T A S

TESS AS

TAS   Photometer

User Manual

Versión: 2.4

15/05/2024
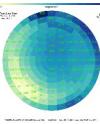
Cristobal Garcia   STARS4ALL

CONTROL SHEET

Proyect	STARS4ALL EU project		
Model	TAS (TESS Auto Scan)		
Document	User Manual		
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CHANGELOG

Versión	Concerned	Responsible for change	Date
1.0	Initial versión	Cristóbal García	30/11/2019
2.0	General changes	Cristóbal García	15/01/2020
2.1	5.1 TasPlot	Cristobal Garcia	28/04/2021
2.2	2. App Tess-P. 4. Reading files. 6.1 Example of TAS File.	"	12/05/2021
2.3	8. Added troubleshooting.	"	24/03/2023
2.4	Translation to English.	"	12/05/2024

ÍNDICE

1 INTRODUCTION

TAS (Tess Auto Scan) emerges as a continuation of the TESS-W photometer in the framework of the European project STARS4ALL, and the collaboration between UCM and UPM.

1.1 General description.

TAS is a motorized photometer, with TESS-W compatible optics, for the study of light pollution.

It incorporates two stepper motors for automatic sweeps of 145 measurements of brightness and apparent IR sky temperature.
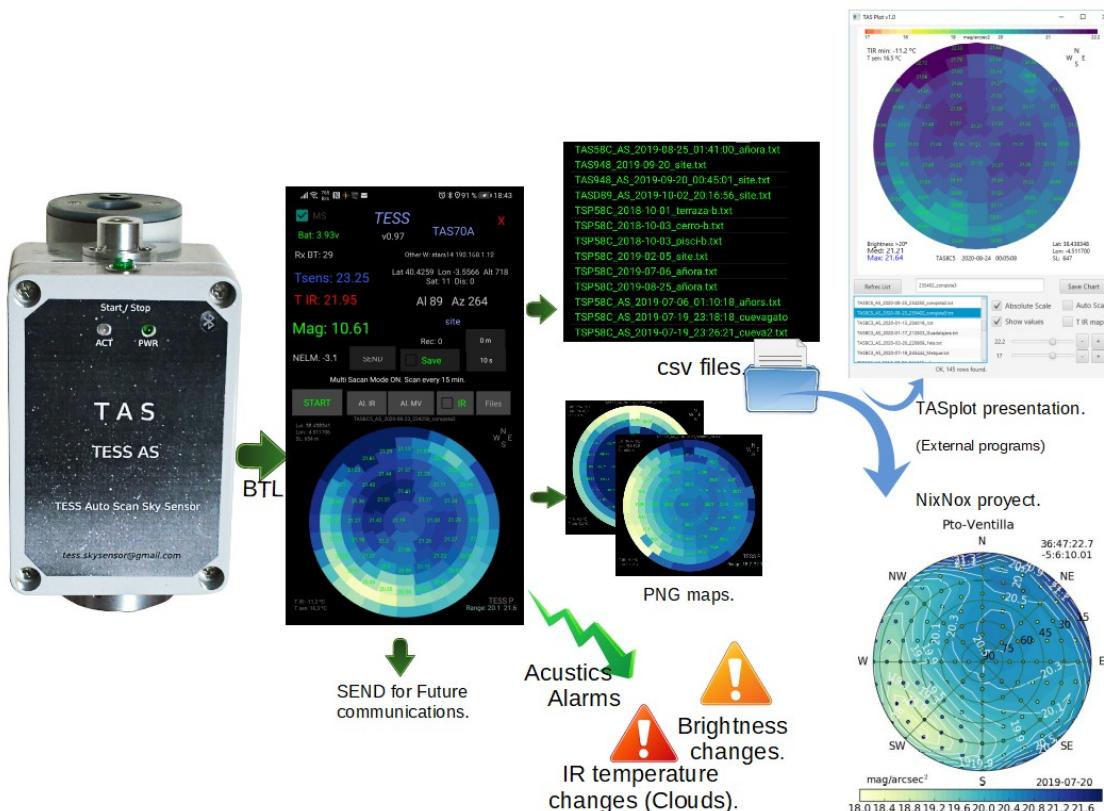
Ilustración 1: Overview of TAS operation with Android app.

To use TAS you need a cell phone with the TESS app. The app presents the readings graphically and stores them referenced to the GPS position of the cell phone.

The infrared readings complement the brightness measurement. In a completely clear sky the IR temperature differences in nearby areas are less than one degree Celsius.
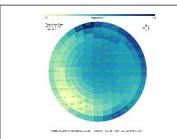
1.2 Physical descriptión.

TAS consists of two parts, the main body and the sensor block. The main body contains the electronics, battery and motors, and rotates 360º horizontally. The sensor block contains the brightness and IR temperature sensor, moves vertically.

Ilustración 2: Main elements.

1   Bubble level.

2   Sweep start / stop button.

3   Activity LED. Flashes at power on, when the button is pressed and continuously with low battery.

4   Power on indicator LED.

5   Micro-usb input for battery recharging and static communication.

6   ON/OFF switch, ON position for battery charging.

7   Sensor head, brightness and IR temperature.

8   Base with thread for photographic tripod.
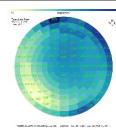
Ilustración 3: Carrying case. A small table tripod and a USB charging cable are included.

1.3 Requirements.

To use TAS and record measurements, a smartphone is required. The app for TAS is called TESS, available for Android and iOS.
The battery is recharged with a micro-usb cable and any charger or USB-A port.

1.4 Precautions for use.

TAS is intended for static use on a photographic tripod.
It is not suitable for continuous outdoor operation.
TAS contains delicate mechanical parts and should be transported and handled with care. Positioning and orientation prior to measurement is manual and should be done gently.
The device should not get wet and fingers should not touch the sensor inputs sensors.
Any small dirt will induce an error in the measurement. To clean the optical window, the usual optical products are recommended.
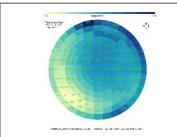
1.5 Battery.

Battery charge.

The device is recharged with any mobile power supply through the connector micro-USB (5). For charging, the switch (6) must be in the ON position, facing down. Full charge time is four hours.

Battery Level.

The charge level in volts is presented in the upper left part of the TESS app. The text color summarizes the status: green >80%, white >50% and red discharged.

The ACT LED, located on the front of the TASS, also indicates the battery status:
-With enough battery, it flashes briefly when turned on.
-With low battery it flashes continuously.
-Battery too discharged, the initial flashing will not occur when turning on.
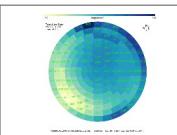
1.6 Technical specifications.

Power system	Rechargeable lithium battery 1200 mAh Micro USB 5v 1A.
USB Consumption	750 mA under load and 200 mA with a charged battery.
Battery duration	1 hour of sweeps.
Communication	BT. Optional USB for static readings.
Working temperature	-30ºC a 70ºC
Dimensions	11 x 7 x 9 cm
Weight	250 gr
Sweep measurement points	145, starting at 10º height.
Sweep aiming precision	+ - 5º
Sweep Duration	Variable depending on the brightness, 5 minutes for brightness over magnitude 20 or less. 15 minutes in very dark skies.
Brightness sensor type	Silicon photodiode TSL237.
FOV Brightness measurement	17º
Brightness Spectral Range	400 a 750 nm
Precision Brightness	+ - 0.1 mag/arcs2.
Brightness Range	8 a 23 mag/arcs2.
IR sensor type	MLX90614-BAC
FOV IR sensor	35º
IR Temperature Resolution	+ - 0.02 ºC
IR Temperature Range	-70 .. +380 ºC
Temperature sensor range	-40 .. 125 ºC
Temperature Accuracy	+ - 0.5 ºC
Brightness Calibration	LICA UCM Laboratory

2 TESS app.

The TESS P app is responsible for communicating with TAS.
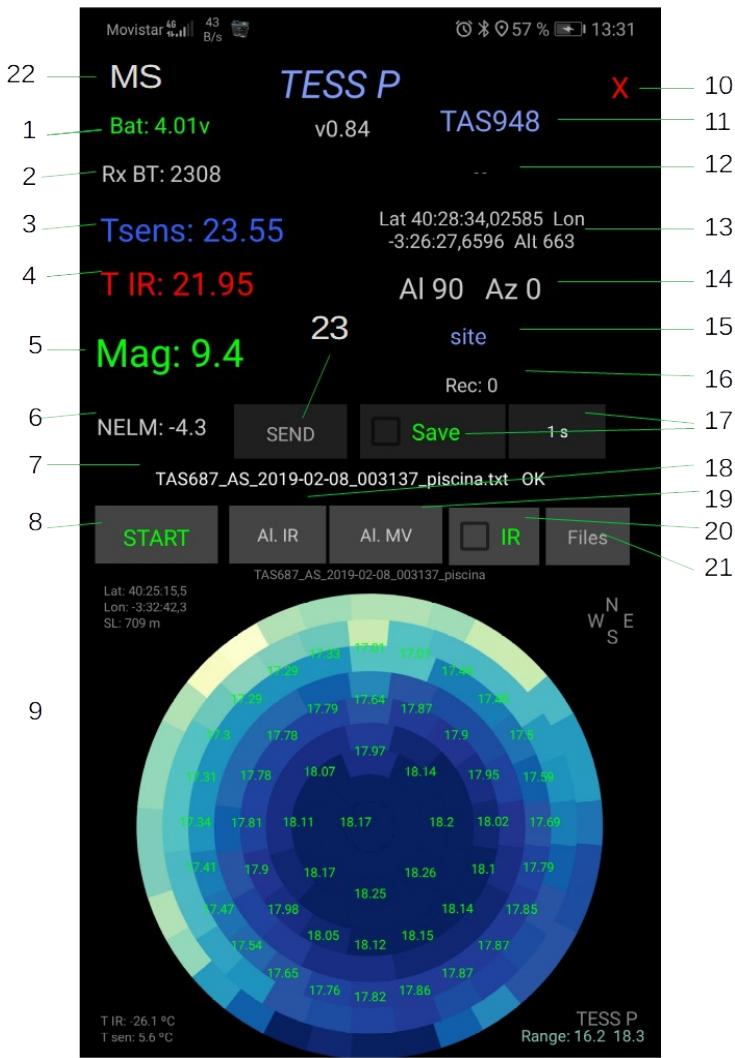
1 Batery level: Green full, Red low .
2 Message counter.
3 Sensor Temperature.
4 IR Temperature.
5 Magnitude.
6 NELM, Near Eye Limit Magnitude.
7 Log
8 Start Scan button.
9 Presentation area.
10 Close app.
11 Name sensor, click to edit.
12 IP for TESS-W.

13 GPS coordinates.
14 Alt Az from scan or accelerometer.
15 Optional text aded to filename.
16 Record counter.
17 Button and time for no scan records.
18 T IR shift alarm (+-2 ºC).
19 Magnitude shift alarm (+- 0.5 mag).
20 Check for show IR maps.
21 List auto files, click to show.
22 Multi Scan. Launch scan every 15min.
23 Send current single data to broker.

Ilustración 4: Elementos de la app TESS-P para Android.
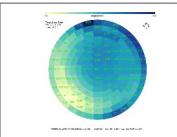
The app communicates with TAS via BT and from it you can launch a sweep of measurements by pressing the START button for a few seconds or also store static data periodically by checking Save.

It is possible to add an indicator to the file name, for example of the location, in the
Site box.

The measurements are saved georeferenced with the mobile phone's GPS, which must be activated.

The app can produce acoustic alarms for changes in brightness (+-0.5Mag.) and IR temperature (+-2ºC). Simply press the Al.IR and Al.MV buttons.

2.1 Setting.

The app automatically connects with TAS but the first time it is necessary
Enter the identifier of our sensor (TASXXX). This name is found
at the top right of the app. By clicking on it we can edit it. The
Letters must be capital letters.

In the mobile's BT settings, TAS should NOT appear as a paired device.
It should only appear as an available device.

The appearance of the app may be affected by the general presentation settings of the mobile. For example, adjusting font sizes that are too large can result in cuts in the app's texts.

2.2 Record static measurements.

The program presents the TAS readings continuously without having to perform a sweep These readings can be saved by checking the Save button in the Android app. The writing period can be set between 1 and 60 seconds by pressing the button to the right of Save.

Below these buttons a counter appears with the number of saved readings.

If you want to perform static measurements over a long period, e.g. all one night, you have to power TAS via USB to avoid depleting the internal battery.

2.3 Perform a scan.

To perform the sweep:

- Screw the TAS base to a photographic tripod.
- Adjust the tripod to level the photometer.
- Orient the main body to the north and move the sensor head to the zenith.
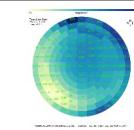
- Lower the switch on the back to the ON position (red dot). The PWR led will light up and the ACT led will flash twice, one short and one long. If ACT continues flashing or
nothing flashes, the battery is too low and communication will not be established with the mobile.

- Launch the TESS app. The app automatically tries to connect to the photometer that you have configured. If all goes well, in a few seconds the readings will be done
visible.

- To start a sweep, simply press the START button in the app or the button above of the photometer. It is possible to cancel the sweep by pressing the STOP button. In this case,
Before restarting a new sweep it is necessary to reorient to the north and zenith manually.

During the scan, the progress is shown in the lower area. Upon completion, the map obtained is presented and you are notified with a beep.
For each sweep, a new file will be created automatically. Your name
appears on the log line.

It is possible to stop the sweep by pressing the STOP button in the app or the green button
until the ACT led flashes.

The sweep time is variable depending on the sky. For skies of
Magnitude 20 can be 5 minutes, 15 minutes for very dark skies.

2.4 Multiple sweeps.

It is possible to perform continuous scans by checking MS (Multi Scan) in the upper left part of the app. A sweep will be automatically launched every 15 minutes. A montage of the results can be seen HERE.

2.5 File location.

When a file is created, the destination folder appears in the log line of the program.
On the Android mobile we can find the files with the file explorer in: *Internal memory/Android/data/b4a.tessp/files/*

The maps generated by the app are automatically saved in png format in the /maps folder in the same directory.
All files created are kept in the updates but will be deleted when the app is uninstalled.

2.6 Graphic presentation.

The app displays the auto scan data in the form of a circular map. The brilliance of the resentation automatically adjusts to the range of measurements.
Every time a scan file is viewed, the image obtained is saved automatically in the same folder. The map contains position data and summary measurements.

To view a map of a stored file, press the "Files" button and the list will appear.

TAS58C_AS_2019-08-25_01:41:00_añora.txt
TAS948_2019-09-20_site.txt
TAS948_AS_2019-09-20_00:45:01_site.txt
TASD89_AS_2019-10-02_20:16:56_site.txt
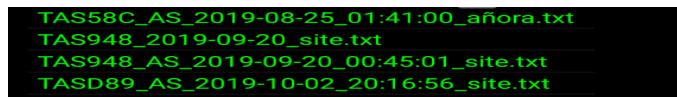
Ilustración 5: List of files when clicking "Files".

If the file is single readings, it will be displayed in text mode.
If the file is a scan, it will be presented as a brightness or IR temperature map if the IR check is marked.
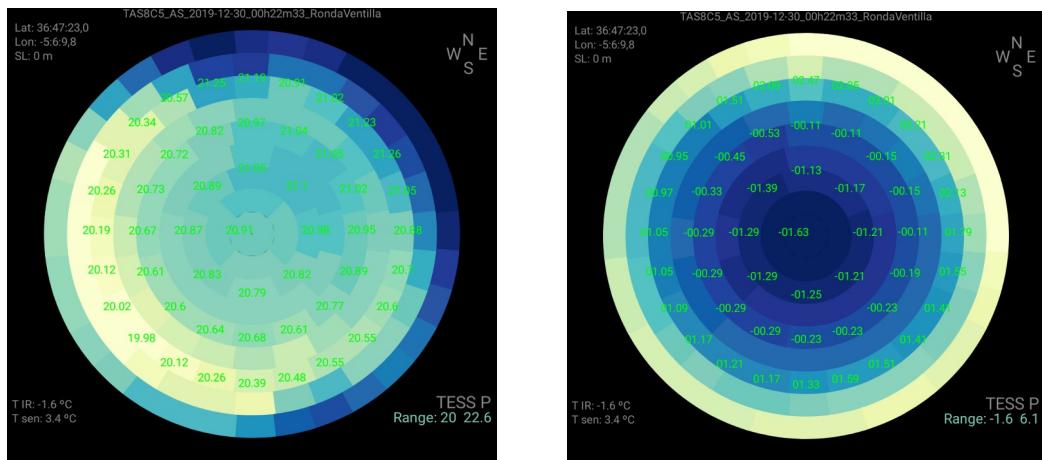
Ilustración 6: Brightness map in a place where there is a population to the west.
Its IR map showing a sky without high clouds.

2.7 Alarms.

Brightness and/or temperature alarm.

Two acoustic alarms can be activated in case of unexpected changes in brightness and IR temperature. Simply press the Al.MV or Al.IR buttons respectively to activate or desactivate.
The trip level is +-0.5MV and +-2ºC respectively, it is updated each time the alarm is activated and is displayed in the log line.
This function can be useful for static measurements.
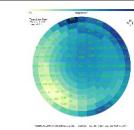
Alarm if forgotten to turn off.

If we forget to turn off the device and keep it in total darkness, the app will emit a periodic acoustic warning.

2.8 Closing the app.

The minimized app continues to run in the background. In this case, its icon remains visible at the top of the phone. Background operation allows us to store data while we use other applications, but once TAS is turned off, the program will try to reconnect, spending some battery.

To completely close the app it is necessary to press the red X located at the top right for two seconds.

3 iOS Acquisition Program.

The TESS-P app for IOS allows you to perform scans, generating the same type of files. When you launch the app, the available TAS devices are displayed.
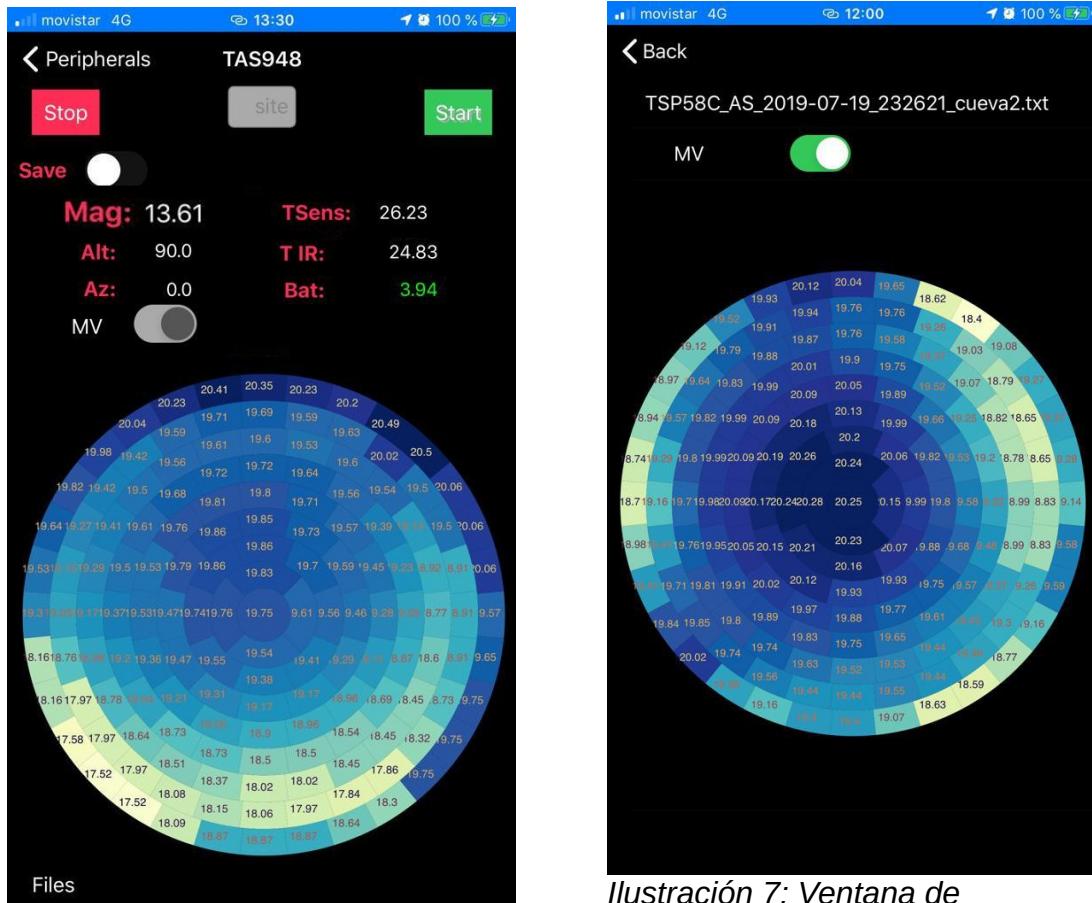
Ilustración 8: Ventana de Adquisición alterminar un barrido.

Ilustración 7: Ventana de presentandocapturas almacenadas. Aparece alpulsar "Files".

To examine previous scans, click Files at the bottom left.

3.1 Perform a scan..

To perform a sweep we will follow the following steps:
- Screw the TAS base to a photographic tripod.
- Adjust the tripod to level it.
- Orient the main body to the north.
- Move the sensor head to the zenith.
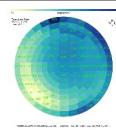
- Lower the switch on the back to the ON position (red dot). The PWR led will light up and the ACT led will flash twice, one short and one long. If the ACT led continues flashing or
nothing flashes, the battery is too low and communication will not be established with the mobile.
- Launch the TESS P app. If everything goes well, in a few seconds the readings will become visible.
- To start a scan, simply press the START button or the button located above the photometer. It is possible to cancel the scan by pressing the STOP button in the app or the photometer button until the ACT LED flashes. In this case, before restarting a new sweep it is necessary to reorient to the north and zenith manually.

The map becomes visible as the scan progresses.

For each sweep, a new file will be created automatically.

The scanning time is variable depending on the sky (5 minutes for skies of magnitude 20, 15 for the darkest skies).
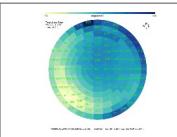
4 Acquisition files.

On Android, we can find the files generated with the file explorer in: *Memoriainterna/Android/data/b4a.tessp/files/*

The content of the text files consists of numbered lines that, in addition to the readings, include date, time and GPS position of the mobile phone.

4.1 Scan file.

The file name begins with "TAS" followed by its identification number
of three characters. It continues with "_AS_" + date + time and ends with an optional tag entered in the site´ field.

Ex.: TAS58C_AS_2019-08-04_003455_colladomed.txt
In this case the file name means:
- TAS58C: Sensor SN = TAS + 3 digits of the internal MAC.
- _AS_: This is an Auto Scan. If the name does not contain "_AS_" it is loose measurements.
- 2019-08-04: Date of the measure.
- 003455: measurement time, 0h 34m 55sg
- colladomed: optional text entered in the "site" field of the app, to identify the place.
Section 6.1 shows the content of an example file.

4.2 Static reading file.

The file name contains the name, day and site field e.g.:

TAS58C_2019-08-04_colladomed.csv.

Section 6.1 shows the content of an example file.

5 Auxiliary programs.

5.1 TasPlot.

This small application allows you to quickly view and compare TAS captures. It can work on Windows, Linux or Mac.
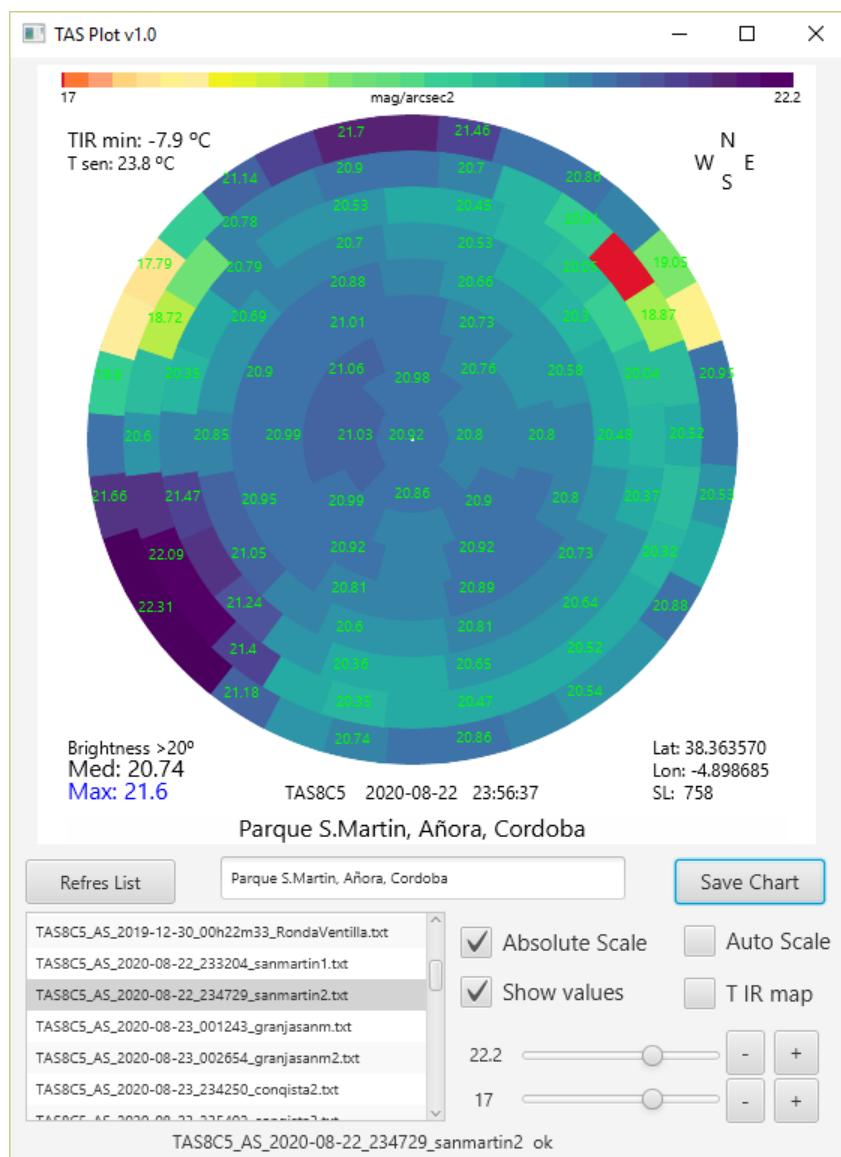
Dibujo 1: Appearance of the TasPlot program.

The map uses the color palette of the NixNox project. The generated maps can be saved in png format, adding a caption.
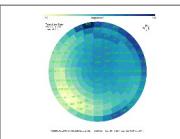
The program does not need installation, it requires having Java 8 32-bit installed. It is available, along with some example files, here: www.observatorioremoto.com/tess/tasplot.zip

Brightness scales.

The adjustment of the measurements to the color palette can be absolute, automatic or manual.

Absolute scale: presents measurements on a fixed brightness scale of 17 to 22.2 magnitudes. This allows you to compare different places at a glance.

Automatic scaling: the color palette automatically adjusts between the maximum and minimum brightness of the measurements contained in that file. Allows maximum contrast to be displayed.

Manual scale: the brightness range to be displayed is adjusted by hand to customize the scale.

The following maps correspond to the same location, before and after turning off the exterior lighting, using the absolute scale.
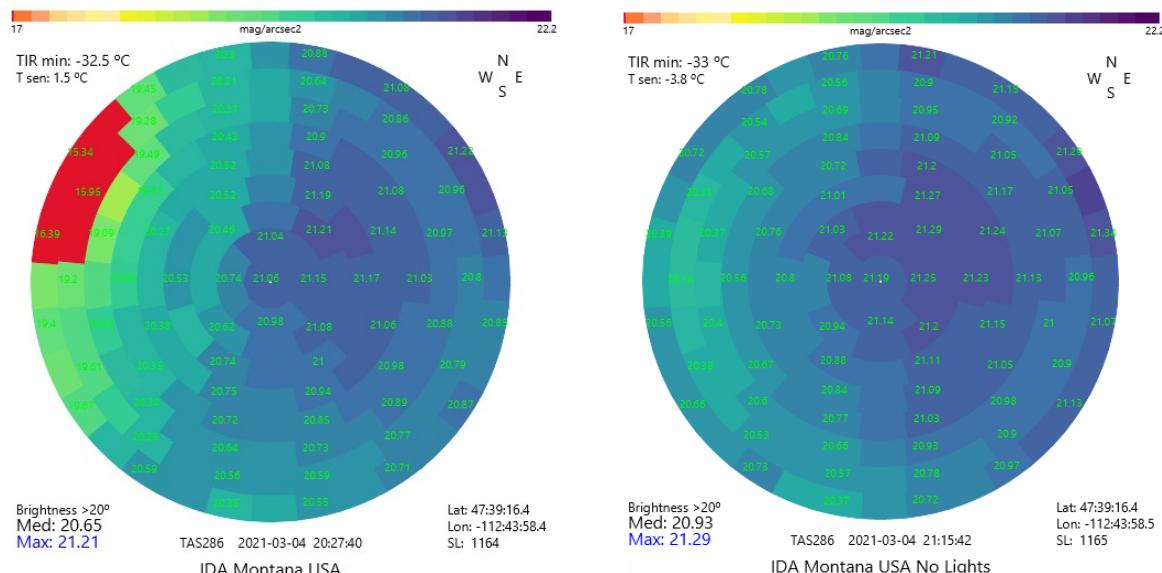
To quickly display the maps, simply press the up and down arrow keys on the keyboard.

Below is a comparison of very diverse sites.
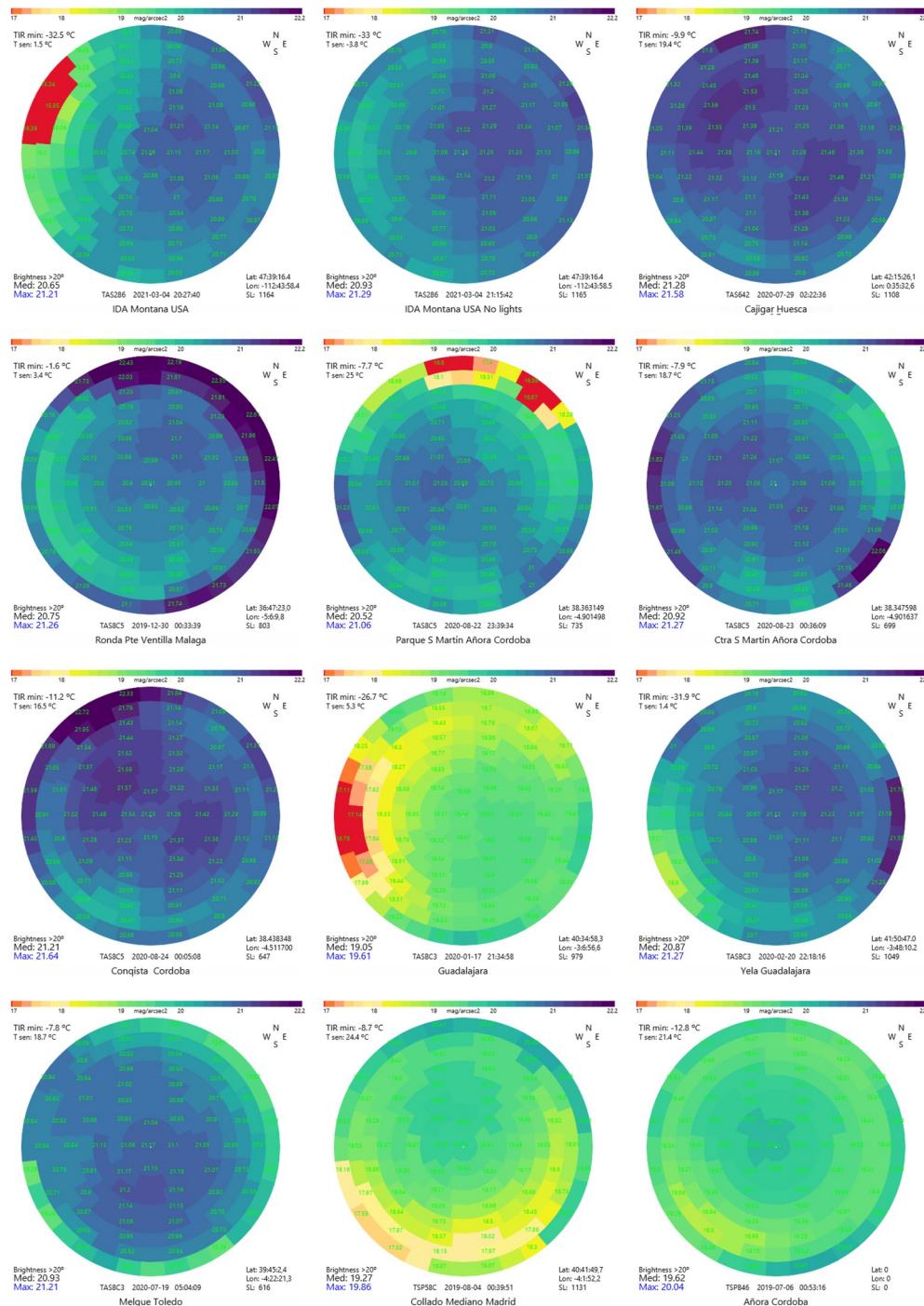
Ilustración 9: Mosaic based on maps of different places, with highly variable quality, using the absolute brightness scale.
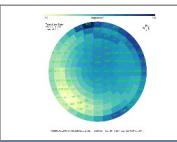
6 ANEXOS

6.1 Ejemplos de ficheros TAS.

We can find the files saved with the Android app with the file explorer in: *Memoria interna/Android/data/b4a.tessp/files/*
There are two types of files, static readings and scanning.

Static readings file.

The file name does not contain the letters AS for Auto Scan. This file has the same format as for TESS-P, with a csv extension. Can be imported into Google Maps to display measurement routes. Clarify that TAS can be damaged by vibrations if a car is bolted to the roof to take routes.

Ej. *TAS889_2021-03-20_prueba.txt*

#	TAS889	ci:20.2	T IR	T Sens	Mag	Hz	Alt	Azi	Lat	Lon	SL	Bat
410	2021-03-20	14:34:41	"0"	"0"	"9.09"	"0"	"0"	"0"	40.425855	-3.556681	707	"3,9"
411	2021-03-20	14:34:42	"0"	"0"	"9"	"30303"	"0"	"0"	40.425855	-3.556681	707	"3,92"
412	2021-03-20	14:34:43	"0"	"0"	"9"	"30303"	"0"	"0"	40.425855	-3.556681	707	"3,9"
413	2021-03-20	14:34:44	"0"	"0"	"9.09"	"27778"	"0"	"0"	40.425855	-3.556681	707	"3,93"
414	2021-03-20	14:34:45	"0"	"0"	"9.15"	"26316"	"0"	"0"	40.425855	-3.556681	707	"3,91"
415	2021-03-20	14:34:46	"0"	"0"	"9.09"	"27778"	"0"	"0"	40.425855	-3.556681	707	"3,93"
416	2021-03-20	14:34:48	"0"	"0"	"9.09"	"27778"	"0"	"0"	40.425855	-3.556681	707	"3,9"
417	2021-03-20	14:34:49	"0"	"0"	"9.12"	"27027"	"0"	"0"	40.425855	-3.556681	707	"3,9"
418	2021-03-20	14:34:50	"0"	"0"	"9.12"	"27027"	"0"	"0"	40.425855	-3.556681	707	"3,91"
419	2021-03-20	14:34:51	"0"	"0"	"9.06"	"28571"	"0"	"0"	40.425855	-3.556681	707	"3,93"
516	2021-03-20	14:36:44	"0"	"0"	"9.12"	"0"	"0"	"0"	40.425855	-3.556681	707	"3,92"
525	2021-03-20	14:36:54	"0"	"0"	"9.11"	"27286"	"0"	"0"	40.425855	-3.556681	707	"3,92"
534	2021-03-20	14:37:04	"0"	"0"	"9.11"	"27199"	"0"	"0"	40.425855	-3.556681	707	"3,91"

Scan file:

Ej *TAS8C5_AS_2020-08-23_001243_granjasanm.txt*

| #	TAS8C5	ci:20.42	T IR	T Sens	Mag	Hz	Alt	Azi	Lat	Lon	SL	Bat
1	2020-08-23	00:12:43	15.01	24.77	20.64	0.82	10	0	38.347593	-4.901636	702	3.84
2	2020-08-23	00:12:46	14.01	24.75	20.43	0.99	10	11	38.347593	-4.901636	702	3.84
3	2020-08-23	00:12:49	13.41	24.73	20.45	0.97	10	22	38.347593	-4.901636	702	3.83
4	2020-08-23	00:12:52	14.01	24.65	20.5	0.93	10	33	38.347593	-4.901636	702	3.83
5	2020-08-23	00:12:55	14.25	24.61	20.53	0.91	10	45	38.347593	-4.901636	702	3.83
6	2020-08-23	00:12:58	14.45	24.57	20.07	1.38	10	56	38.347593	-4.901636	702	3.84
7	2020-08-23	00:12:59	13.91	24.55	19.83	1.72	10	67	38.347593	-4.901636	702	3.82
8	2020-08-23	00:13:01	13.99	24.53	19.98	1.51	10	78	38.347593	-4.901636	702	3.85
9	2020-08-23	00:13:04	14.11	24.51	20.21	1.21	10	90	38.347593	-4.901636	702	3.83
10	2020-08-23	00:13:06	13.55	24.47	20.37	1.05	10	101	38.347593	-4.901636	702	3.83
11	2020-08-23	00:13:09	12.51	24.45	20.67	0.79	10	112	38.347593	-4.901636	702	3.82
12	2020-08-23	00:13:13	12.91	24.37	21.33	0.43	10	123	38.347593	-4.901636	702	3.83
13	2020-08-23	00:13:20	13.55	24.33	21.9	0.26	10	135	38.347593	-4.901636	702	3.82
14	2020-08-23	00:13:28	13.05	24.27	21.84	0.27	10	146	38.347593	-4.901636	702	3.82
15	2020-08-23	00:13:33	13.59	24.25	21.38	0.41	10	157	38.347593	-4.901636	702	3.84
16	2020-08-23	00:13:36	15.55	24.21	20.97	0.6	10	168	38.347593	-4.901636	702	3.83
17	2020-08-23	00:13:39	17.15	24.17	20.76	0.73	10	180	38.347593	-4.901636	702	3.82
18	2020-08-23	00:13:42	16.95	24.17	20.74	0.75	10	191	38.347593	-4.901636	702	3.82
19	2020-08-23	00:13:45	17.27	24.11	20.82	0.69	10	202	38.347593	-4.901636	702	3.84
20	2020-08-23	00:13:48	17.53	24.07	21	0.59	10	213	38.347593	-4.901636	702	3.82
21	2020-08-23	00:13:53	18.05	24.07	21.43	0.39	10	225	38.347593	-4.901636	702	3.82
22	2020-08-23	00:13:58	17.53	24.03	21.46	0.38	10	236	38.347593	-4.901636	702	3.83
23	2020-08-23	00:14:04	17.59	24.01	21.56	0.35	10	247	38.347593	-4.901636	702	3.82
24	2020-08-23	00:14:10	17.67	23.95	21.71	0.31	10	258	38.347593	-4.901636	702	3.83
25	2020-08-23	00:14:16	17.67	23.89	21.63	0.33	10	270	38.347593	-4.901636	702	3.83
26	2020-08-23	00:14:23	17.99	23.87	21.81	0.28	10	281	38.347593	-4.901636	702	3.83
27	2020-08-23	00:14:30	18.65	23.83	21.74	0.3	10	292	38.347593	-4.901636	702	3.81
28	2020-08-23	00:14:35	18.25	23.79	21.32	0.44	10	303	38.347593	-4.901636	702	3.82
29	2020-08-23	00:14:39	18.15	23.79	21.2	0.49	10	315	38.347593	-4.901636	702	3.82
30	2020-08-23	00:14:43	17.75	23.73	21.09	0.54	10	326	38.347593	-4.901636	702	3.82
31	2020-08-23	00:14:46	16.53	23.73	20.85	0.67	10	337	38.347593	-4.901636	702	3.83
32	2020-08-23	00:14:49	15.55	23.73	20.87	0.66	10	348	38.347593	-4.901636	702	3.82
33	2020-08-23	00:14:52	8.61	23.65	20.38	1.03	20	0	38.347593	-4.901636	702	3.82
34	2020-08-23	00:14:55	8.29	23.65	20.27	1.15	20	12	38.347593	-4.901636	702	3.83
35	2020-08-23	00:14:57	8.51	23.61	20.24	1.18	20	25	38.347593	-4.901636	702	3.81
36	2020-08-23	00:15:00	9.01	23.61	20.21	1.22	20	38	38.347593	-4.901636	702	3.81
37	2020-08-23	00:15:02	9.25	23.59	20.01	1.45	20	51	38.347593	-4.901636	702	3.81
38	2020-08-23	00:15:04	9.01	23.61	19.83	1.72	20	64	38.347593	-4.901636	702	3.76
39	2020-08-23	00:15:06	8.55	23.57	19.92	1.58	20	77	38.347593	-4.901636	702	3.81
40	2020-08-23	00:15:08	8.75	23.53	20.14	1.3	20	90	38.347593	-4.901636	702	3.81
41	2020-08-23	00:15:11	9.15	23.51	20.37	1.05	20	102	38.347593	-4.901636	702	3.82
42	2020-08-23	00:15:14	9.29	23.47	20.67	0.79	20	115	38.347593	-4.901636	702	3.81
43	2020-08-23	00:15:18	10.23	23.41	21.23	0.47	20	128	38.347593	-4.901636	702	3.81
44	2020-08-23	00:15:23	10.19	23.39	21.29	0.45	20	141	38.347593	-4.901636	702	3.8
45	2020-08-23	00:15:26	9.43	23.35	20.94	0.62	20	154	38.347593	-4.901636	702	3.81
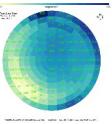
46	2020-08-23	00:15:28	10.95	23.33	20.58	0.86	20	167	38.347593	-4.901636	702	3.81
47	2020-08-23	00:15:31	11.81	23.29	20.52	0.91	20	180	38.347593	-4.901636	702	3.81
48	2020-08-23	00:15:34	10.61	23.29	20.47	0.95	20	192	38.347593	-4.901636	702	3.8
49	2020-08-23	00:15:37	11.21	23.29	20.41	1.01	20	205	38.347593	-4.901636	702	3.81
50	2020-08-23	00:15:39	11.67	23.19	20.75	0.74	20	218	38.347593	-4.901636	702	3.82
51	2020-08-23	00:15:43	12.05	23.19	20.98	0.6	20	231	38.347593	-4.901636	702	3.81
52	2020-08-23	00:15:46	12.27	23.19	21.05	0.56	20	244	38.347593	-4.901636	702	3.81
53	2020-08-23	00:15:50	12.03	23.15	21.25	0.46	20	257	38.347593	-4.901636	702	3.83
54	2020-08-23	00:15:54	12.67	23.15	21.13	0.52	20	270	38.347593	-4.901636	702	3.79
55	2020-08-23	00:15:59	12.73	23.11	21.42	0.4	20	282	38.347593	-4.901636	702	3.81
56	2020-08-23	00:16:03	12.81	23.11	21.15	0.51	20	295	38.347593	-4.901636	702	3.81
57	2020-08-23	00:16:06	12.51	23.07	20.91	0.63	20	308	38.347593	-4.901636	702	3.81
58	2020-08-23	00:16:10	11.45	23.03	20.93	0.63	20	321	38.347593	-4.901636	702	3.8
59	2020-08-23	00:16:12	10.69	23.01	20.6	0.84	20	334	38.347593	-4.901636	702	3.8
60	2020-08-23	00:16:14	9.35	22.99	20.54	0.89	20	347	38.347593	-4.901636	702	3.8
61	2020-08-23	00:16:18	2.17	22.95	20.65	0.81	30	0	38.347593	-4.901636	702	3.78
62	2020-08-23	00:16:20	1.97	22.93	20.57	0.87	30	15	38.347593	-4.901636	702	3.8
63	2020-08-23	00:16:23	2.13	22.91	20.44	0.98	30	30	38.347593	-4.901636	702	3.79
64	2020-08-23	00:16:26	2.77	22.87	20.3	1.11	30	45	38.347593	-4.901636	702	3.8
65	2020-08-23	00:16:29	2.31	22.85	20.27	1.15	30	60	38.347593	-4.901636	702	3.8
66	2020-08-23	00:16:31	2.13	22.79	20.34	1.08	30	75	38.347593	-4.901636	702	3.8
67	2020-08-23	00:16:34	2.35	22.79	20.5	0.93	30	90	38.347593	-4.901636	702	3.79
68	2020-08-23	00:16:37	2.65	22.79	20.68	0.79	30	105	38.347593	-4.901636	702	3.8
69	2020-08-23	00:16:40	4.23	22.71	20.85	0.67	30	120	38.347593	-4.901636	702	3.8
70	2020-08-23	00:16:43	5.49	22.69	20.99	0.59	30	135	38.347593	-4.901636	702	3.79
71	2020-08-23	00:16:46	4.53	22.65	20.88	0.66	30	150	38.347593	-4.901636	702	3.8
72	2020-08-23	00:16:49	3.81	22.65	20.78	0.71	30	165	38.347593	-4.901636	702	3.78
73	2020-08-23	00:16:52	4.49	22.59	20.69	0.78	30	180	38.347593	-4.901636	702	3.79
74	2020-08-23	00:16:55	4.71	22.57	20.45	0.97	30	195	38.347593	-4.901636	702	3.79
75	2020-08-23	00:16:58	4.49	22.55	20.51	0.92	30	210	38.347593	-4.901636	702	3.8
76	2020-08-23	00:17:02	5.45	22.53	20.78	0.72	30	225	38.347593	-4.901636	702	3.8
77	2020-08-23	00:17:05	5.51	22.49	20.91	0.63	30	240	38.347593	-4.901636	702	3.8
78	2020-08-23	00:17:09	5.49	22.47	21.01	0.58	30	255	38.347593	-4.901636	702	3.81
79	2020-08-23	00:17:12	6.03	22.43	21.01	0.58	30	270	38.347593	-4.901636	702	3.78
80	2020-08-23	00:17:16	6.39	22.43	21.07	0.55	30	285	38.347593	-4.901636	702	3.79
81	2020-08-23	00:17:19	6.29	22.39	20.9	0.64	30	300	38.347593	-4.901636	702	3.79
82	2020-08-23	00:17:22	4.97	22.41	20.88	0.66	30	315	38.347593	-4.901636	702	3.79
83	2020-08-23	00:17:25	4.11	22.37	20.82	0.69	30	330	38.347593	-4.901636	702	3.8
84	2020-08-23	00:17:27	2.47	22.31	20.75	0.74	30	345	38.347593	-4.901636	702	3.8
85	2020-08-23	00:17:32	-1.87	22.29	20.89	0.65	40	0	38.347593	-4.901636	702	3.79
86	2020-08-23	00:17:35	-2.03	22.23	20.77	0.72	40	18	38.347593	-4.901636	702	3.8
87	2020-08-23	00:17:38	-2.31	22.17	20.62	0.83	40	36	38.347593	-4.901636	702	3.79
88	2020-08-23	00:17:42	-2.03	22.17	20.58	0.86	40	54	38.347593	-4.901636	702	3.8
89	2020-08-23	00:17:46	-1.91	22.13	20.65	0.81	40	72	38.347593	-4.901636	702	3.79
90	2020-08-23	00:17:50	-2.23	22.09	20.77	0.72	40	90	38.347593	-4.901636	702	3.8
91	2020-08-23	00:17:53	-1.79	22.07	20.9	0.64	40	108	38.347593	-4.901636	702	3.8
92	2020-08-23	00:17:56	-0.89	22.01	20.98	0.6	40	126	38.347593	-4.901636	702	3.79
93	2020-08-23	00:17:59	-0.53	21.99	20.99	0.59	40	144	38.347593	-4.901636	702	3.79
94	2020-08-23	00:18:03	-1.39	21.95	20.98	0.6	40	162	38.347593	-4.901636	702	3.79
95	2020-08-23	00:18:06	-1.29	21.91	20.81	0.7	40	180	38.347593	-4.901636	702	3.79
96	2020-08-23	00:18:09	-1.21	21.91	20.54	0.89	40	198	38.347593	-4.901636	702	3.79
97	2020-08-23	00:18:13	-0.65	21.87	20.8	0.71	40	216	38.347593	-4.901636	702	3.79
98	2020-08-23	00:18:17	-0.81	21.85	21.01	0.58	40	234	38.347593	-4.901636	702	3.78
99	2020-08-23	00:18:20	-0.57	21.83	21.09	0.54	40	252	38.347593	-4.901636	702	3.79
100	2020-08-23	00:18:24	-0.53	21.77	21.11	0.53	40	270	38.347593	-4.901636	702	3.78
101	2020-08-23	00:18:28	-0.27	21.79	21.1	0.54	40	288	38.347593	-4.901636	702	3.8
102	2020-08-23	00:18:31	-1.35	21.75	21.06	0.56	40	306	38.347593	-4.901636	702	3.78
103	2020-08-23	00:18:35	-1.17	21.73	21.02	0.57	40	324	38.347593	-4.901636	702	3.78
104	2020-08-23	00:18:38	-1.87	21.69	20.98	0.6	40	342	38.347593	-4.901636	702	3.78
105	2020-08-23	00:18:43	-4.57	21.67	21.05	0.56	50	0	38.347593	-4.901636	702	3.78
106	2020-08-23	00:18:46	-4.69	21.63	20.89	0.65	50	22	38.347593	-4.901636	702	3.78
107	2020-08-23	00:18:51	-4.65	21.59	20.76	0.73	50	45	38.347593	-4.901636	702	3.79
108	2020-08-23	00:18:55	-4.33	21.55	20.84	0.68	50	67	38.347593	-4.901636	702	3.76
109	2020-08-23	00:18:58	-4.53	21.49	20.96	0.61	50	90	38.347593	-4.901636	702	3.78
110	2020-08-23	00:19:02	-4.53	21.49	21.06	0.55	50	112	38.347593	-4.901636	702	3.78
111	2020-08-23	00:19:06	-4.25	21.45	21.1	0.53	50	135	38.347593	-4.901636	702	3.78
112	2020-08-23	00:19:09	-4.01	21.41	21.1	0.53	50	157	38.347593	-4.901636	702	3.78
113	2020-08-23	00:19:13	-3.91	21.41	21.02	0.57	50	180	38.347593	-4.901636	702	3.77
114	2020-08-23	00:19:16	-3.43	21.39	20.88	0.66	50	202	38.347593	-4.901636	702	3.78
115	2020-08-23	00:19:19	-3.75	21.37	21.02	0.57	50	225	38.347593	-4.901636	702	3.78
116	2020-08-23	00:19:23	-4.21	21.31	21.14	0.51	50	247	38.347593	-4.901636	702	3.78
117	2020-08-23	00:19:27	-3.83	21.31	21.21	0.48	50	270	38.347593	-4.901636	702	3.78
118	2020-08-23	00:19:31	-3.95	21.29	21.22	0.48	50	292	38.347593	-4.901636	702	3.78
119	2020-08-23	00:19:35	-4.29	21.27	21.19	0.49	50	315	38.347593	-4.901636	702	3.77
120	2020-08-23	00:19:39	-3.91	21.25	21.14	0.52	50	337	38.347593	-4.901636	702	3.77
121	2020-08-23	00:19:45	-6.01	21.17	21.13	0.52	60	0	38.347593	-4.901636	702	3.78
122	2020-08-23	00:19:50	-6.05	21.17	20.93	0.62	60	30	38.347593	-4.901636	702	3.78
123	2020-08-23	00:19:55	-6.19	21.15	20.91	0.64	60	60	38.347593	-4.901636	702	3.77
124	2020-08-23	00:20:00	-6.27	21.07	21.07	0.55	60	90	38.347593	-4.901636	702	3.77
125	2020-08-23	00:20:06	-5.77	21.05	21.16	0.51	60	120	38.347593	-4.901636	702	3.78
126	2020-08-23	00:20:10	-5.43	20.99	21.16	0.51	60	150	38.347593	-4.901636	702	3.78
127	2020-08-23	00:20:15	-5.89	20.97	21.06	0.55	60	180	38.347593	-4.901636	702	3.77
128	2020-08-23	00:20:20	-5.23	20.95	20.98	0.59	60	210	38.347593	-4.901636	702	3.76
129	2020-08-23	00:20:26	-5.73	20.93	21.13	0.52	60	240	38.347593	-4.901636	702	3.77
130	2020-08-23	00:20:30	-5.55	20.91	21.26	0.46	60	270	38.347593	-4.901636	702	3.76
131	2020-08-23	00:20:35	-5.69	20.83	21.28	0.45	60	300	38.347593	-4.901636	702	3.77
132	2020-08-23	00:20:39	-5.85	20.87	21.24	0.47	60	330	38.347593	-4.901636	702	3.77
133	2020-08-23	00:20:45	-7.05	20.81	21.14	0.52	70	0	38.347593	-4.901636	702	3.78
134	2020-08-23	00:20:50	-6.97	20.75	20.93	0.62	70	45	38.347593	-4.901636	702	3.77
135	2020-08-23	00:20:55	-7.05	20.73	21.09	0.54	70	90	38.347593	-4.901636	702	3.76
136	2020-08-23	00:21:01	-6.77	20.71	21.16	0.5	70	135	38.347593	-4.901636	702	3.76
137	2020-08-23	00:21:07	-6.69	20.67	21.02	0.58	70	180	38.347593	-4.901636	702	3.77
138	2020-08-23	00:21:12	-6.63	20.61	21.06	0.56	70	225	38.347593	-4.901636	702	3.76
139	2020-08-23	00:21:18	-6.73	20.57	21.23	0.48	70	270	38.347593	-4.901636	702	3.76
140	2020-08-23	00:21:25	-6.89	20.57	21.26	0.46	70	315	38.347593	-4.901636	702	3.77
141	2020-08-23	00:21:30	-7.61	20.51	21.09	0.54	80	0	38.347593	-4.901636	702	3.78
142	2020-08-23	00:21:37	-7.69	20.47	21.03	0.57	80	90	38.347593	-4.901636	702	3.76
143	2020-08-23	00:21:44	-7.61	20.45	21	0.58	80	180	38.347593	-4.901636	702	3.76
144	2020-08-23	00:21:52	-7.91	20.37	21.11	0.53	80	270	38.347593	-4.901636	702	3.78
145	2020-08-23	00:21:59	-8.33	20.35	21	0.58	90	0	38.347593	-4.901636	702	3.75

6.2 Capture and adjustments by serial port.

It is possible to receive TAS readings and perform some operations via a USB cable and any serial terminal at 9600 baud. With the cable connected it is not possible to perform a sweep, only static measurements.

Data Capture.

With a 9600 baud serial terminal (e.g. Termite, from Compuphase), we can receive the readings periodically every second. The following is an example:

{"seq":810, "rev":3, "name":"TASF84", "ci":20.50, "freq":2028.40, "mag":12.23, "tamb":22.17, "tsky":22.69, "vbat":4.06, "alt":0.00, "azi":0.00, "ala":13.59, "azm":300.00}

The string, in json format, contains all the reads. It is the same string that is sent by BT to the app. It can be easily interpreted. It contains a sequence number, sensor name, instrument constant, raw frequency, calibrated brightness, temperatures, battery voltage, the pointing direction in the sweep (alt and azi) and the pointing direction reported by the accelerometer-magnetometer (ala and azm).

Calibration adjustment.

The device is delivered calibrated with a reference from the LICA laboratory (UCM). It is possible to know the version and calibration with a 9600 serial terminal, sending a question mark: ? we will obtain the following:
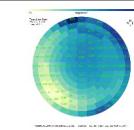
Compiled Dec 13 2022 09:56:19
MAC: 200803A7DBCC
TAS SN: TAS200
Actual CI: 20.41

Motor constans: KV1600   KH1600   TH1   TV1
Motor USB external comands:
Vertical: v10 -> 10deg down, v-10 -> 10deg up
Horizontal: h10 -> 10deg CW,   h-10 -> 10deg CCW

To change the calibration, simply send a string of the type through the terminal

CI2045 followed by a return. The answer will be:

New CI: 20.45

Write EEPROM done!

Motor movement.

It is possible to move the two motors from the terminal, within the limits imposed by having a cable connected to TAS.

The letter of the motor, vertical or horizontal, is sent followed by the degrees to move.

The command ? Indicates how to do it:

Motor USB external comands:

*Vertical: **v10** -> 10º down, **v-10** -> 10º up*

*Horizontal: **h10** -> 10º CW,   **h-10** -> 10º CCW*
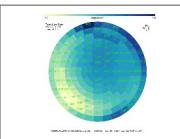
7 GLOSARIO

Término	Descripción
TESS	Telescope Encoder & Sky Sensor.
TAS	TESS Auto Scan.
MQTT	MQ Telemetry Transport. (Protocolo IoT, internet of things.)
LICA	Laboratorio de Instrumentación Científica Avanzada.
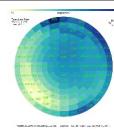
8 Troubleshooting.

	Problem	Solution
1	When the power supply is connected, the PWR LED lights up but the **battery does not charge**.	Activate the power switch, lowering the switch to the red point.
2	The app sees TAS but does not connect.	Battery very low, recharge.
3	The **app detects TAS but does not connect**.	Deactivate the BT on the mobile for a few seconds.
4	You cannot see the TAS from the app..	Get closer than one meter. Check that TAS does not appear as a linked device.
5	**Connection is lost**.	Bring the phone closer than 2m.
6	A **beep sounds**.	The brightness or temperature **alarm has been activated**. Deactivate it.
7	The map or the texts in the app are cut off.	Try other screen settings on mobile, such as text size, and display.
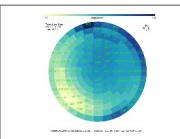
9 BIBLIOGRAPHY AND REFERENCES

Addresses of interest:

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