

TESS Photometer Manual



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STARS4ALL



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1. Introduction

The TESS-W photometer is a scientific device designed to measure continuously from a fixed location for monitoring the evolution of the night sky brightness along numerous continuous nights. The absolute calibration is performed at *Laboratorio de Instrumentación Científica Avanzada* at Universidad Complutense de Madrid (LICA-UCM). The most updated version of this manual should be available at: <http://tess.stars4all.eu/software/>

There is a [TESS fast installation guide \(ENG\)](#) if you are in a rush.

TESS-W was developed during the STARS4ALL European project: “A Collective Awareness Platform for Promoting Dark Skies in Europe, Stars4All, Grant Agreement number 688135”. STARS4ALL <https://foundation.stars4all.eu/> is a general-interest foundation, as a mechanism to provide sustainability to the main results obtained in the context of the H2020 EU project STARS4ALL, especially in relation to the production and maintenance of the TESS photometer network and the provision of open data from such network to researchers and civil society organisations. Furthermore, the STARS4ALL Foundation organizes and participates often in outreach events to encourage the protection of night skies and provide information about light pollution and its negative effects.

2. Installation and configuration

2.1 General information

In order to function properly, the station needs to be installed on an elevated spot -preferably on a roof-, with a power outlet and WIFI coverage to send the measurements in real time. TESS-W has a USB connector that allows it to be powered with a normal mobile phone charger. The charger must be placed in a covered outlet protected from the elements.

A DC power source of 5V is needed. The intensity of the current ranges from 50 to 100 mA (for different WiFi signals) when the ambient temperature is over 10°C. For lower temperatures, $T < 10^{\circ}\text{C}$, the resistance is activated to increase the internal temperature of the photometer in order to prevent fog in the window and also to melt frost. In this situation the current ranges from 500 to 600mA. The power consumption varies from 0,25W to 3W depending on the external temperature.

After installation and setup the TESS-W photometer will form part of STARS4ALL's photometers network monitoring sky brightness. The measurements sent by the

photometers of the network are archived in the repositories that allow free access to the data. In the page <https://guaix.fis.ucm.es/tess/> there are links to download the data files and to visualize the graphs of the whole series of measures including those that were sent at that moment in real time.

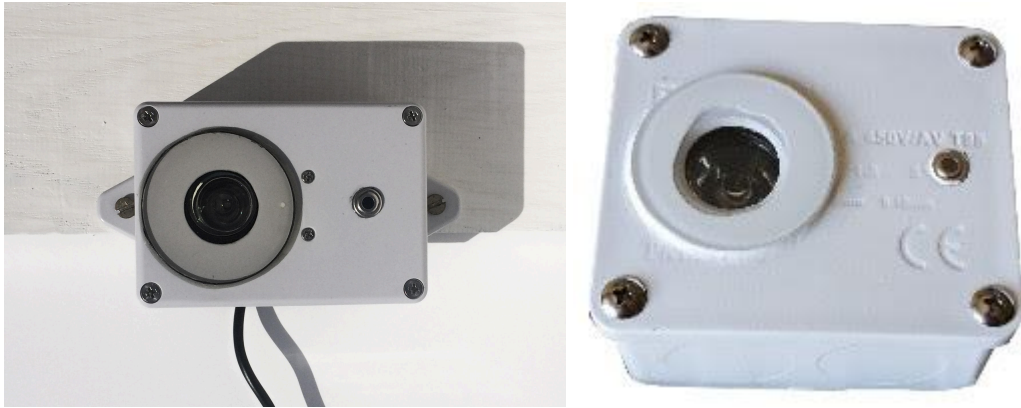


Figure 1. First version of the fixed TESS-W Photometer. On the right the current version with a better weather resistant enclosure.

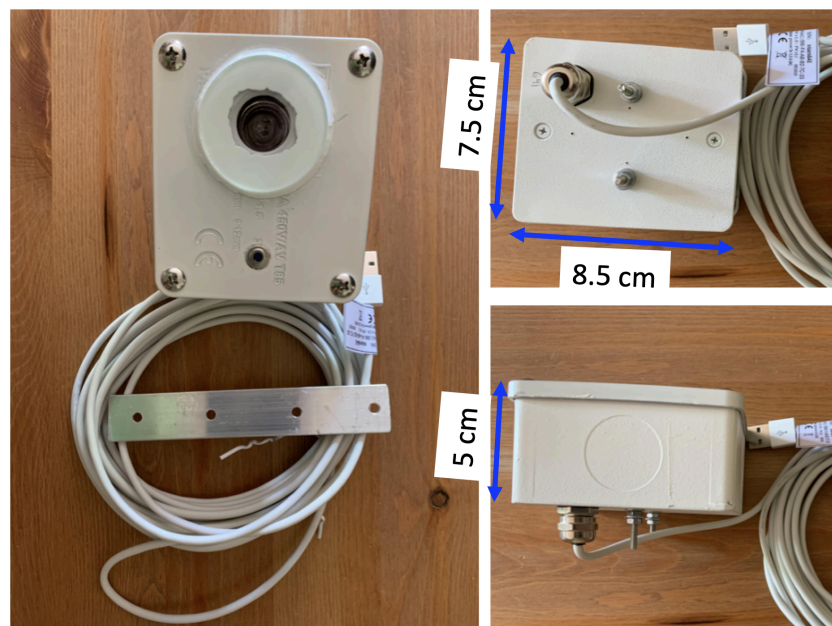


Figure 2. Dimensions of the TESS-W.

TESS-W photometer is designed to serve as a fixed station measuring night brightness and cloudiness. **Make sure it is properly configured before installing it.**

2.2 Setting up TESS-W photometer

A local and active WIFI network will be necessary for the photometer to send the data. Once installed it will not need more human interaction as measurements will be sent automatically in real time to the repository.

Step 1) The first time the photometer TESS-W is plugged in, it creates its own WIFI network called TESS-stars1234 (for stars1234 photometer as an example) or *TESS-W* for old version which can be accessed freely from a computer, smartphone or any mobile device.

Step 2) After connecting to the TESS-W network please open a browser and enter the address: <http://192.168.4.1>

Step 3) You should get this screen and click on the link for Wi-Fi Settings (Edit wifi). If your WIFI is not active the first time the photometer is plugged it will be necessary to reboot TESS-W.

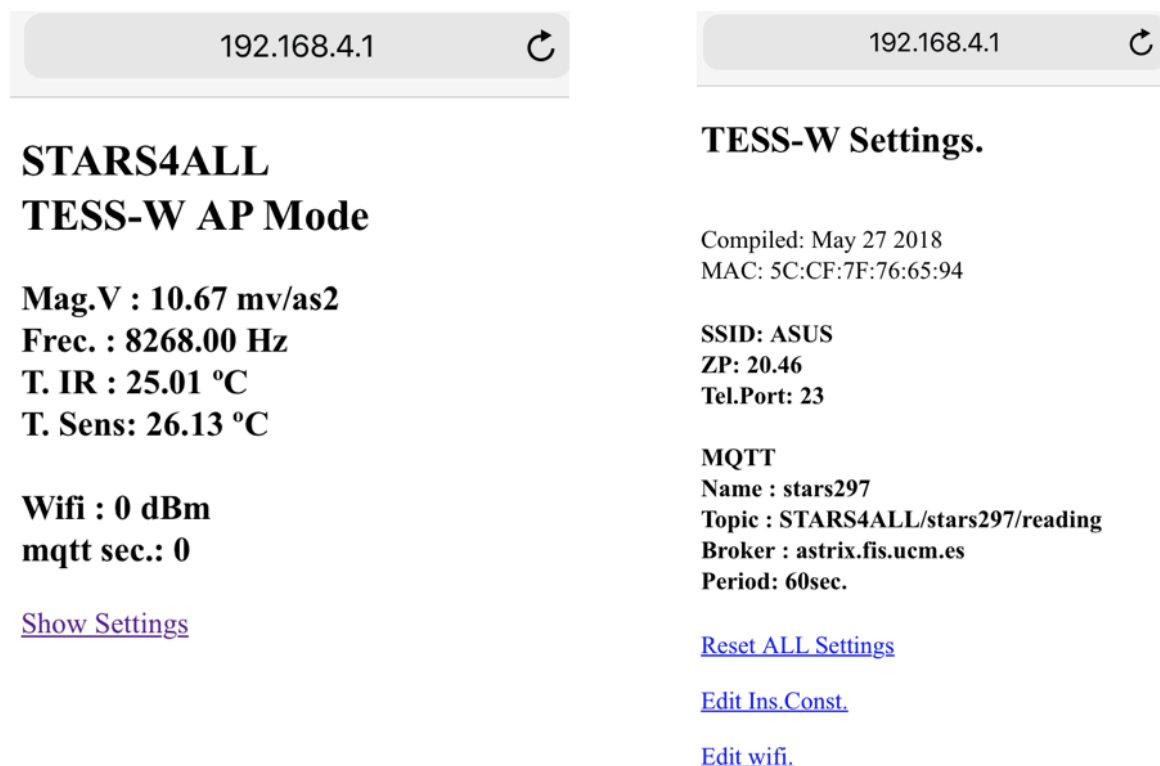


Figure 3. TESS-W Setting as seen from a mobile device or a computer.

In the most recent versions the photometer name and the calibration zero point (stars297 and ZP=20.46 in the example) are already stored in the device after calibration. In most cases you only need to “edit wifi”. In Figure 3 the SSID is an example.

Step 4) Set the parameters, using lowercase letters, as follows:

SSID: Enter the ‘Edit wifi’ setup page. There is a list in a dropdown menu to select the WIFI (SSID) you want your photometer to be connected to

Password: Enter the password that is required to connect to that WIFI

Step 5) Check connection to broker

Once this part of the configuration is done it will be then necessary to unplug the photometer from the electricity outlet and plug it in again after 30 seconds. The configuration is completed now and TESS-W should take measurements and send the data to the Broker. The wifi created by the photometer during setup should disappear. Check it by listing the available SSID with your mobile device.

Use this link to check the raw data from your photometer arriving

https://tess.dashboards.stars4all.eu/d/tess_raw/s4a-photometer-network-raw?orgId=1&from=now-3h&to=now&refresh=1m&var-Tess=stars19

where you should change ‘stars19’ with the name of your photometer.



Figure 4. Grafana panel showing raw data arriving to the STARS4ALL repositories in real time. In this example the time range is set to ‘last 3 hours’ but you can change it using the menu at top right.

If you encounter any problem or have any questions, please contact the researchers of the UCM before continuing with the next step.

In extraordinary situations (please ask) you can reset all the photometer information and insert it from the beginning (Reset all settings). Enter into the 'Reset all settings' page and fill the parameters:

- | | |
|-------------------|--|
| Name: | Give your photometer a name. It must be the word stars in lowercase followed by the serial number. This name is in the label tag of the electrical cable or ask. |
| ZP | Add the zero point value of the photometer. Every photometer has its own. Please mind your computer is probably configured to use a dot as a decimal symbol, if not please change this symbol as needed. |
| Seg. | This parameter determines the frequency the photometer is to take measures. Please set this value to 60 . The photometer will read the brightness every 60 s. |
| Tel. Port: | Local access port. 23 by default. |
| Broker: | To enable the remote observatory please set astrix.fis.ucm.es as server.
(astrix, not asterix). |

In case you want to change the settings, such as after a password change in the wireless network, the photometer needs to be turned on in an environment in which the network is not available. To do this you can either switch off the network, or inhibit the WIFI signal, or uninstall the photometer from its location and switch it on out of the reach of the network signal.

Once you have plugged the photometer again, on the page <http://192.168.4.1> a reset message will appear asking you to do so. After the reset you will be able to access the "WIFI Tess Settings" menu if you unplug the photometer again and plug it within the range of the new wireless network. It is possible that the photometer will need a few minutes to find it.

Step 6) Registering the photometer.

In order to create the corresponding webpage for your photometer and to include the data in the TESS database, please send us the relevant information to register your photometer using [the register form](#).

2.3. Where and how to install TESS-W photometer

Both the brightness sensor and the clouds sensor must point to the sky. Please point both vertically to the zenith so the box is placed horizontally.



Figure 5. Possible installation of TESS-W photometer It must be in horizontal position so the sensors point toward the zenith.

Any direct or indirect light reaching the sensor will disrupt the measures. We recommend the installation place to be selected on the night previous to installation to ensure that the photometer will receive no direct or indirect light of any kind. It is also necessary to be sure that nothing is blocking the photometer's view of the sky, like a building or a tree. The optimal place for installation is usually a flat roof.

You will need to connect a TESS-W photometer to a power supply through a plug protected from rain. Make sure to choose a place within the range of your WIFI network.

3. Online data access.

This instrument is part of the STARS4ALL photometers network monitoring the night sky brightness. Photometers monitor sky brightness to estimate light pollution and study its evolution. The data is open to any researcher. You can browse and download the observations of any photometer of the network.

Follow <https://tess.dashboards.stars4all.eu/dashboards> to access grafana panels with graphs.

3.1. Checking TESS-W data online

Use this link to check the raw data from your photometer arriving

https://tess.dashboards.stars4all.eu/d/tess_raw/s4a-photometer-network-raw?orgId=1&from=now-3h&to=now&refresh=1m&var-Tess=stars19

where you should change 'stars19' with the name of your photometer.

The time range can also be selected from the upper right menu. This feature allows you to browse data from any time.

3.2 Visualizing active and inactive photometers on the map

The map tab shows active photometers in green and inactive in red. The marker of a new photometer is registered in this map manually so unfortunately it's not a way of checking a new installation, however, it is a quick way to check that a photometer already installed is still working correctly after any event like a power failure.

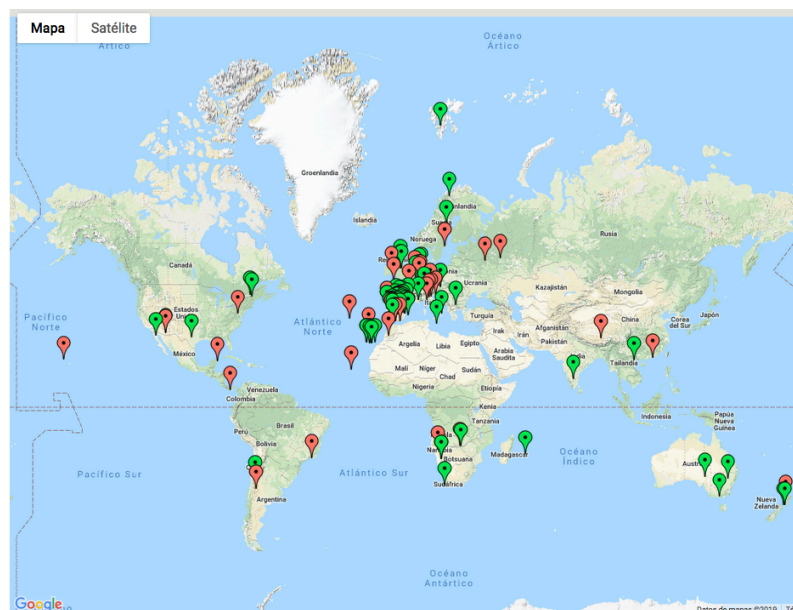


Figure 7. TESS-W photometer network map

You can access the map from

https://tess.dashboards.stars4all.eu/d/tess_network_map/map?orgId=1

and also zoom and pan to any region of the globe.

3.3 Plots in real time

Night sky brightness graphs of any STARS4ALL photometer can be viewed at the [STARS4ALL GRAFANA panels](#). You can search for your dashboard at <https://tess.dashboards.stars4all.eu/dashboards>

After registering your photometer a dedicated webpage is created.

Browse for instance the [webpage for stars19](#) or the [real time data for stars19](#)

Other GRAFANA panels can be used and shared in your own webpage.

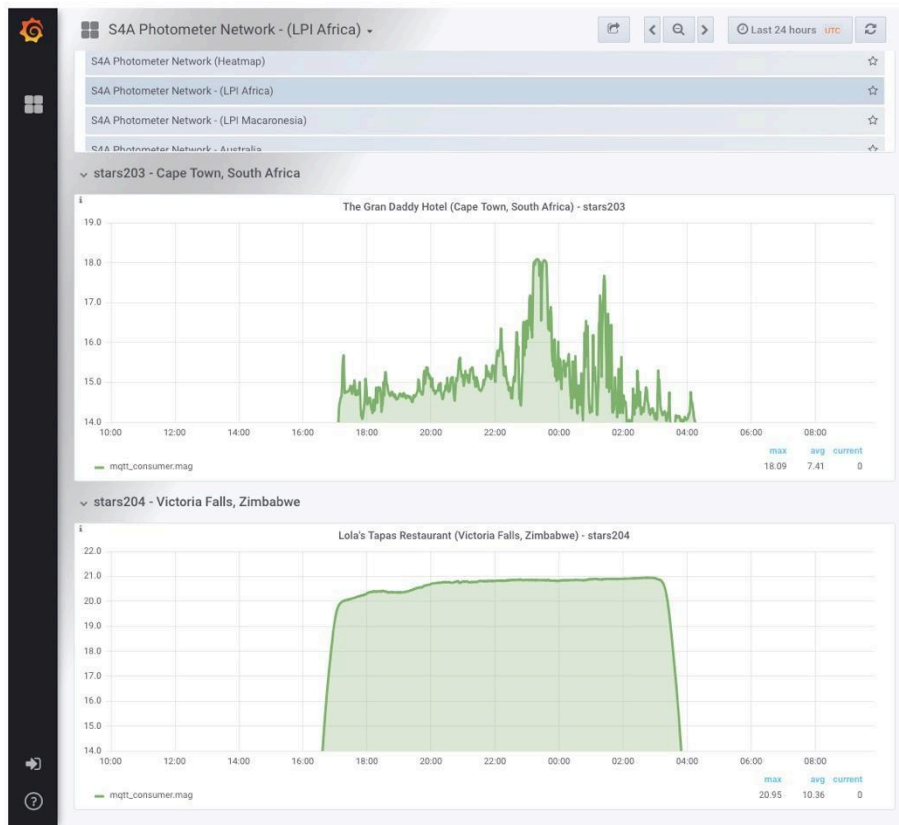


Figure 8. Example of TESS-W photometer network plots

More information at: <http://tess.stars4all.eu/plots/>

3.4 Downloading the data

You can download the data taken by any photometer at any time in the past. There is no need to register.

3.4.1 Grafana panels

Open data and real time graphs available at <https://tess.dashboards.stars4all.eu>

After selecting the corresponding panel you can browse the data at any time range using the menus. Then you can download the data using the 'Download data' menu.



3.4.2 UCM nextcloud

The data is stored in several redundant repositories. The database at Universidad Complutense de Madrid provides Archived data at [UCM GUAIX cloud](#). The data is stored using the IDA-IAU standard format in monthly files.

Tipo	Nombre	Tipo de archivo	Tam...	Modific...
☐	stars1	...	357,7 MB	hace 23 horas
☐	stars2	...	117,2 MB	3 de septiemb...
☐	stars3	...	997 KB	3 de septiemb...
☐	stars4	...	307,6 MB	hace 23 horas
☐	stars6	...	5,6 MB	3 de septiemb...
☐	stars7	...	175,5 MB	30 de noviem...
☐	stars8	...	114,2 MB	3 de septiemb...
☐	stars9	...	183,6 MB	hace 23 horas
☐	stars11	...	21,7 MB	3 de septiemb...
☐	stars12	...	24,5 MB	3 de septiemb...
☐	stars14	...	7,8 MB	3 de septiemb...
☐	stars15	...	103,8 MB	3 de septiemb...
☐	stars16	...	2,6 MB	3 de septiemb...
☐	stars17	...	90,9 MB	hace 23 horas
☐	stars18	...	91,1 MB	3 de septiemb...
☐	stars19	...	166,2 MB	hace 23 horas

Tipo	Nombre	Tipo de archivo	Tam...	Modific...
☐	stars19_2017-06.dat	...	48 KB	3 de septiemb...
☐	stars19_2017-07.dat	...	314 KB	3 de septiemb...
☐	stars19_2017-08.dat	...	1,4 MB	3 de septiemb...
☐	stars19_2017-09.dat	...	1,4 MB	3 de septiemb...
☐	stars19_2017-10.dat	...	1,4 MB	3 de septiemb...
☐	stars19_2017-11.dat	...	1,6 MB	3 de septiemb...
☐	stars19_2017-12.dat	...	1,6 MB	3 de septiemb...
☐	stars19_2018-01.dat	...	1,5 MB	3 de septiemb...
☐	stars19_2018-02.dat	...	1,2 MB	3 de septiemb...

Notes:

- TESS-W manual was originally written in Spanish. You will find full information of this photometer and other versions at the webpage written by Cristobal Garcia at: <https://tessskysensor.blogspot.com/> The use of TESS-W in local mode is explained in those pages.
- Online presentation that you could find useful "[Monitoring with TESS photometers](#)"

If you find any mistake or would like to suggest any improve on this manual please report them at jzamorano@fis.ucm.es