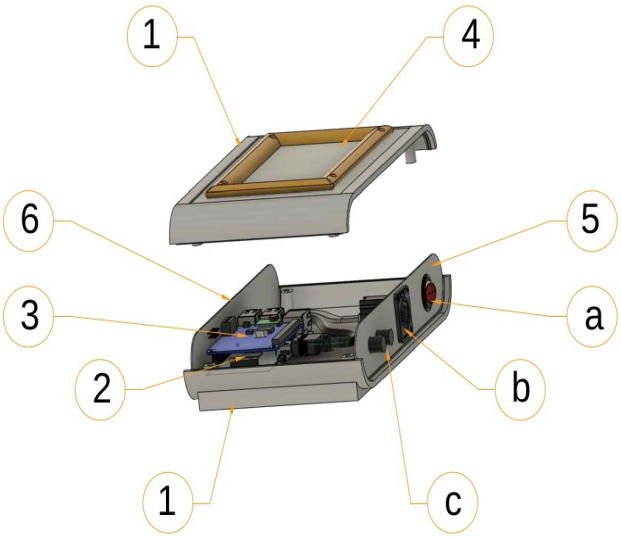


Figure 15: Solarbrain (Exloded view).

Description

*The **main parts** in **Figure 15** of the Solarbrain are:*

1. the box enclosure, which contains all the electronic parts
2. ARM based microcontroller
3. MODBUS / CAN Bus Shield
4. a five-inch touchscreen for UI.
5. the front panel
    a) on/off switch
    b) Ethernet plug
    c) CAN Bus/Mod Bus circular connectors
6. the back panel

Solarbrain connects to the Internet via its Ethernet plug, while you can turn it on/off by its switch. Also, some mini fans are used for cooling the electronic parts.
A frame is used for the protection of the screen. Other than that the Solarbrain is accompanied by a pen for the control of the touchscreen.

7 Software/Firmware

Control and monitoring software that adds backtracking capabilities to solar tracking panels.

7.1 Solarbrain Panel

The Solarbrain Web U.I. consists of 1 main screen that allows you to monitor and control the overall system Figure 16.The monitoring consist of an overall look and view with great detail of the daily plotted movement of all trackers as well as the wind speed The control consists of multiple options and more specifically the total system reset (hardware and software), the cleaning of any inaccurate errors, the CAN Bus communication reset but also the horizontal/ safe positioning of the trackers and the cleaning/ east positioning (more details on section 7.3).

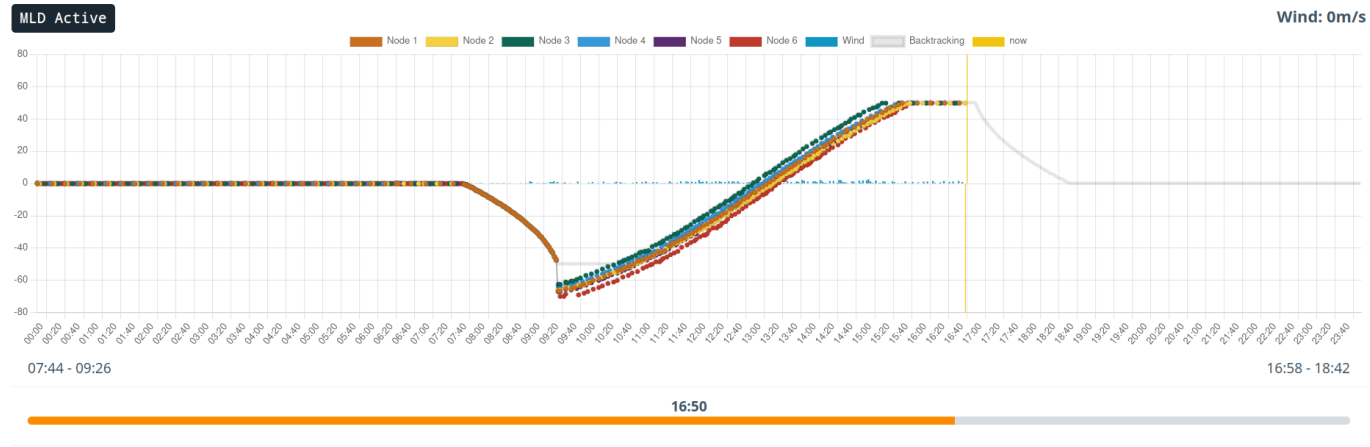


Figure 16: Solarbrain Web U.I. main screen.

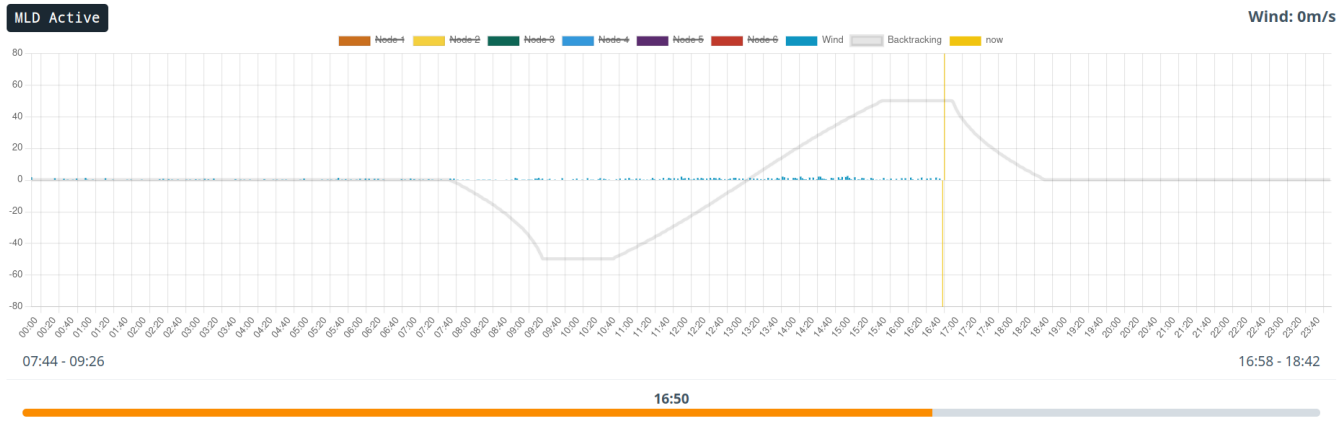


Figure 17: Accurate diagram of the wind data.

In this section, we view the main diagram where each dot represents a specific EKS1 and their respective trackers (Master & Slave). In the back-round of this diagram we have access to the wind plots light blue bar chart, the theoretical path* light gray dots and also the current position of the trackers yellow line. By ticking on each category (NODES, WIND, BACKTRACKING, NOW) on the top part of the panel you can see the condition of a specific node or the wind which is very practical for troubleshooting remotely

*Our MLD (Maximum Light Detectin) sensor further optimizes the trackers position so the optimal path is deferent form the theoretical. This phenomenon is very characteristic on cloudy days when the radiation is dispersed in the atmosphere in a different way than on a sunny day.

7.2 Backtracking

The Backtracking algorithm takes control of the solar trackers from sunrise to early in the morning and from afternoon until sunset Figure 18. *The purpose of the backtracking algorithm is to place each tracker at a specific angle. This happens to eliminate the shadows, which are caused by adjacent trackers when the elevation angle of the sun is low (sunrise and sunset). Solarbrain main screen Backtracking explanation.*

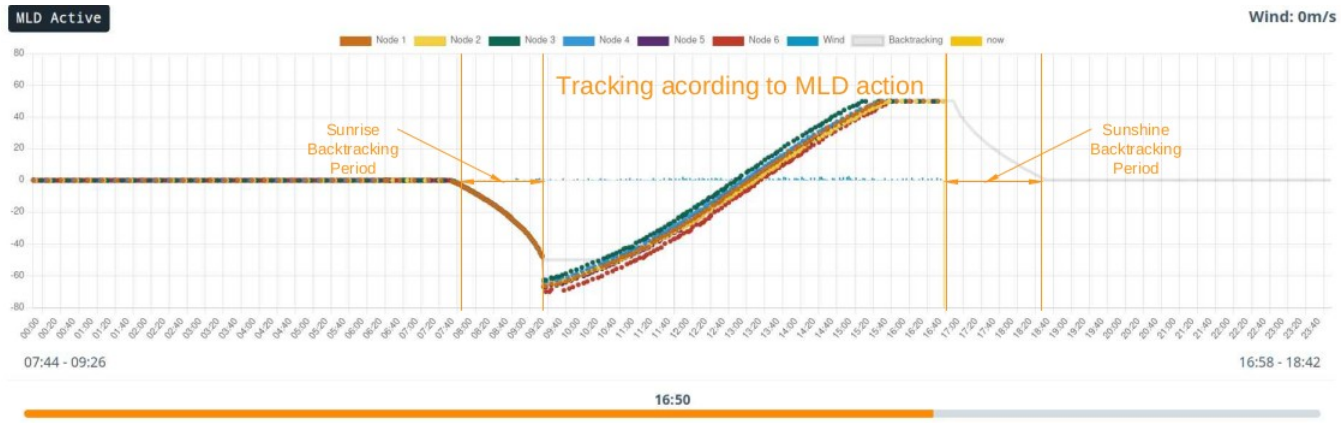


Figure 18: Solarbrain main screen Backtracking explenation.

7.3 Modes of operation

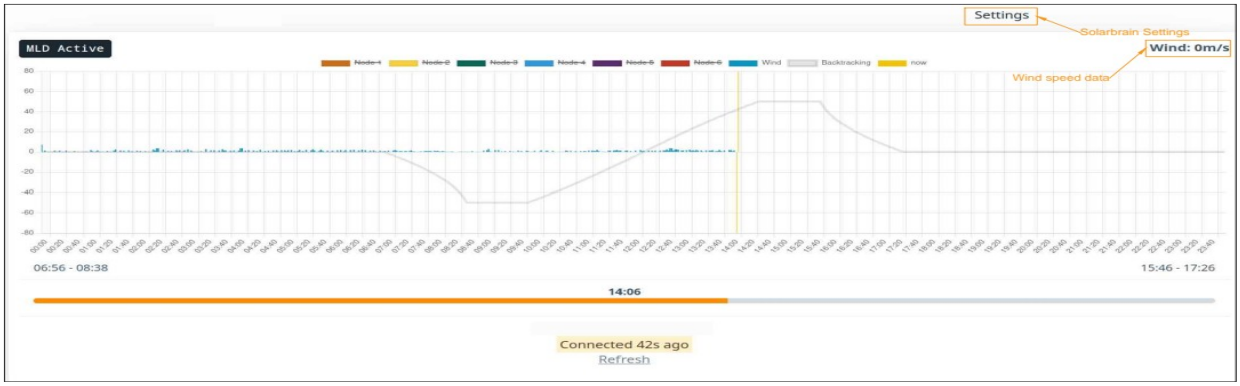


Figure 19: Solarbrain Settings access.

To get access to the modes of operation of the Solarbrain you just have to click to ***Settings*** *option which is located on the top left corner of the main screen next to wind speed data* Figure . *After that it's simple you just have to choose one of the available options* Figure 20 *and* 21.

Normal use	The backtracking algorithm is enabled and the rest of the day the trackers are controlled via the MLD sensor.
Water cleaning	The trackers are forced to be vertical, which means they face east position. It is an excellent option for snow removal when there is high concentration on the panels
Grass cutting	The trackers are forced to be horizontal *(safe position)*, which means panels are parallel to the ground. It is an excellent option for cases like high wind speed in the area as a prevention measure and for the facilitation of the technicians when they maintain or repair the PV plant
Pause mode	The trackers will be controlled only via the MLD sensor and the CTC Software and not from the Solarbrain.
Screenshot	You can take an actual screenshot of the main screen.
Refresh Browser	You can refresh the diagram of the main screen so that the new data can be uploaded.
Reset CAN	You can reset the CAN Bus communication.
Clear Errors	You can clear errors that may have occurred without a specific reason.
System Reset	You can rest both the hardware and software of your HSAT system.

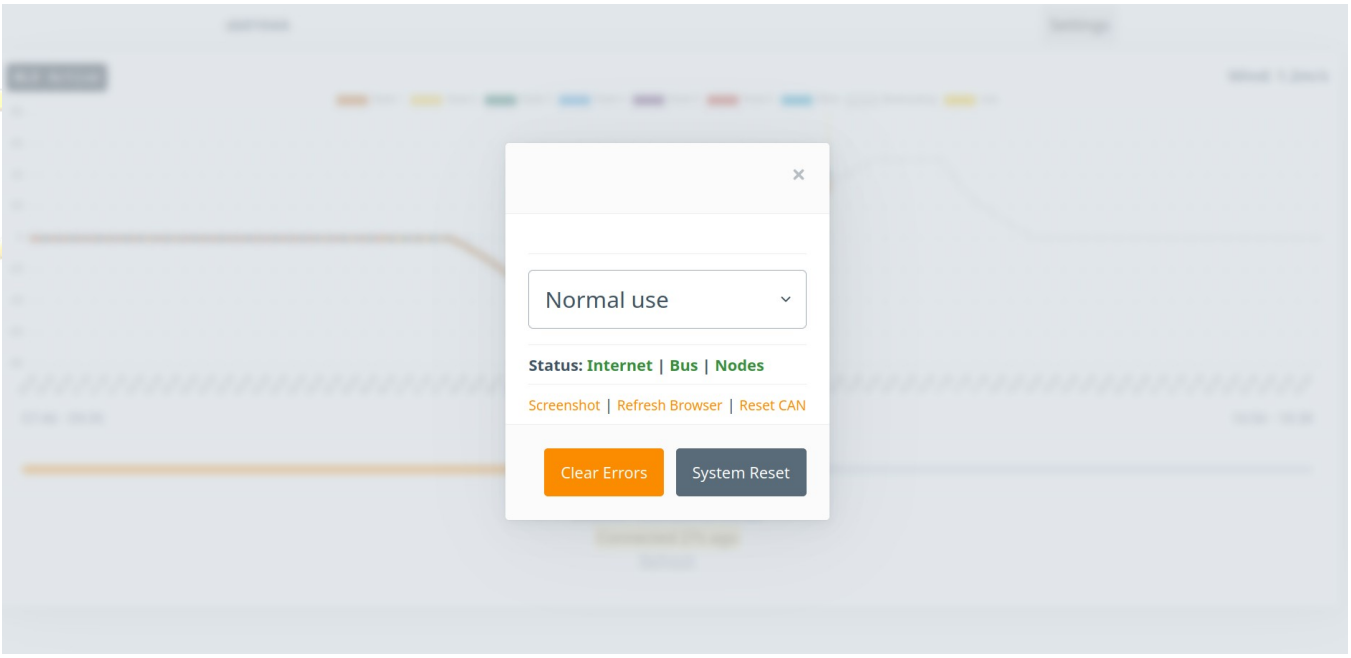


Figure 20: Solarbrain Settings options.

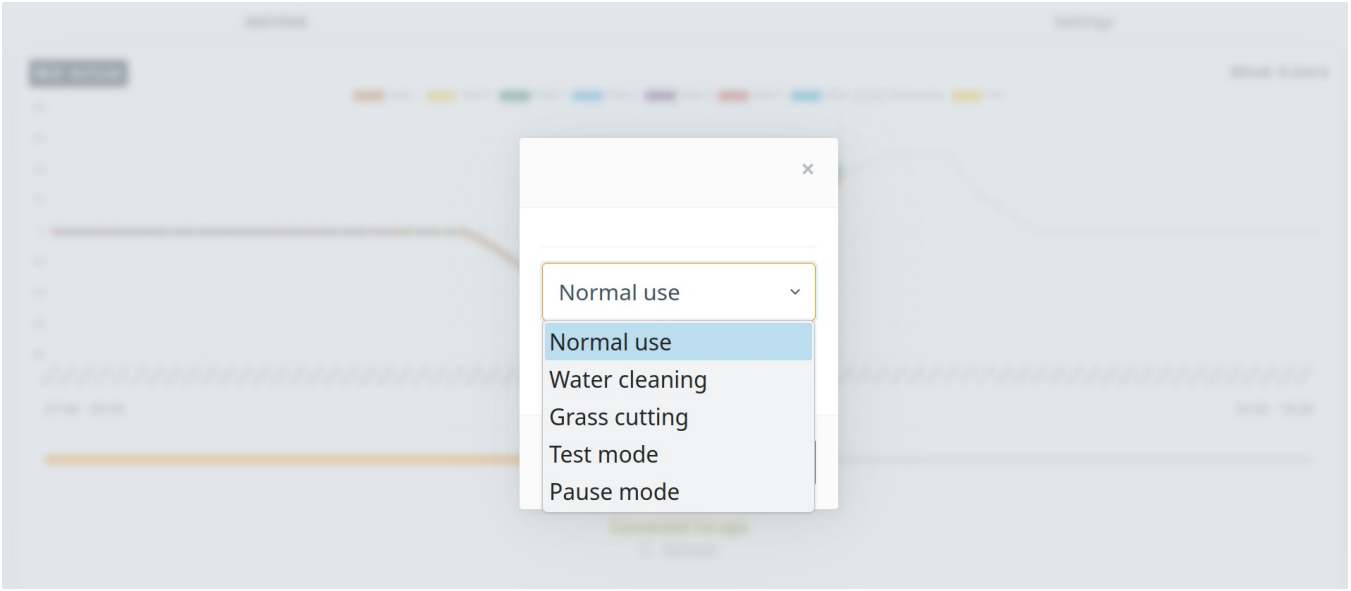


Figure 21: Solarbrain modes of operation.

For example, we can set our nodes or zones to maintenance mode or fix their position if severe weather conditions are expected.

Please bear in mind that Solarbrain as an IoT device, is capable of getting all its menu updates and new functionalities automatically.

7.4 SCADA Integration

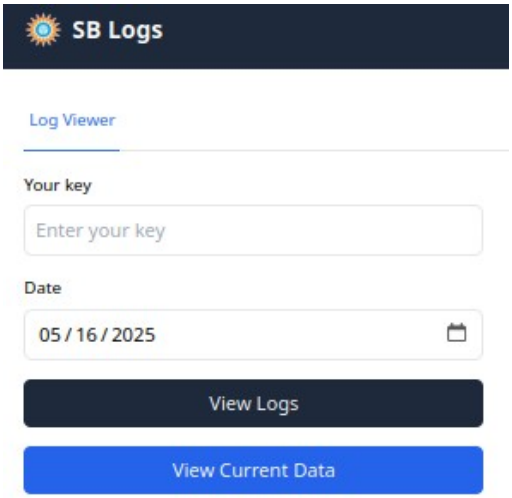
Solarbrain provides native support for integration with external SCADA (Supervisory Control and Data Acquisition) systems, enabling seamless remote monitoring and control of solar tracking infrastructure. This is made possible via the Solarbrain Logs API, a secure and lightweight interface that offers structured access to key operational data ** Soon to come-> MODBUS Functionality**.

The Solarbrain device broadcasts its operational log as a **JSON file** through a dedicated cloud server at:

📡 https://logs.solarbrain.gr

This data can be retrieved using a **POST request** to the endpoint /api/logs. The API responds with structured information on:

- Real-time tracker angle
- Full angle history of the day
- Backtracking operation status (AM/PM)
- System state (active, error, standby, etc.)
- Any warnings or operational alerts



API Request
To interface with the Solarbrain API, external SCADA systems must send a valid JSON payload with the **device UUID** and a **date** in the format YYYY-MM-DD. A typical request looks like this:

A successful call returns a JSON object with the tracker node ID, current tilt angle, timestamp of last update, and detailed history of movement and backtracking activity.

Example SCADA Integration Use Cases

- Display current tilt angle and position history of each tracker
- Monitor real-time system state and alert logs
- Validate backtracking activation periods for performance diagnostics
- Synchronize SCADA dashboards with field operation

The Solarbrain SCADA integration allows third-party systems to benefit from the device's precision tracking and diagnostics, creating a truly interconnected solar monitoring environment.

> ***For complete technical details and examples, refer to the Solarbrain API Documentation provided by DegerHellas&DegerEnergie Engineering Teams.***

8 Technical Data

8.1 Electrical ratings

Provided DC P.S.U. input voltage	220-240 VAC
Fused	4ADC
Nominal input voltage (DC jack)	12V/4A DC
Line frequency	50/60 Hz
Input power	≤ 48W

8.2 Electrical norms

IP protection class	IP 20
Flammability	UL50, UL94, UL746C
Electromagnetic Interference (EMI)	EN 61000-3 EN 61000-4 EN 61000-6
Directives	2014/30/EU 2014/53/EU 2011/65/EU

8.3 Climatic conditions general

Installation above sea level	max. 2000 m
Operating ambient temperature	-20 °C to +65 °C
Relative humidity	5% - 95%, non-condensing

8.4 General

Dimensions	220mm x 140mm x 60mm
Total weight	Approx. 700gr