



EXPLORE THE CLIMATE

Multiband photometer CE318-T

User's Manual (rev. May 2024)



www.cimel.fr

Dear Customer and users,

You have just purchased a Cimel photometer CE318-T and we would like to thank you. The CE318-T is the most recent model of the well-known Cimel CE318 photometer. This model is available and recommended to all users who intend to operate it in a network, such as AERONET, CARSNET, or SONET.

We have placed in this instrument all our passion and know-how so that it best meets your needs. Innovation and performance: we designed it to be always easy to use.

In the line of Cimel products, you will also find a wide range of remote sensing instruments like the Cimel LiDAR CE710 and CE376 automatic aerosol LiDARs.

Of course, in an ongoing effort to satisfy your demands as best as possible concerning our products, our after-sales service department is at your disposal and ready to listen and answer all your questions and suggestions (contact information at the end of this booklet).

Please visit our website at www.cimel.fr: you will find all our products, as well as additional and useful information.

As part of our commitment to constantly improve our products, we reserve the right to make changes to their technical, functional, and/or esthetical properties in line with their technological development.

Caution: Before installing and using your instrument, please read this guide carefully, which will help you to quickly familiarize yourself with its operation. Please read carefully the preventive maintenance that has to be done weekly and yearly on the CE318-T.

Table of Contents

| | | |
|----------|---|-----------|
| 1 | Product overview..... | 4 |
| 1.1. | Presentation..... | 4 |
| 1.2. | System components quick description | 5 |
| 1.3. | Sensor head types | 13 |
| 1.4. | Data transmission | 15 |
| 2 | Installation | 15 |
| 2.1. | Installation site recommendations | 15 |
| 2.2. | Hardware installation and setup | 15 |
| 2.2.1. | Needed tools | 16 |
| 2.2.2. | Tripod mounting..... | 16 |
| 2.2.3. | Case mounting | 18 |
| 2.2.4. | Robot and sensor head mounting | 19 |
| 2.2.5. | Optional pyranometer global radiation sensor | 28 |
| 2.3. | Communication protocol installation and setup | 29 |
| 2.3.1. | RS232 communication | 29 |
| 2.3.2. | USB communication | 30 |
| 2.3.3. | Communication over GPRS | 31 |
| 2.3.4. | Satellite transmission installation and configuration..... | 35 |
| 2.4. | Control Unit firmware update..... | 42 |
| 3 | Control Unit navigation menu | 42 |
| 3.1. | Capacitive key functions | 42 |
| 3.2. | Switch on / Switch off / Standby | 42 |
| 3.3. | Menu description..... | 43 |
| 3.4. | SCENARIOS..... | 43 |
| 3.5. | MEASURES..... | 45 |
| 3.6. | MEMORY..... | 45 |
| 3.7. | SETTINGS..... | 45 |
| 3.8. | DATE | 47 |
| 3.9. | CIMEL..... | 48 |
| 3.10. | INFO | 49 |
| 4 | General description of the scenarios and their sequence..... | 49 |
| 4.1. | Scenario description and sequencing..... | 49 |
| 4.2. | Group of measurement scenarios | 61 |
| 4.3. | Day and night measurement schedule in Auto mode | 61 |
| 4.3.1. | Standard (CE318-TS9) and polarized (CE318-TP9)..... | 61 |
| 4.3.2. | BRDF (CE318-TU9) and BRDF 12 filters (CE318-TU12) | 63 |
| 4.3.3. | SEAPRISM (CE318-TV12)..... | 64 |
| 4.3.4. | Polarized (CE318-TP9) | 64 |
| 4.4. | Execution time of scenario | 65 |
| 5 | On-site maintenance | 66 |
| 5.1. | Weekly check preventive maintenance | 66 |
| 5.2. | Corrective maintenance | 67 |
| 5.2.1. | Solar panel and wet sensor replacement..... | 67 |
| 5.2.2. | Robot leveling adjustment..... | 69 |
| 5.2.3. | Flash memory formatting..... | 70 |
| 6 | Factory calibration and maintenance | 71 |

| | | |
|-----------|---|-----------|
| 6.1. | Sensor head calibration and maintenance | 71 |
| 6.1.1. | Calibration | 71 |
| 6.1.2. | Maintenance | 71 |
| 6.2. | Robot maintenance..... | 72 |
| 7 | Troubleshooting | 73 |
| 7.1. | Communication and data transfer is down | 73 |
| 7.1.1. | Using serial port transfer protocol | 73 |
| 7.1.2. | Using satellite transmitter | 73 |
| 7.2. | Robot errors..... | 74 |
| 7.3. | Battery low..... | 75 |
| 7.4. | GPRS – communication errors..... | 75 |
| 7.4.1. | GPRS errors | 76 |
| 7.4.2. | FTP communication errors | 76 |
| 7.4.3. | HTTP(S) communication errors..... | 77 |
| 8 | Frequently Asked Questions (FAQ)..... | 77 |
| 9 | Technical specifications | 79 |
| 9.1. | General..... | 79 |
| 9.2. | Dimensional drawings..... | 80 |
| 10 | After-Sales Service and Customer Relations..... | 88 |
| 11 | Annexes | 89 |
| 11.1. | Packing List | 89 |
| 11.2. | AERONET network (FAQ) | 90 |
| 11.2.1. | What is the AERONET network? | 90 |
| 11.2.2. | How to enter it? | 91 |
| 11.2.3. | What to do when there is a “Bad sun tracking”? | 91 |
| 11.2.4. | What to do when there is an “InGaAs / silicon discrepancy”? | 91 |
| 11.2.5. | What to do when there is a “High dark current”? | 92 |
| 11.2.6. | What to do when there is constant humidity? | 92 |
| 11.2.7. | What to do with a dissymmetric Almucantar? | 93 |

1 Product overview

1.1. *Presentation*

This high-precision photometer for observing networks measures the optical properties of the atmosphere, especially by measuring on one hand, the sun and moon irradiance and on the other hand the sea, soil, and sky radiance. It provides the quantification and physical-optical characterizations of the aerosols.

Due to its very low power consumption thanks to the MicroAmps® technology, its self-powered system, and its rugged design, the CE318-T fully meets the operational requirements of continuous monitoring in terms of reliability, long lifetime, and very low maintenance cost.

The CE318-T photometer technology is constantly enhanced to match the new technological challenges for climate observation and monitoring. Cimel's photometers are the benchmark devices for most aerosol observing networks and more specifically for the international federation of AERONET.

The large range of parameters that are derived and calculated from the measurements and the atmospheric physics equations make the CE318-T photometer a worldwide benchmark device for the following applications:

- Characterization and quantification of aerosols
- Satellite calibration of aerosol measurements
- Detection of volcanic ashes plumes in real time
- Determination of Aerosol Optical Depth
- Determination of fine mode and coarse mode AODs
- Determination of the optical properties of the atmosphere for satellite imaging
- Determination of the ocean's color
- Determination of the amount of precipitable water vapor
- Air quality monitoring
- Volume size distribution
- Nature of aerosols

1.2. System components quick description

The photometer system is delivered with:

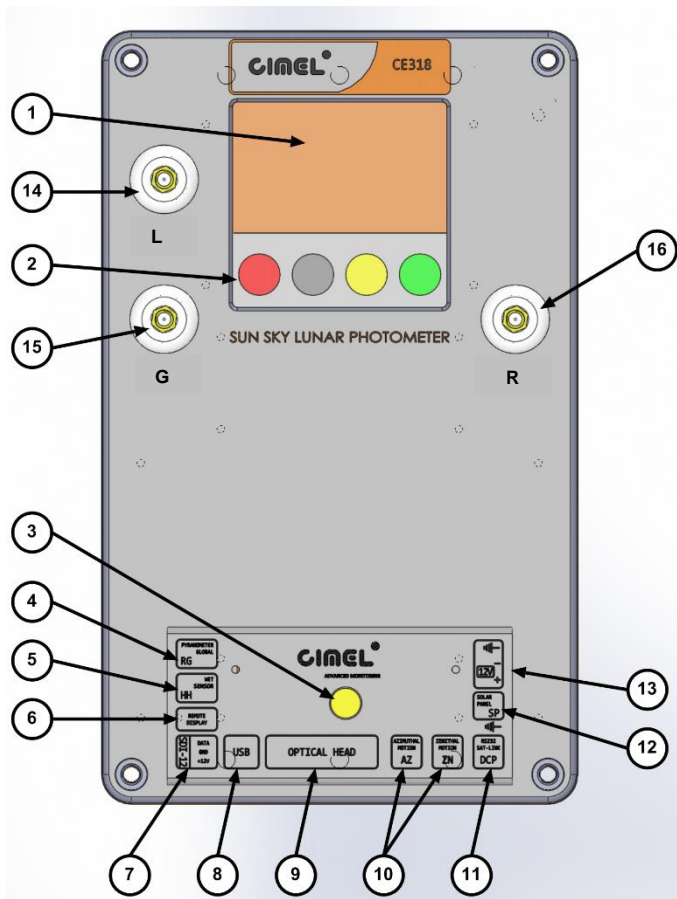
1. Control Unit (CU)

The Control Unit is the component that receives all the data acquired by the optical head and it is used as the user interface to parameterize the whole system running.

The CU can transmit the data using different communication protocols ([see Chapter 1.4 for detailed information](#)).

The CU gets four keys, a yellow push button, and a screen display that enables the users to navigate through the menus.

The features and the menus are described more precisely in **Chapter 3**.



User interface:

- 1: Graphic display.
- 2: Capacitive keys.
- 3: Mechanical push button.

Removable terminal block:

- 4: Pyranometer.*
- 5: Wet sensor.
- 6: Remote display.
- 7: SDI12.
- 8: USB.
- 9: Sensor head.
- 10: Robot azimuth and zenith motion.
- 11: DCP / Serial communication.
- 12: Solar panel.
- 13: External battery.

Other:

- 14: GPS antenna.
- 15: GSM antenna.
- 16: Short-range radio antenna.**

* Refer to chapter 2.2.5 "Optional pyranometer global radiation sensor"

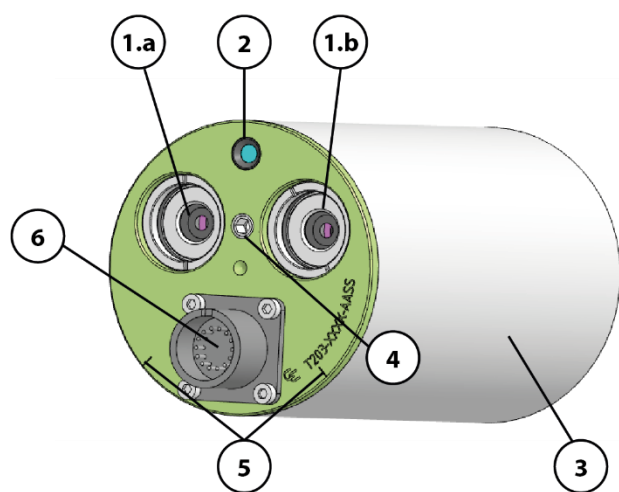
** Short-range radio has been canceled.

2. Sensor head and collimator

a. The sensor head

The sensor head measures the received signal from the sun, sky, soil, or sea. Then it is sent and recorded to the CU.

Detectors can be either silicon or InGaAs detectors used for near-infrared wavelengths.



1: Front plate lenses and optical chambers entrance (a: Silicon / b: InGaAs)

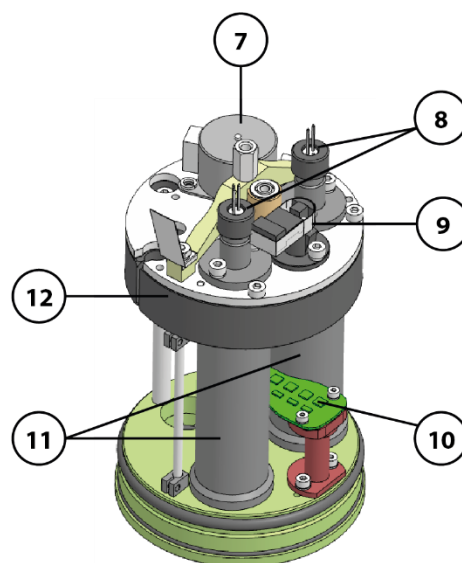
2: 4-quadrant detector lens

3: Cover

4: Threaded hole for collimator

5: Positioning notches

6: Head sensor cord connector



7: Step by step motor

8: Detectors

9: Filter wheel detector

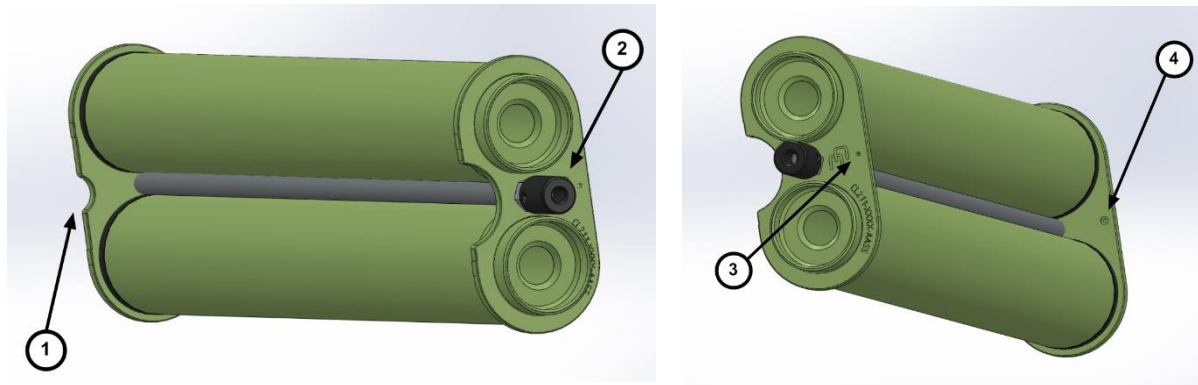
10: 4-quadrant

11: Optical chambers

12: Filter wheel carter

b. Collimator

The collimator is a component that enables the light to be guided correctly to the sensor head outside lenses. The collimator helps to reduce the stray light.

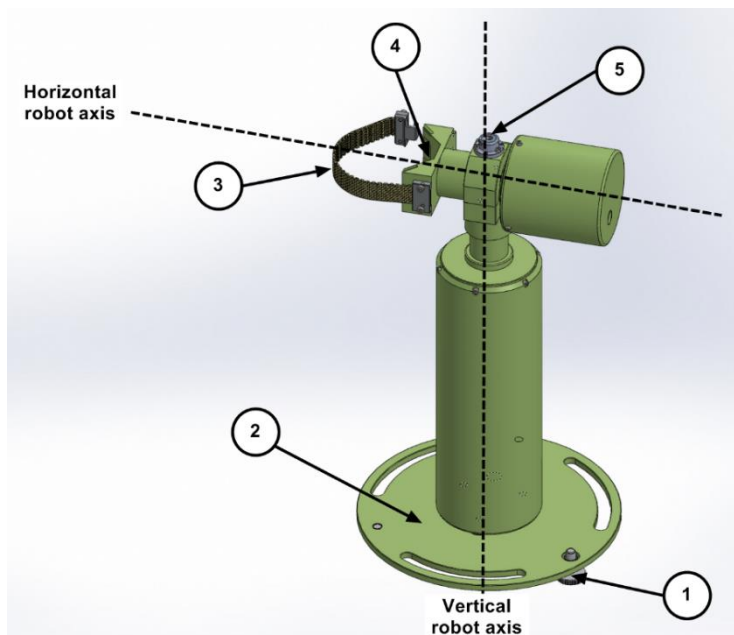


1: notch 2: tightening screw 3: alignment hole 4: spot

3. Robot

The robot is the component to which the sensor head is attached. Its mechanical design enables it to point in whole directions of the sky on the azimuthal and polar (zenith) angles with a very high accuracy.

It is controlled through 2 cables (with RJ11 connectors), one for each axis.

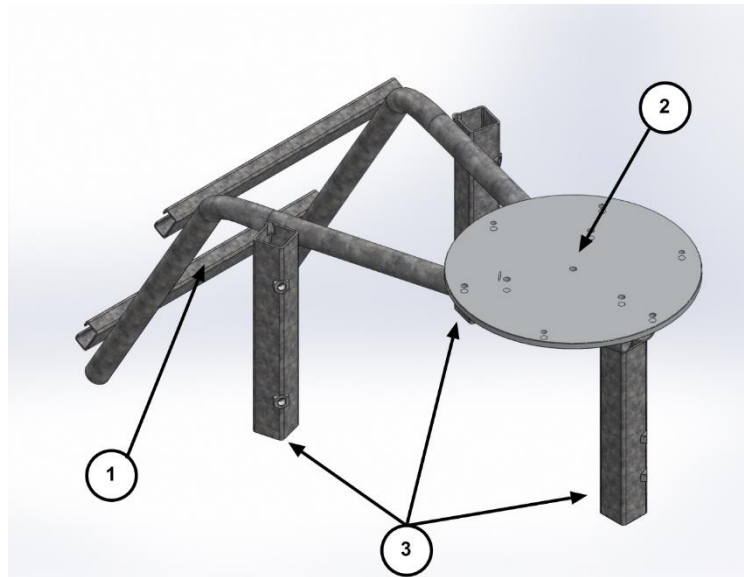


1: adjustment wheel (X2)
2: robot base
3: strap
4: V-shaped part and positioning notches
5: spirit level

4. Tripod and tray

The tripod is the supplied infrastructure where the protection case and the robot are fixed and that enables the whole system to be stably fixed on the ground.

The tray is a part fixed horizontally on the tripod and where the robot will be fixed.



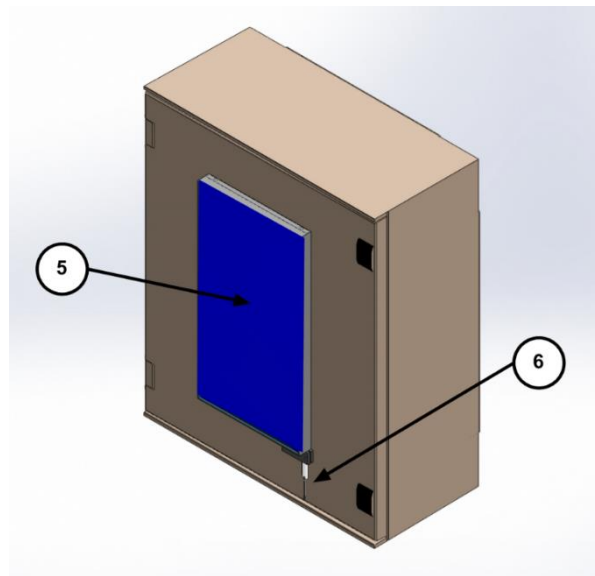
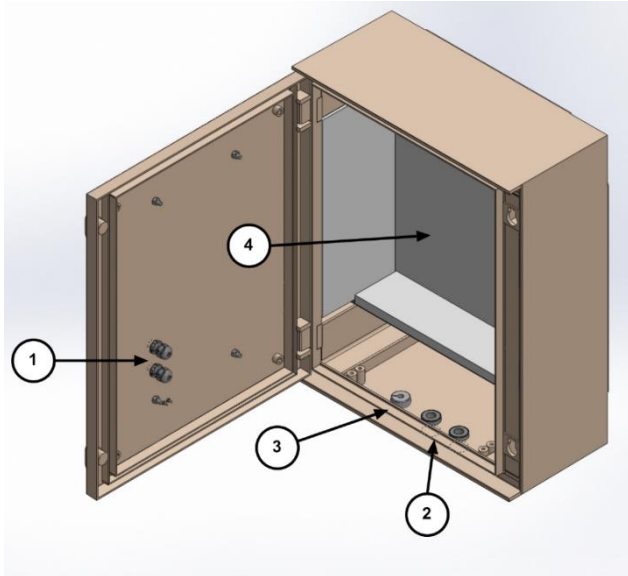
1: emplacement for the protection case

2: tray

3: tripod feet

5. Protection case with solar panel

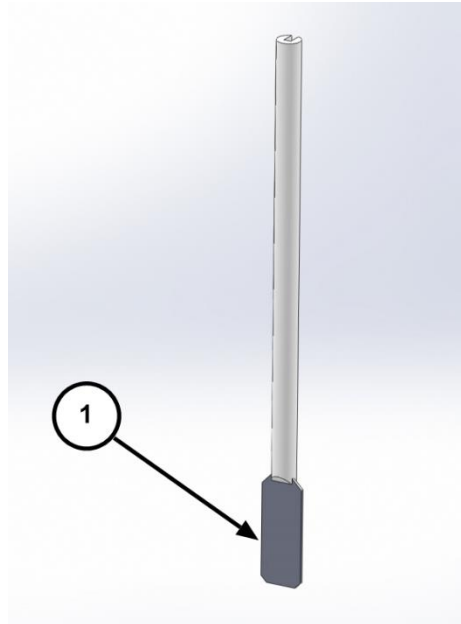
In order to isolate the CU and the batteries from external conditions they must be placed inside the weatherproof case. The solar panel that powers the system is incorporated in the case. The output plug of the solar panel is a RJ11 connector.



- 1: Cable gland. The wet sensor and solar panel wires will go through.
- 2: Cable gland. The robot and computer wires will go through
- 3: Cap. The sensor head cord will go through
- 4: Foam
- 5: Solar Panel
- 6: Wet sensor

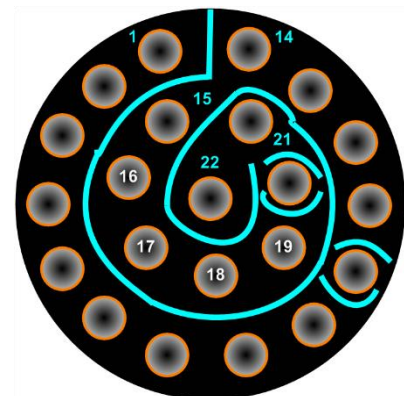
6. Wet sensor

The wet sensor detects rain to stop measurements and protect the sensor head from water when it is raining. The output plug of the sensor is an RJ11 connector. The standard length of the wire is 3m.



7. Sensor head cord

The sensor head cord connects the CU and the sensor head. The standard length is 3 meters. One side connector is DB15 (male) type and this other side is Jupiter type with 22 pins (female)



8. Batteries and charger

The black batteries supply power to the CU. The battery is 8AH.

The YUASA battery is supplied when the satellite transmitter is used. The battery is 24AH.

The Mascot 2240 battery charger is provided in case of powering the device through mains.



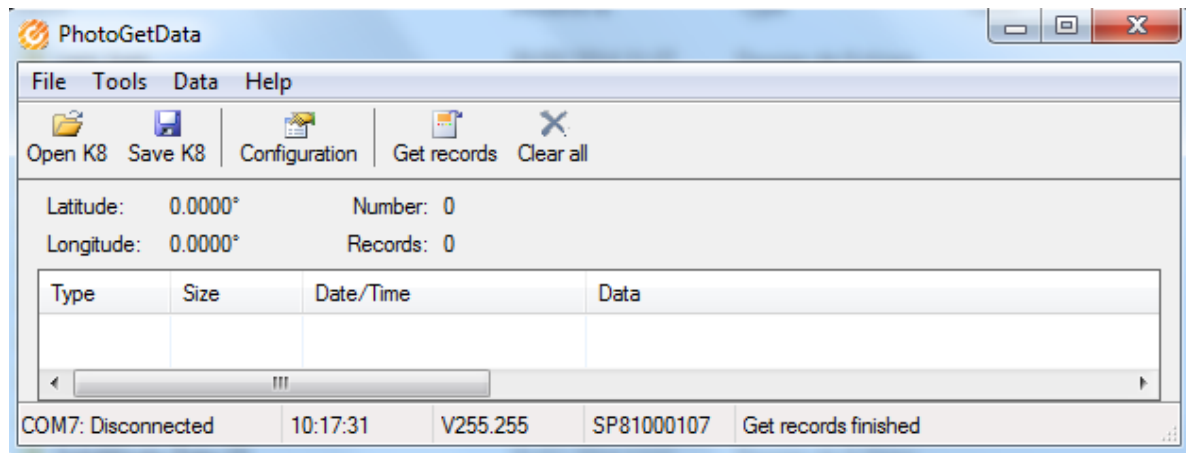
9. Fly case



10. PhotoGetData software

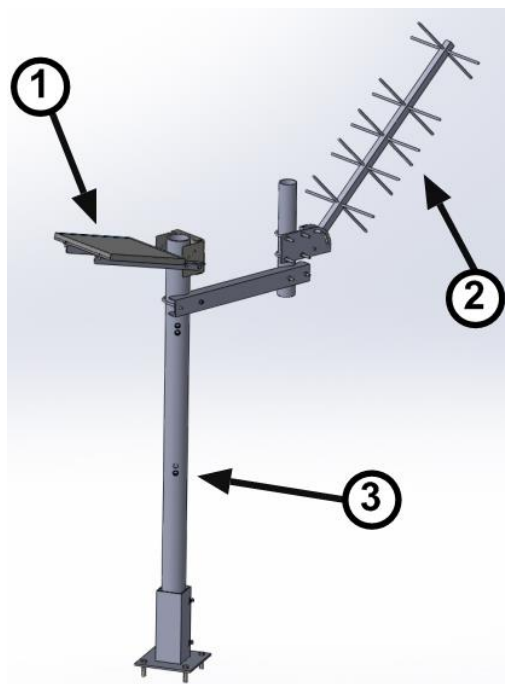
PhotoGetData is the software used to communicate from the acquisition PC to the CU. PhotoGetData is not needed when using data transfer by satellite communication protocol. Read the associated documentation delivered with the photometer.

PhotoGetData software is available on the www.cimel.fr website in the download section.



11. Satellite transmitter (optional)

The satellite transmitter is useful in remote places where no reliable PC is available. It enables sending the data directly to an appropriate geostationary satellite which has a dedicated transmission channel for the CIMEL photometers.



- 1: Solar Panel Solartek
- 2: YAGI antenna
- 3: Mast

1.3. *Sensor head types*

6 different sensor head types exist:

- **Standard / CE318-TS9:** It uses 340, 380, 440, 500, 675, 870, 937, 1020 and 1640 nm filters (Fig.1).
- **BRDF / CE318-TU9:** it uses 380, 440, 550, 675, 740, 870, 937, 1020 and 1640 nm filters (Fig.2).
- **Polarized / CE318-TP9:** A filter wheel containing 3 sets of 3 polarizers operating in infrared (POL1), Ultraviolet (POL2), and visible (POL3) which are orientated with a 120° angle is added on top of the wheel containing the Standard filters. Additional information about the aerosols' nature and shapes can then be retrieved (Fig.3).
- **BRDF 12 filters / CE318-TU12:** It is designed for satellite calibration. It uses 415, 440, 490, 555, 675, 702, 740, 782, 870, 937, 1020, and 1640 nm filters (Fig.4).
- **Ocean Color (OC) 12 filters / CE318-TV12-OC / SeaPRISM:** It uses 400, 412.5, 442.5, 490, 510, 560, 620, 665, 779, 865, 937, 1020 nm filters (Fig.5)
- **Lake Color (LC) 12 filters / CE318-TV12-LC:** It uses 412.5, 442.5, 490, 510, 560, 620, 665, 681, 709, 865, 937, 1020 nm filters (Fig.6)

The sensor head types differ in the presence of an additional wheel filter containing polarizers for the Polarized type, the filter wavelengths mounted in the head sensor, and the scenario sequence established.

Filter wavelengths are defined in the UV-visible-IR spectrum according to scientific retrieval purposes.

The filters and polarizers curves are delivered with the photometer.

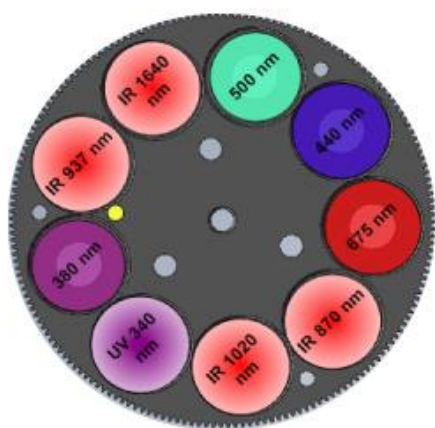


Figure 1: Standard type (CE318-TS9)

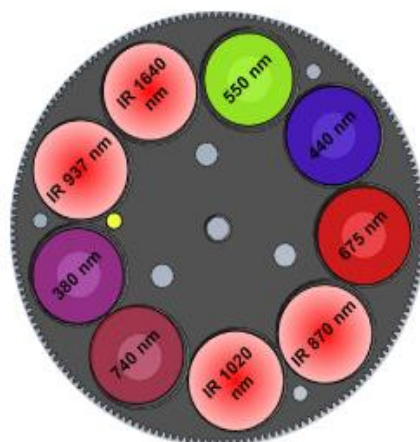
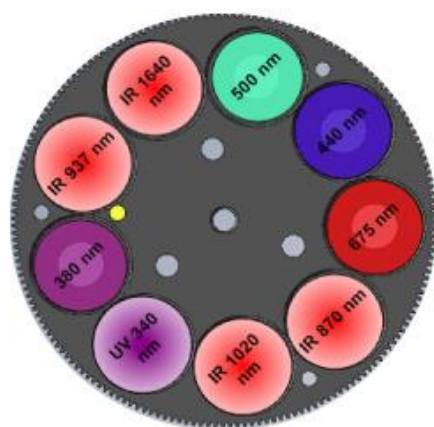


Figure 2: BRDF Type (CE318-TU9)



+

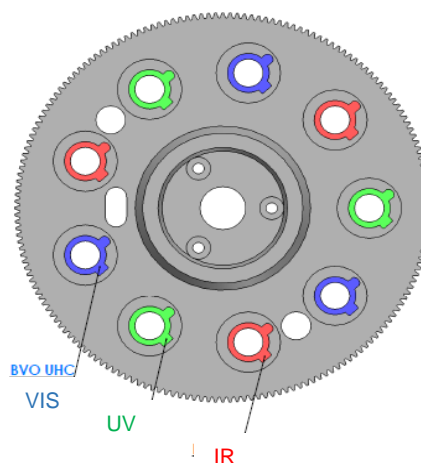


Figure 3: POLARIZED type (CE318-TP9)

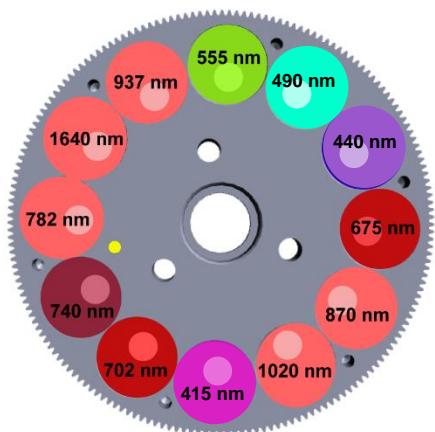


Figure 4: BRDF 12 filters type (CE318-TU12)

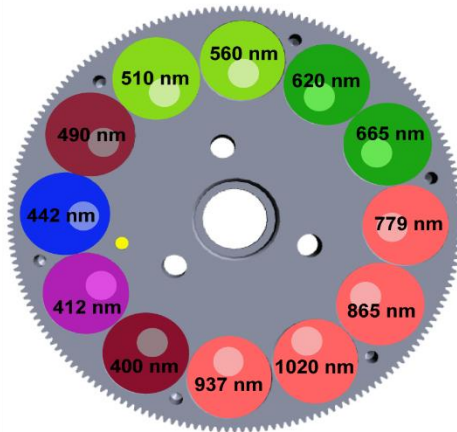


Figure 5: Ocean Color 12 filters (CE318-TV12-OC)

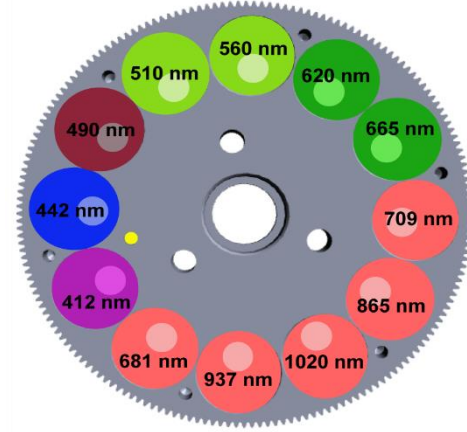


Figure 6: Lake Color 12 filters (CE318-TV12-LC)

1.4. *Data transmission*

The photometer can use 4 different communication protocols to send its data from the CU.

- PC data transfer using an RS232 link to an acquisition PC. (Default data transmission). The PC is not provided.
- Satellite data transfer using a DCP transmitter module. The proper way to set the module is explained in the Installation chapter.
- USB link for punctual connections.
- Communication over GPRS.

2 *Installation*

2.1. *Installation site recommendations*

The site should be chosen carefully to comply with the following conditions:

- Easy access to facilitate the weekly maintenance of the device.
- The device should be installed in a clear area where it has the largest possible field of view so that it can track the sun from sunrise to sunset (no buildings, trees, cables...).
- Less than 100m cable distance to a PC (for RS232 link connection).
- A support where it can be strongly fixed so that the system is stable (preferably the tripod). It is strongly recommended to embed three M10 studs in a concrete surface (diameter 1273 cm) placed at 120° to each other, leaving the top 50 mm protruding so that at least two bolts can be tightened on top of each foot of the tripod.

2.2. *Hardware installation and setup*

In this description, notions on how to manually control the photometer via the CU are necessary, it is recommended to read **chapters 3 and 4** to have a better overview of what is done when installing the system.

However, the following instructions are detailed enough so that it is not mandatory to read the 2 chapters cited above.

If the tripod system is not used, skip to part 2.2.4.

2.2.1. Needed tools

To install the system, the following tools are needed:

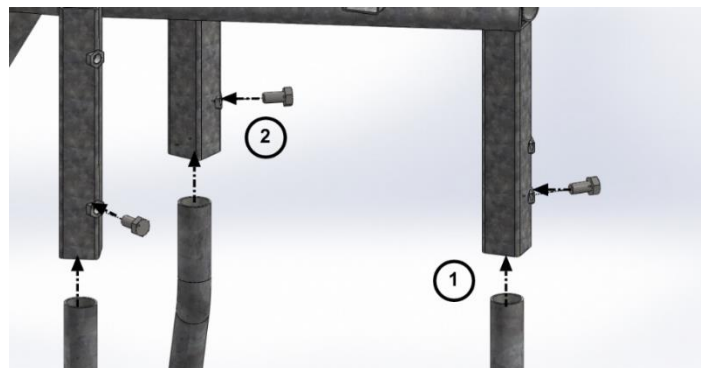
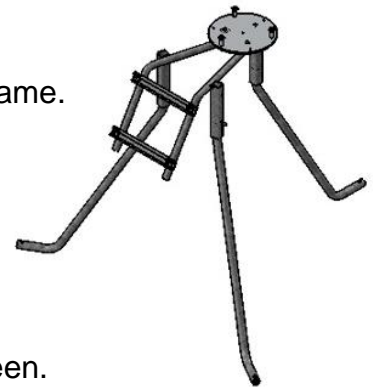
- Open-end wrench size 10.
- Open wrench size 13.

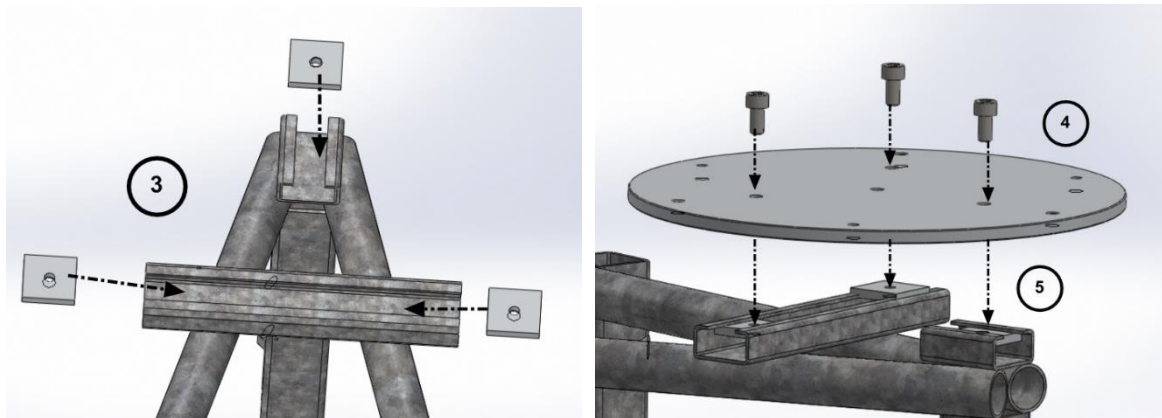
If possible, a tubular spirit level will be used in addition to the robot spirit level to make the installation easier (0.4mm/m accuracy).

2.2.2. Tripod mounting

The tripod mounting system is designed for easy installation of the photometers in most site conditions.

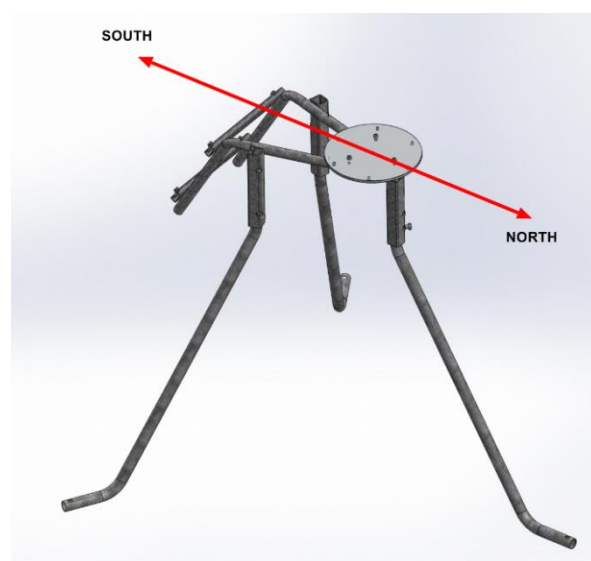
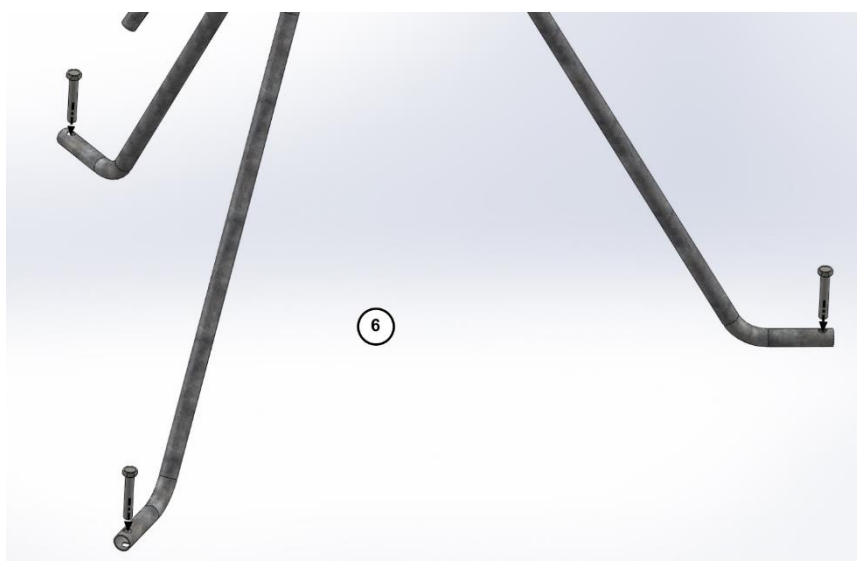
1. Insert the three photometer tripod feet into the metallic frame.
2. Tight the 3 screws on the tripod feet.
3. Insert the ribs into the slides designed for this.
4. Insert the screw into the tray.
5. Tight strongly the screw into the rib with the tray in between.





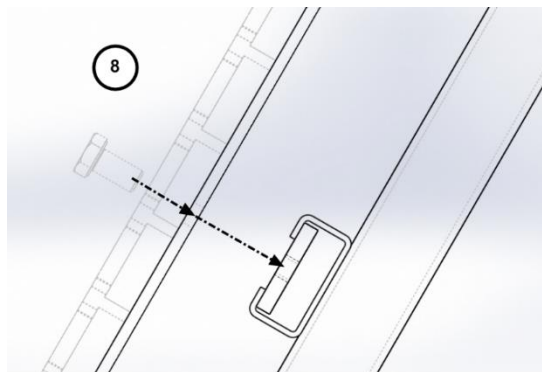
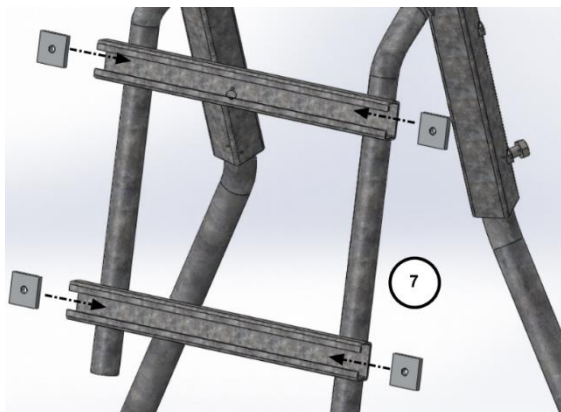
6. Attach the tripod feet to the ground with appropriate screws.

Note: Orientate the protection case emplacement South if the location is in the Northern hemisphere or North if the location is in the Southern Hemisphere.

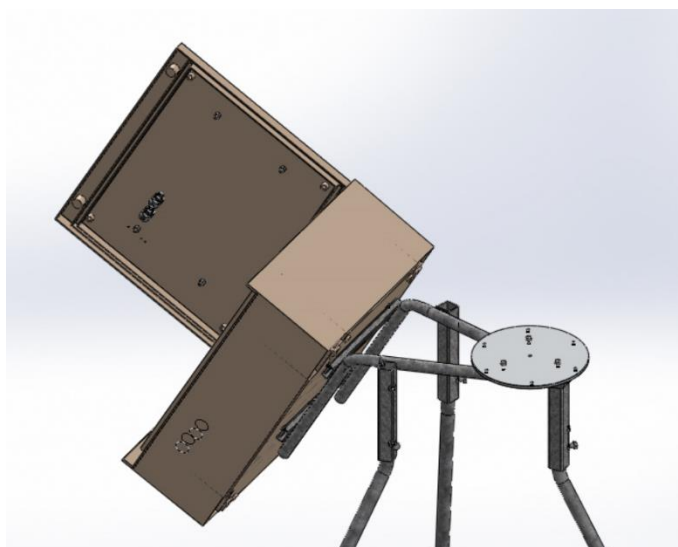
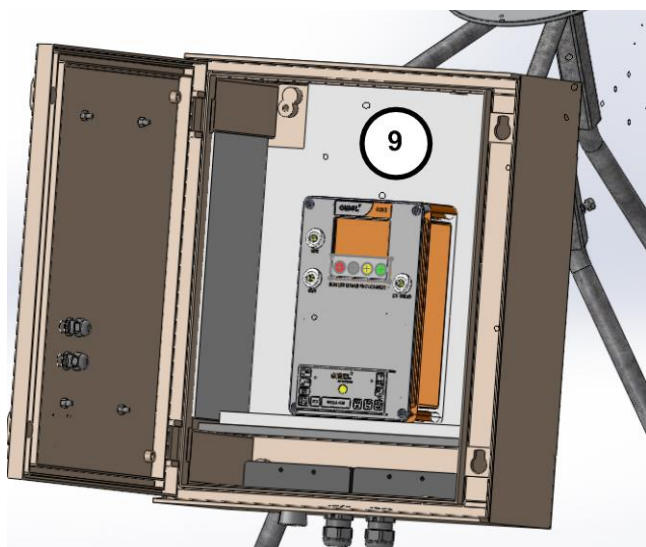


2.2.3. Case mounting

7. Insert the 4 ribs into the metallic frame in order to fix the case.
8. Tight strongly the screw into the ribs with the inside of the case in between.

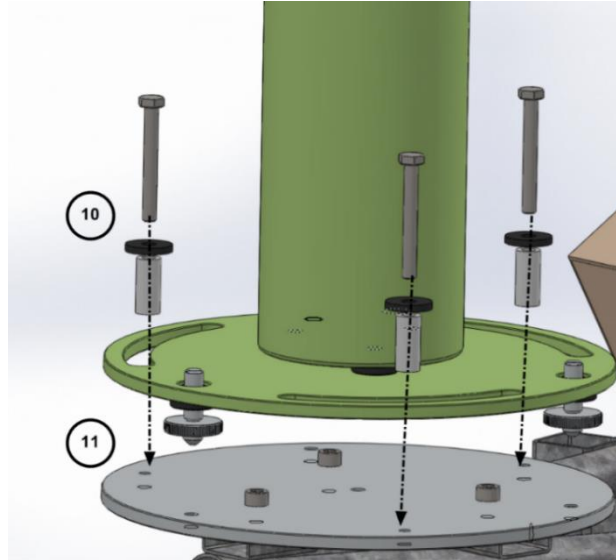


9. Put the foam at the bottom of the case and on the sides, and place the batteries and the CU as shown in the picture below.

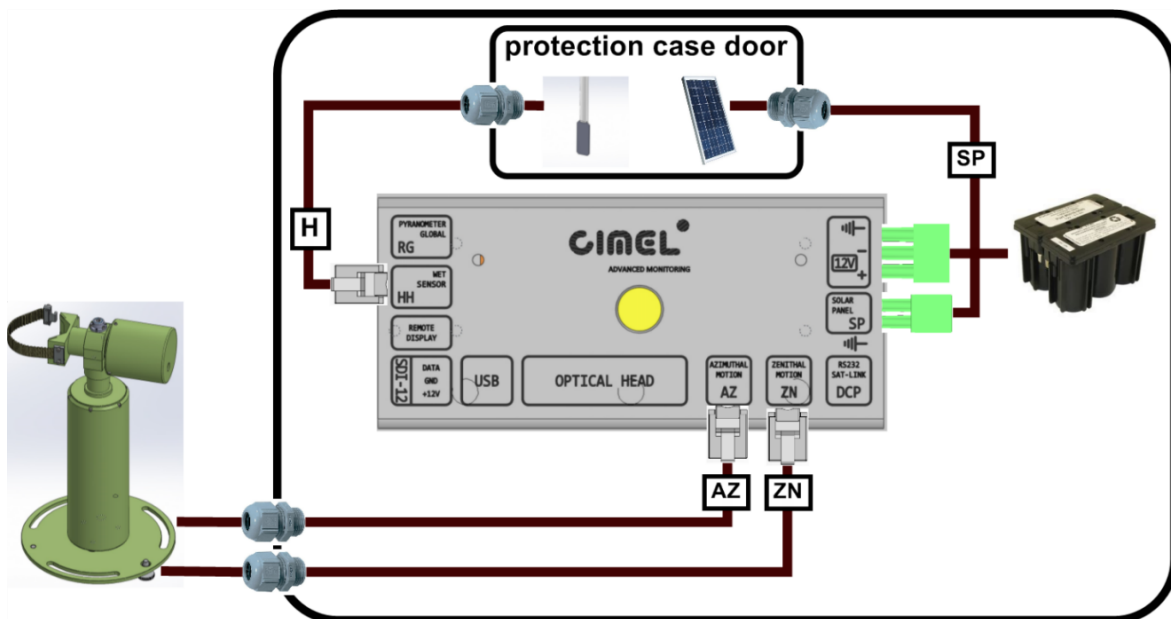


2.2.4. Robot and sensor head mounting

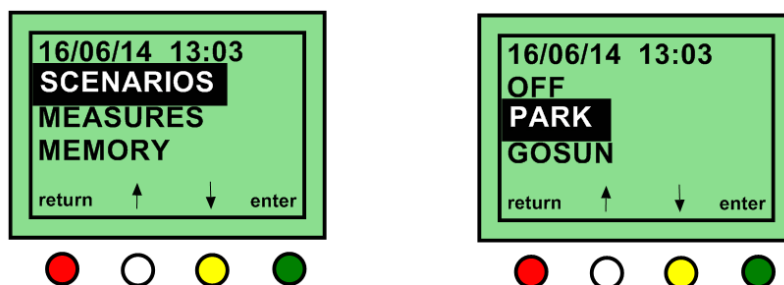
10. Put the screws into the white plastic part.
11. Put the screws on the holes through the robot base but don't tight them to the end, let a 2 or 3 cm backlash so that the leveling that is done in the next part is easier to do.



12. Connect AZ (robot AZimuthal motor), ZN (robot Polar motor), solar panel, and wet sensor and battery wires to the removable terminal block of the CU passing them through the cable glands of the protection case.

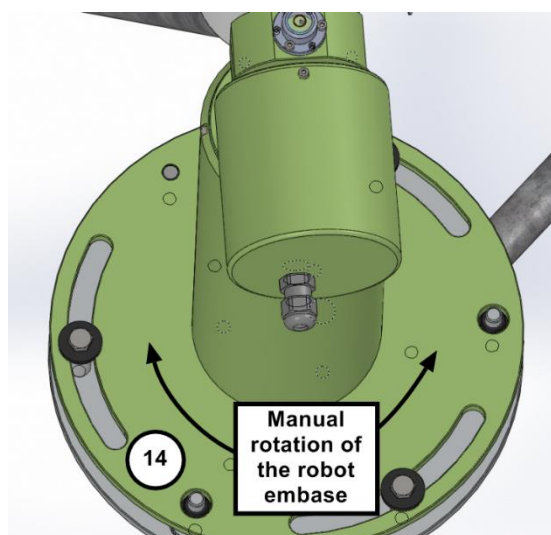
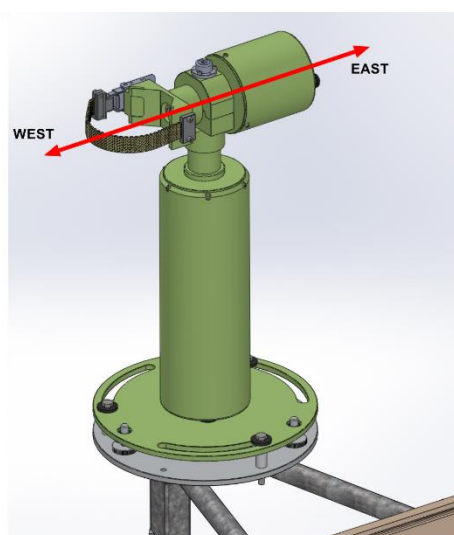


13. Launch a Park scenario in the CU menu. The robot will find its zero position.

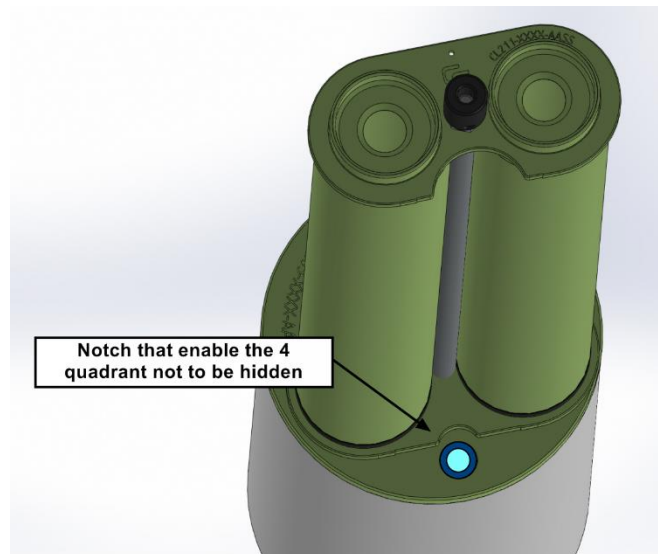
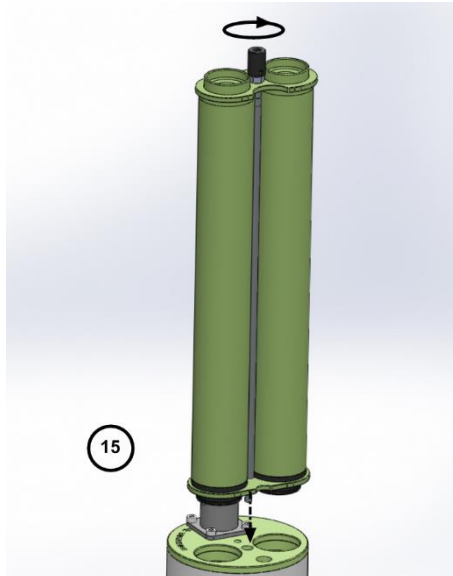


Select **SCENARIOS** then **PARK** and validate with the green button

14. Set the horizontal robot axis in the East-West direction by manually turning the whole base of the robot.

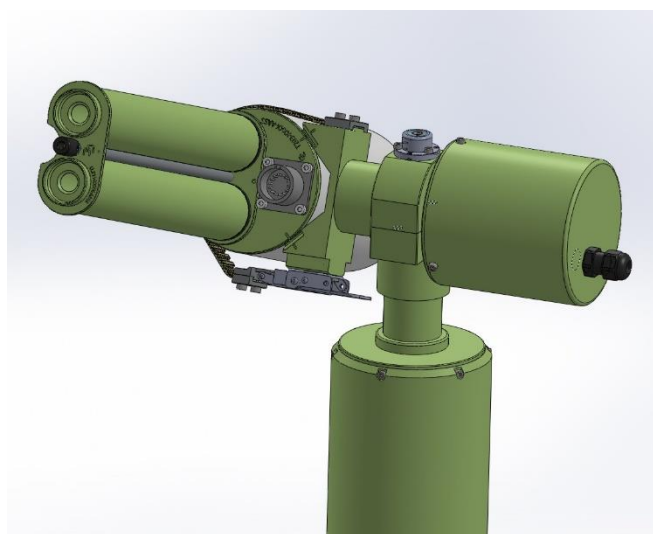


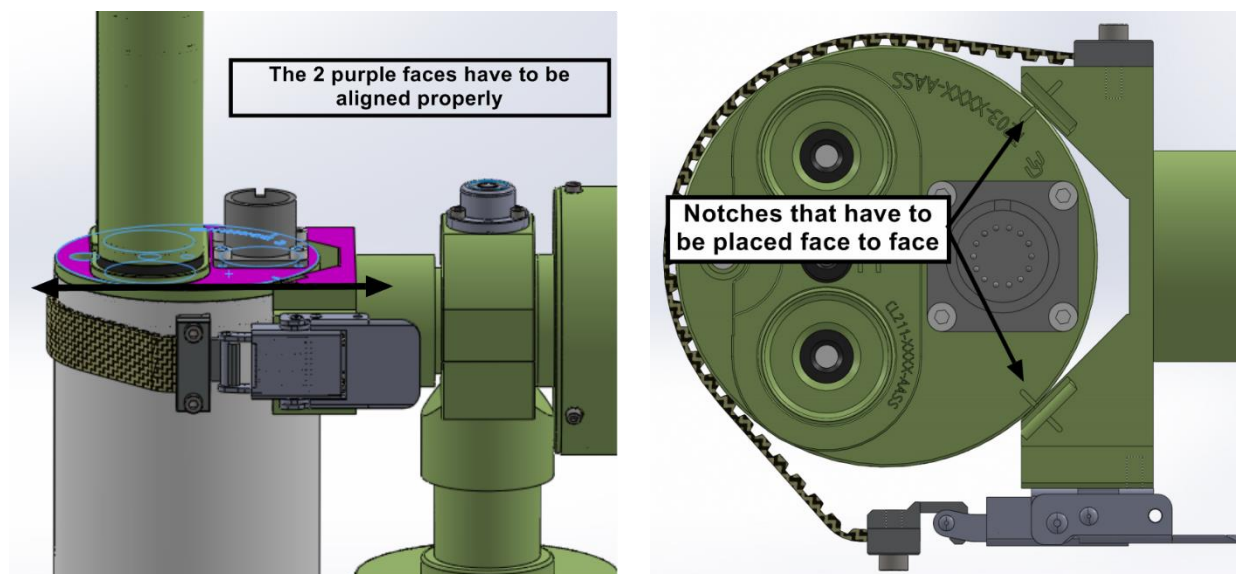
15. Assemble the collimator to the sensor head front plates by tightening strongly the long central threaded rod using a plier. The notch must face the 4 quadrants lens on the sensor head front plate.



Note: Watch out that the collimator and the sensor head are completely interdependent. There should be no slack while trying to move the collimator after having tightened it.

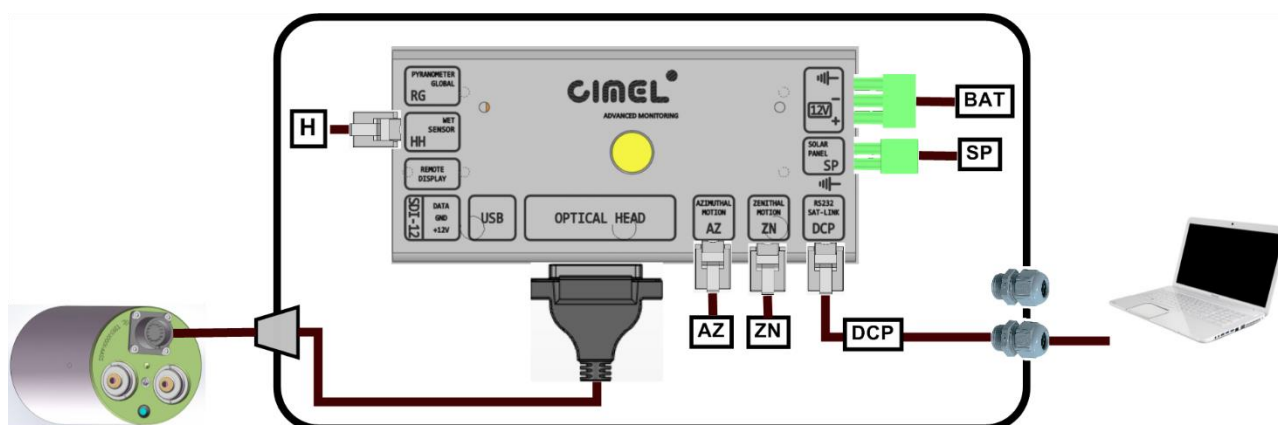
16. Strap the sensor head on the V-shaped support of the robot. Two things are to be checked. First, align the sensor head front plate with the upper surface of the V-shaped support. Then use the notches present both on the robot and the sensor head as a visual indicator to position the sensor head correctly. Notches have to be aligned.

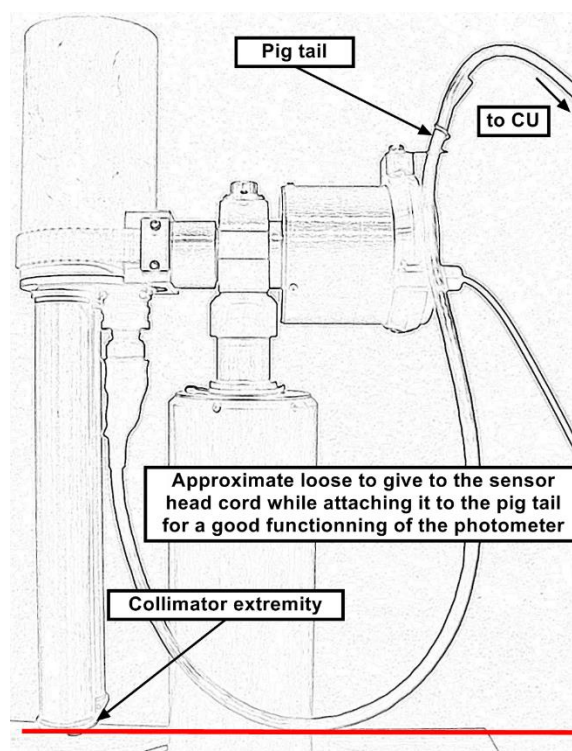




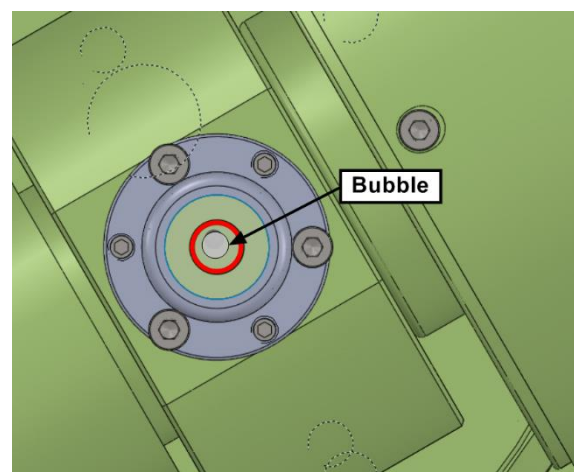
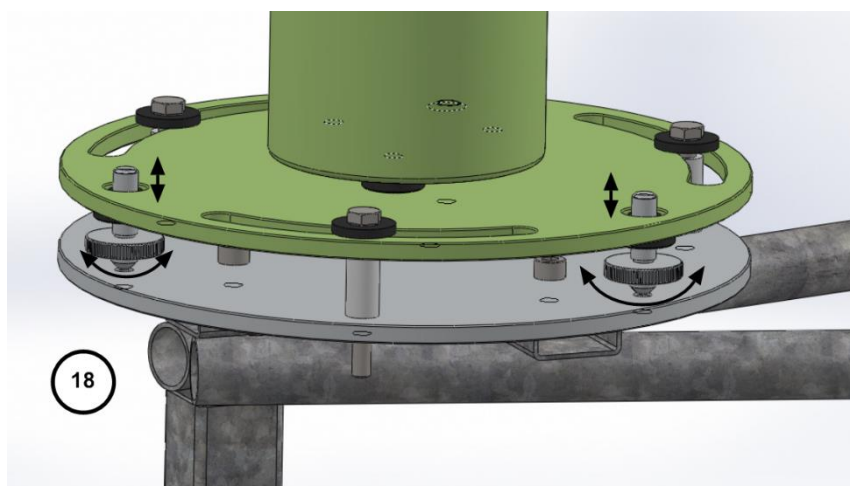
17. Plug the sensor head cord from the CU to the sensor head passing it through the cap and attaching it to the pig tail. Connect the computer or the transmitter to the DCP input on the removable terminal block via an RS232 to RJ11 cable.

Note: A slack has to be maintained so that the head sensor cord will not be too extended while the device is operating, which can lead to the malfunctioning of the photometer.

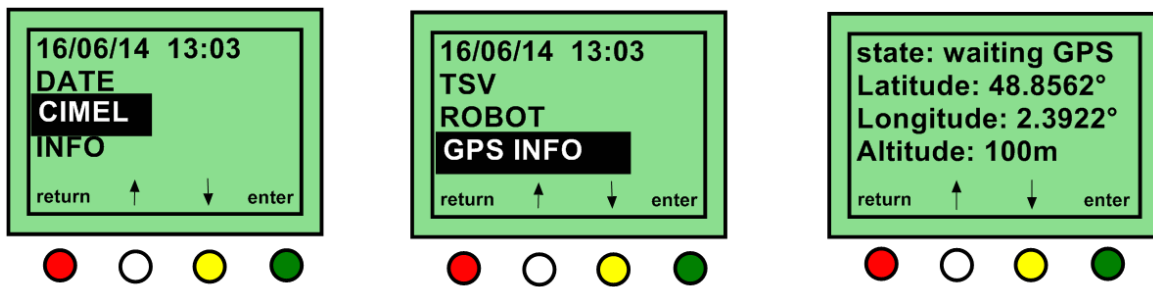




- 18.** Level the robot up so that it's perfectly horizontal by playing on both precision wheels until the spirit level on the top of the robot is centered. This part is a little tricky and may take a few trials. Using an additional tubular spirit level may facilitate this step.



- 19.** Set coordinates, UT time, and date using the following menu. Wait a maximum of 15 min for automatic GPS synchronization. When done, the coordinates will be displayed on the screen.

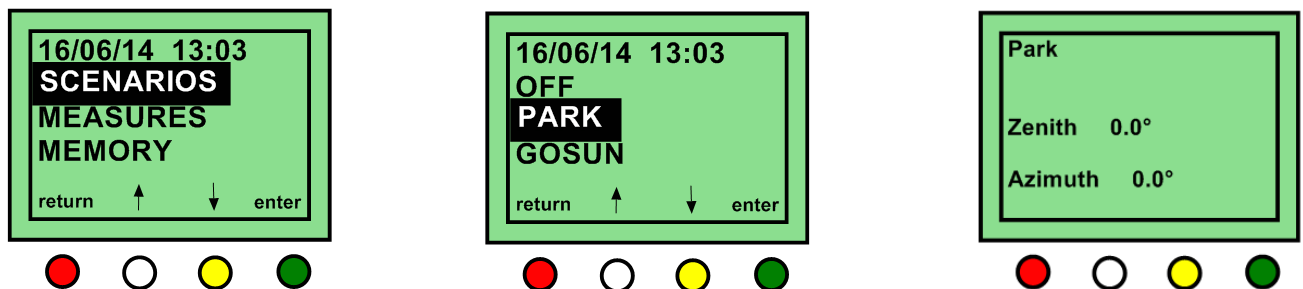


Select CIMEL then GPS INFO and validate with the green button

20. Launch a Park scenario in the CU menu. The photometer head will find its PARK position which is the nadir on the polar angle (head orientated down).

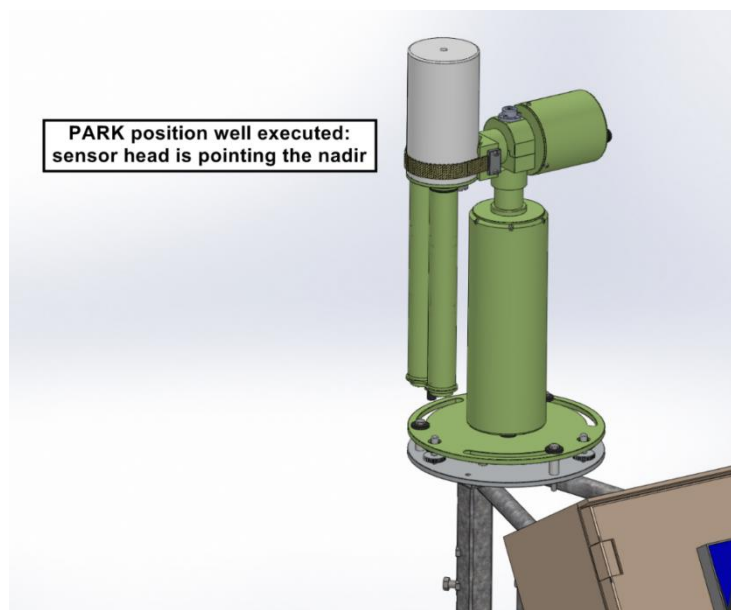
If the head is pointing to the zenith (orientated up), unstrap the sensor head, reposition it in the opposite sense in the straps, and do step 13 again.

Note: Place the spirit level on the robot V-shaped part after the PARK scenario. It should be perfectly horizontal, if not refer to part 5.2.2.

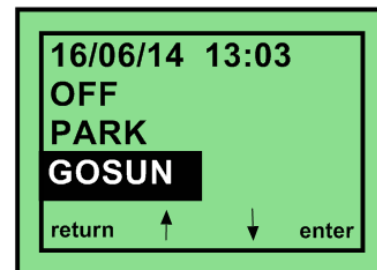
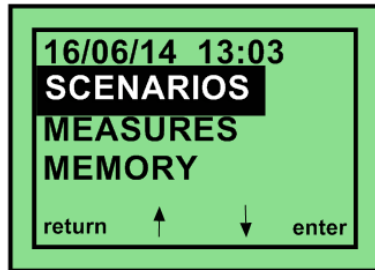


Select SCENARIOS then PARK and validate with the green button

Screen displayed after a PARK

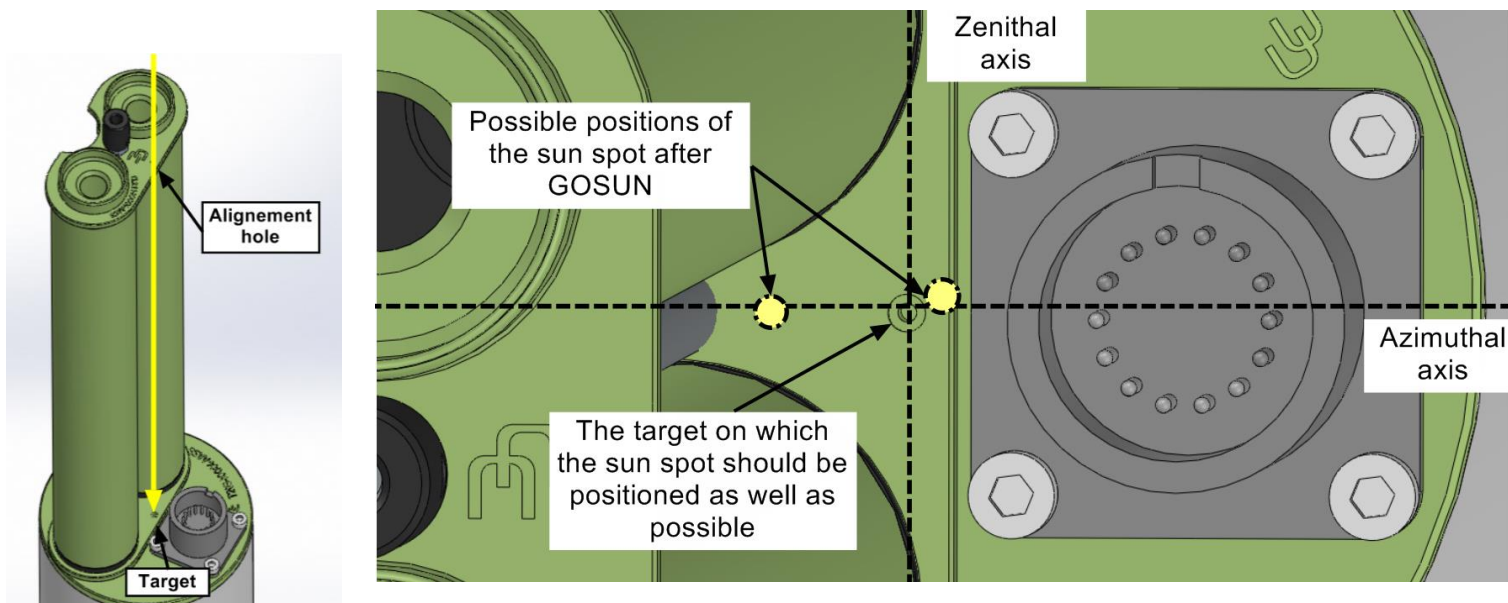


21. Launch a GOSUN scenario in the CU menu. The sensor head is going to point to the sun. Polar and Azimuthal values are displayed in degrees on the CU screen.



Select **SCENARIOS** then **GOSUN** and validate with the green button

After a GOSUN scenario, the sunspot may not be centered on the target.



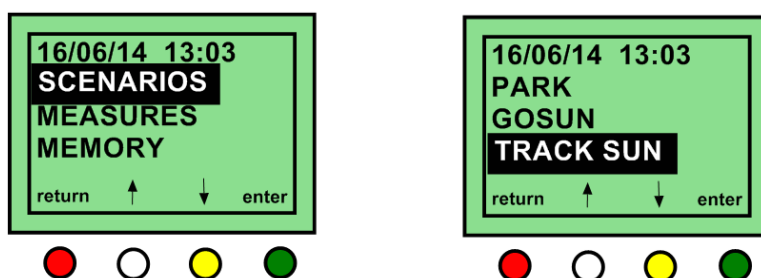
The GPS coordinates, UT time, and date being received automatically from the satellite, the error on the polar axis should be inferior to 1 mm as long as the spirit level is well centered (If superior refer to part 5.2.2).

If not centered on the azimuthal axis, refine the manual positioning of the robot base as done in step 14. (The screws being loosened the base can still be moved).

After having done the corrections, repeat steps 20 and 21 to check again the position of the sunspot. Repeat the correction until the sunspot is almost perfectly centered on the target (a few millimeters off maximum).

Note: The centering error will be compensated by the 4-quadrant sensor in the TRACK process described in the next step.

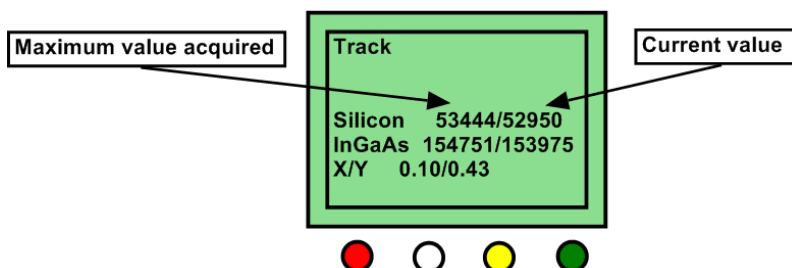
22. Launch a TRACK SUN scenario in the CU menu. The robot will follow the sun's movement. Check that the sunspot is centered on the collimator spot at the end of the scenario. If a problem occurs, please read part 5.3.2.



Select **SCENARIOS** then **TRACK SUN** and validate with the green button

Using a 4-quadrant sensor, the TRACK SUN scenario guides the robot to the point where the intensity of the signal on both the Silicon and InGaAs channels is the highest.

This intensity corresponds to the center of the sun.

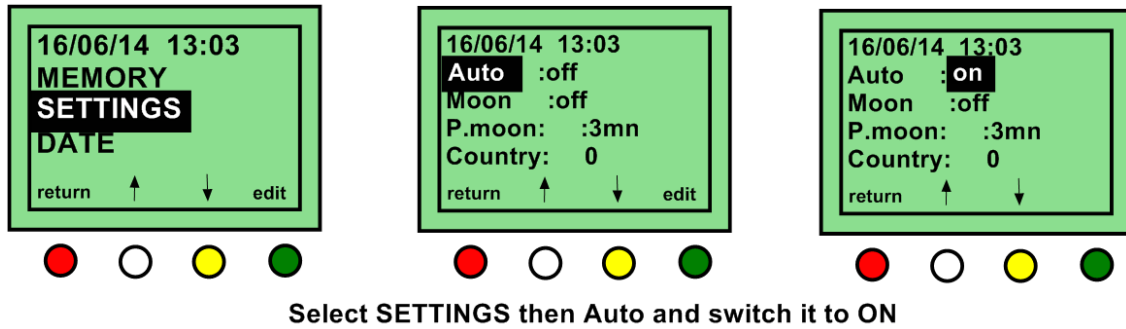
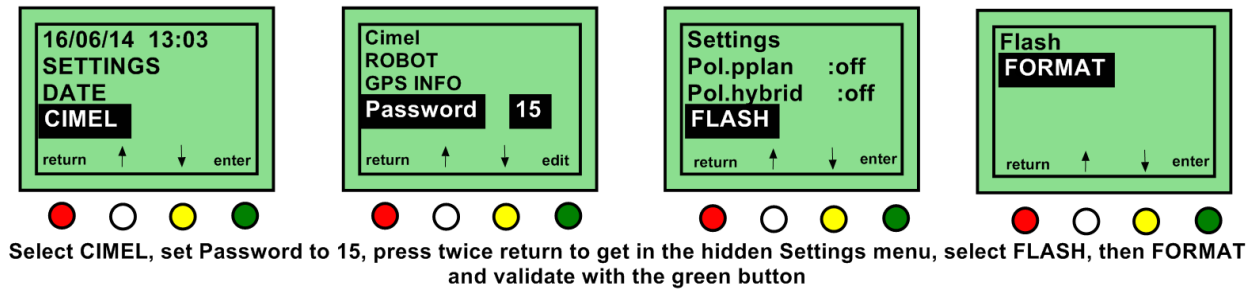
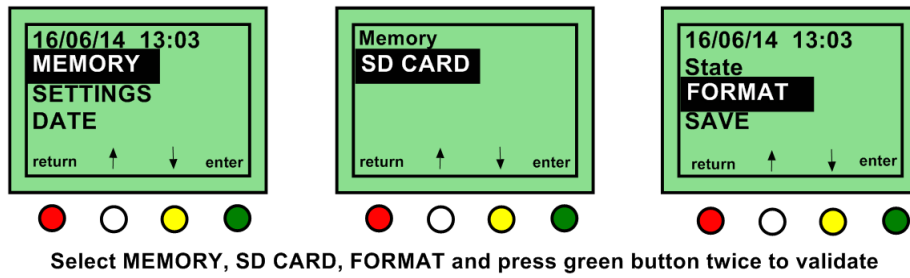


23. When the track is done correctly, repeat steps 20, 21, and 22 once or twice to validate the photometer behavior.

24. Tight the screws into the tray to fix the robot without changing its position.

Important note: watch out that the level didn't move. If the level moved, go back to step 18 and repeat steps 20, 21, 22.

25. Format the SD card and the flash memory.



26. Set the photometer in automatic mode.

2.2.5. Optional pyranometer global radiation sensor

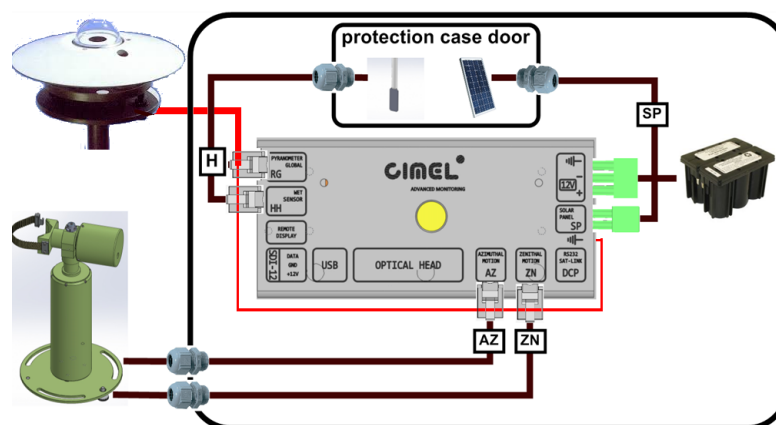
The photometer is ready to receive an optional external pyranometer for global radiation (RG) measurements. Please refer to the Pyranometer manufacturer for the field installation. Take care to not install the Pyranometer in the Photometer field of view.

Compatible global radiation sensors must be with a tension proportional to the global radiation. The sensor must have two wire outputs with this tension proportional to radiation. Best results are obtained with a pyranometer exhibiting a sensibility between $5 \mu\text{V/W/m}^2$ and $50 \mu\text{V/W/m}^2$. Low sensibility decreases resolution and too high sensibility may lead to overflow.

On the photometer parameters, you have to enable the RG (RgEnable/RGEN) and input the RG sensor calibration sensibility (RgSensibility/RGSENS) in $\mu\text{V/W/m}^2$. This sensibility should be present on the calibration sheet provided by the manufacturer.

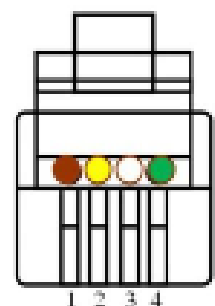
When the global radiation sensor is enabled (RgEnable), two new data will be added in K8 files at the end of each scenario (but moon). The first data is RG: the mean Global Radiation in W/m². The second data is RGDEV: the standard deviation of the RG. RG and RGDEV are averaged during the scenario run with a sample every 5 seconds.

The sensor must be plugged into the RG marked plug and earth plug of the C.U.



The RG RJ9 pinout is:

1. Sensor Out+ or Hi on pin 1 and pin 4 of RJ (red and green dot)
2. Sensor Out- or Low on pin 2 of RJ (yellow dot)
3. Sensor shield on the separate C.U. ground pin.
4. Pin 3 (white dot) is left unconnected.



2.3. *Communication protocol installation and setup*

The photometer supports several communication media.

The USB and the RS232 can be used for local data retrievals, parameter settings, and instrument firmware updates. The RS232 is optically isolated and can be used as a permanent connection. The USB connection has to be used only as a temporary connection.

GPRS FTP can be used to upload data to a server.

Satellite transmission can be used to transfer data from isolated sites. In that case, the user needs to get an account from the satellite manager.

2.3.1. RS232 communication

To transfer the data from the CU to a PC via an RS232 link, then follow the steps described below.

2.3.1.1. Software configuration

- Plug the RS232 link into the dedicated PC (already done in the installation part)
- Install PhotoGetData on the computer

The software is provided on the USB stick sent with the instrument and can be downloaded on the Cimel website.

- Launch PhotoGetData.

In the **tools** → **configuration** menu:

In the *communication tab*:

→ Choose Serial in the communication type and choose the Port COM associated with the photometer.



Note: USB should be used only for punctual data transfer. The backup on the SD card can't be done when the USB link is plugged.

In the *data tab*:

→ Tick enable the creation of automatic recording, create K8 and/or create ASCII

→ Choose the data-saving directory

→ Set the time from which the data will be transferred and the frequency of transfer.

→ Choose the recording period and the generic file name of the records.

2.3.1.2. Computer configuration

The computer must be configured as follows to avoid intervention as much as possible, especially in case of a power cut by applying the following changes in the PC setup:

- Put the PhotoGetData icon in the Windows start folder
- Remove any password request while starting the computer

Control panel → User account

- If possible, an uninterrupted power supply (UPS) should be installed and the PC bios configured so that it restarts automatically after a power cut (See the local PC expert).

2.3.2. USB communication

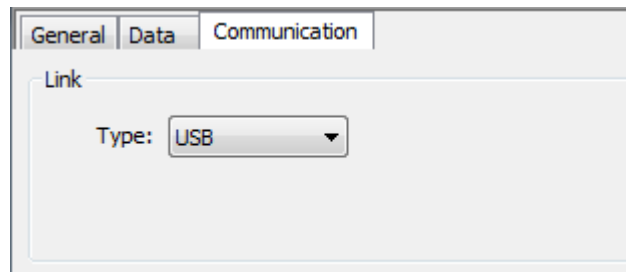
2.3.2.1. Software configuration

The user should install the USB driver provided by Cimel (see PhotoGetData manual). Plug the USB cable into the dedicated PC. Install PhotoGetData. The software is provided on the USB stick sent with the instrument and can be downloaded on the Cimel website. Launch PhotoGetData.

In the **tools** → **configuration** menu:

In the *communication tab*:

→ Choose USB in the communication type photometer.



2.3.3. Communication over GPRS/3G/4G

The CE318-T photometer supports standard communication protocols like FTP, HTTP, and HTTPS over a GPRS/3G/4G connection.

Certified frequency bands are B1, B3, B7, B8, B20, B28 for Europe, but device is operational with B2, B4, B5, B9, B12, B13, B14, B18, B19, B25, B26 frequency bands for the rest of the world.

Maximum output power is 24 dBm.

The user must choose a local telecommunication operator, buy a plan with a SIM card with 4G, 3G or WCDMA capability (that includes GPRS transfers), and subscribe to a subscription. Standard daily operation requires a data transmission of 20 Mo/month/communication protocol.

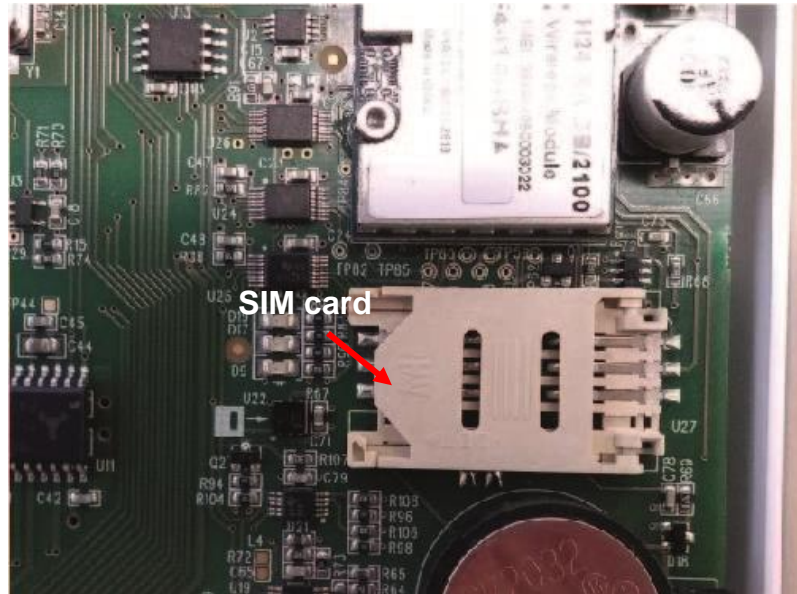
It is possible to enable FTP and/or HTTP/HTTPS simultaneously. The UC will execute the communication one by one.

In agreement with the chosen operator, it is up to the user to ensure that GPRS coverage is effective at their field site.

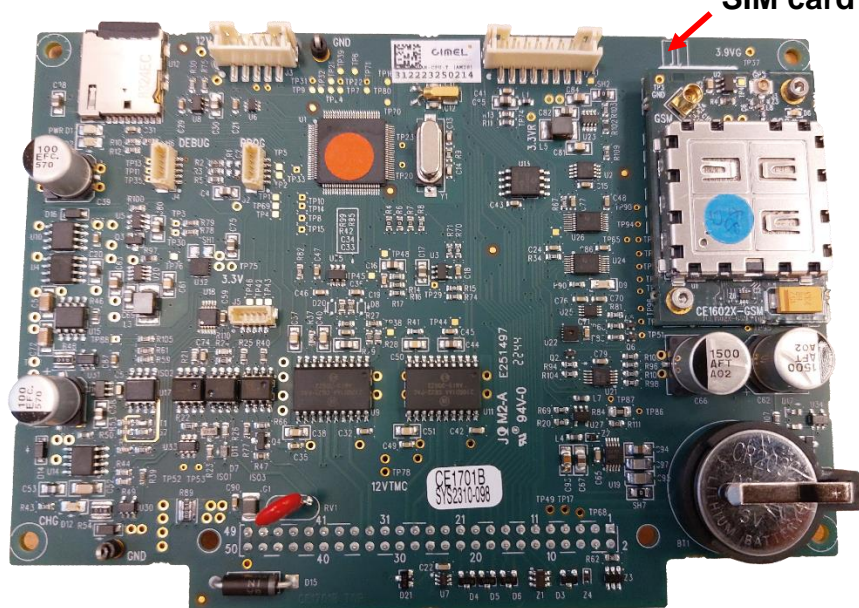
The SIM card must be inserted into the slot provided in the CU. The CU uses two versions of electronic boards. One is CE1201A and the second is CE1701A. To know the version of your CU, go to the INFO menu and read the CPU version.

The user must configure the SIM card provider APN name in the settings of the CU through PhotoGetData and disable the SIM card PIN code.

2.3.3.1. CE1201A SIM card insertion



2.3.3.2. CE1701B SIM card insertion



2.3.3.3. FTP over GPRS

The CU could upload its data automatically to an FTP server. The CU initiates the transmission, it automatically connects to the Internet on the user's FTP server and uploads the data.

The photometer sends its data to only one single FTP server.

The user may use their chosen FTP server. They must enter the user's name and password and specify the name of the directory where the data will be uploaded.

2.3.3.3.1. *Parameters configuration*

Some of these settings cannot be edited/modified on the CU. PhotoGetData has to be used to modify them.

In SETTINGS\GSM\GPRS\FTP

- **FTP:** Enable or disable FTP automatic action [OFF; ON]: **OFF**.
- **ADDR:** Address of the FTP server. Maximum length: 32 characters. Default: "".
- **USER:** Username used to log in on the FTP server. Maximum length: 32 characters. Default: "anonymous".
- **PORT:** Communication port used to establish the FTP session communication with the FTP server [1; 65535]: **21**.
- **DIR:** Directory where the data are stored on the FTP server. Maximum length: 48 characters. Default: "/".
- **FTP interval:** FTP transmission period. [00:00:00; 23:59:59]: **01:00:00**.
- **FTP offset:** FTP start period. [00:00:00; 23:59:59]: **00:00:00**.

Note: You have to enter the password for the FTP server. For security reasons, the password is not displayed in the CU and cannot be read back by the user.

2.3.3.4. **HTTP / HTTPS over GPRS**

The CU could upload its data automatically to an HTTP / HTTPS server. The CU initiates the transmission, it automatically connects to the Internet on the user's HTTP or HTTPS server and uploads the data.

Important: An HTTPS server is an HTTP server with a secured connection. It is important to know that the CU uses two versions of electronic boards. One is "CE1201A" and the second is "CE1701A". The CE1201A cannot use a secured connection so it is not compatible with HTTPS. The CE1701A is compatible with both HTTP and HTTPS. To know the version of your CU, go to the INFO menu and read the CPU version.

During that document, the term "HTTP(S)" is used instead of "HTTP / HTTPS".

The photometer sends its data to only one single HTTP(S) server.

2.3.3.4.1. *Cypher suite profile supported by the AU*

The AU supports these Cypher suites during a secured connection:

- TLS_RSA_WITH_AES_128_CBC_SHA
- TLS_RSA_WITH_AES_256_CBC_SHA
- TLS_RSA_WITH_AES_128_GCM_SHA256

The Cypher suite is automatically negotiated between the server and the AU.

2.3.3.4.2. *Parameters configuration*

Some of these settings cannot be edited/modified on the CU. PhotoGetData has to be used to modify them.

In SETTINGS\GSM\GPRS\HTTP

- **HTTP:** Enable or disable HTTP(S) automatic action [OFF; ON]: **OFF**.
- **Secured:** Use HTTPS instead of HTTP when ON. [OFF; ON]: **OFF**.
- **HOST:** Name of the HTTP(S) host. Maximum length: 32 characters. Default: "".
- **USER:** Username used to log in on the HTTP(S) server. Maximum length: 32 characters. See the note for more information. Default: "".
- **PASS:** See the note for more information.
- **PATH:** PATH of the service to upload the files. Maximum length: 64 characters. Default: "".
- **PORT:** Communication port used to establish the HTTP(S) session communication with the HTTP(S) server [1; 65535]: **80** for HTTP. The user has to change the value to 443 manually when using HTTPS.
- **HTTP interval:** HTTP(S) transmission period. [00:00:00; 23:59:59]: **01:00:00**.
- **HTTP offset:** HTTP(S) start period. [00:00:00; 23:59:59]: **00:00:00**.

Note: Some server requires an authentication to accept the communication. You have to enter a username and a password for the HTTP(S) server. Let empty if not used. For security reasons, the password is not displayed in the CU and cannot be read back by the user.

2.3.3.4.3. *How to convert a HTTP(S) server URL to CU settings?*

Ex: This server URL <https://dummy:foo1234@www.myserver.com:2020/path1/Path2> has to be configured like this in the CU:

- **HTTP:** ON to enable automatic action.
- **Secured:** ON. Because it is an HTTPS server.
- **HOST:** www.myserver.com
- **USER:** dummy
- **PASS:** foo1234 (This field is available in PhotoGetData only).
- **PATH:** /path1/path2
- **PORT:** 2020 (If the port is not present in the URL, set 80 for HTTP and 443 for HTTPS).

2.3.3.4.4. *POST request sent by the CU*

To upload the k8 data file the CE318T submits an http form using a POST request on the HTTP(S) server. The submitted form has the input field *submit* set to *Submit file* and the input field *uploaded_file* of type *file* with the uploaded k8 file. It is equivalent to submitting this form:

```
<!DOCTYPE html>
<html>
<body>
<form action="/PATH1/PATH2" method="post" enctype="multipart/form-data">
  <input type="submit" value="Submit file" name="submit">
  <input type="file" name="uploaded_file" id="uploaded_file">
</form>
</body>
</html>
```

Where */PATH1/PATH2* is the **PATH** field value in the CE318T parameters.

Here is an example of the POST sent by the CU to this destination URL:

https://dummy:foo1234@www.myserver.com:2020/path1/Path2/Upload.php

POST request:

```
POST /path1/Path2/Upload.php HTTP/1.1
Host: www.myserver.com
Authorization: Basic ZHVtbXk6Zm9vMTIzNA==
User-Agent: CE318T/dev 2.3.0
Accept: */*
Content-Length: 2516
Connection: keep-alive
Content-Type: multipart/form-data; boundary=-----4c014a87ef48

-----4c014a87ef48
Content-Disposition: form-data; name="submit"

Submit File
-----4c014a87ef48
Content-Disposition: form-data; name="uploaded_file";
filename="0000_20200101090241.k8"
Content-Type: application/octet-stream

<The binary content>
-----4c014a87ef48-
```

2.3.4. Satellite transmission installation and configuration

The satellite transmission of the data is done using a Satlink 2 logger and transmitter model SL2-G312-1 and a YAGI antenna. The satellite that will receive and transmit the data depends on the geographic location, it can be GOES, or MSG... the satellite has a dedicated communication channel that can be attributed to the Satlink2.

First of all, to install properly the YAGI antenna, the azimuthal and polar angles corresponding to the satellite the antenna will point to must be known.

Choose the satellite the data will be sent to, the coordinates of the photometer's location, and click apply. (Here is an example for longitude 3° and latitude 45°)

Cimel Parameter and Antenna Tool

Select the Satellite :

☒ GOES EAST
☐ GOES WEST
☐ METEOSAT
☐ GMS

Choose Coordinates or AERONET Site

Coordinates in Decimal Degrees (South and West < 0; North and East > 0):

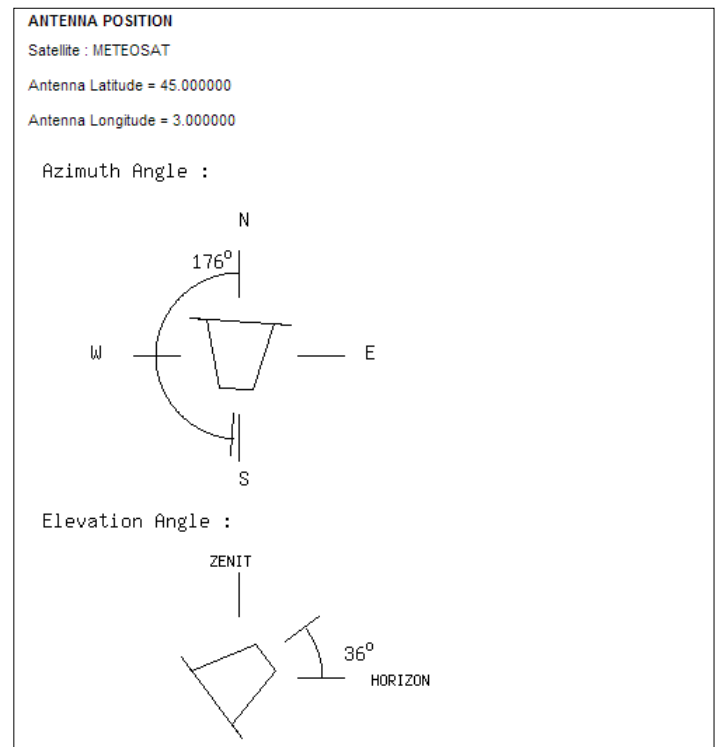
Longitude

Latitude

Or Existing AERONET Site:

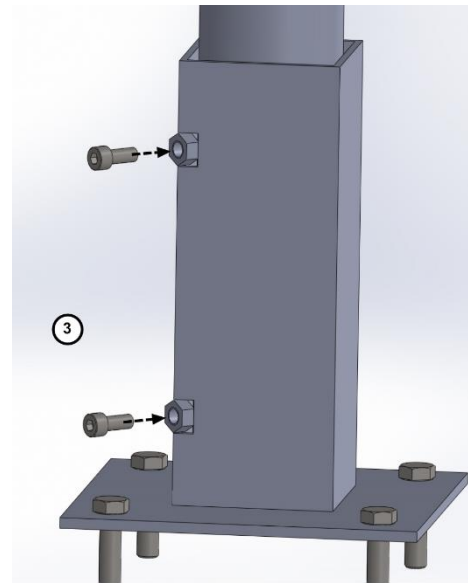
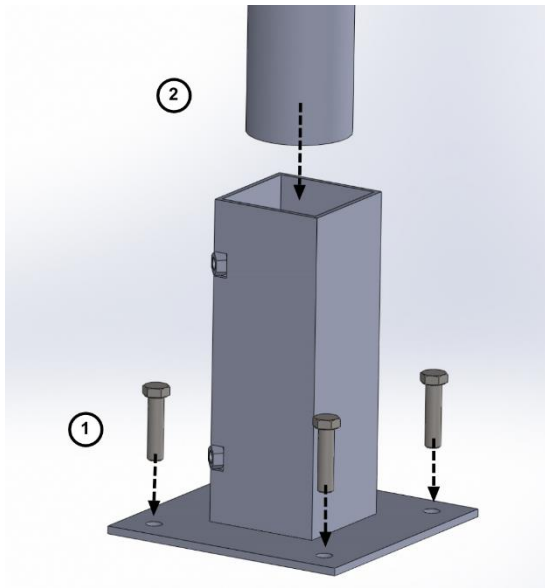
Gosan_SNU
GOT_Seaprim
Gotland
Gozo
Graciosa
Granada
Grand_Forks
Great_Falls
Greenbelt_Park
GSFC

Apply Réinitialiser

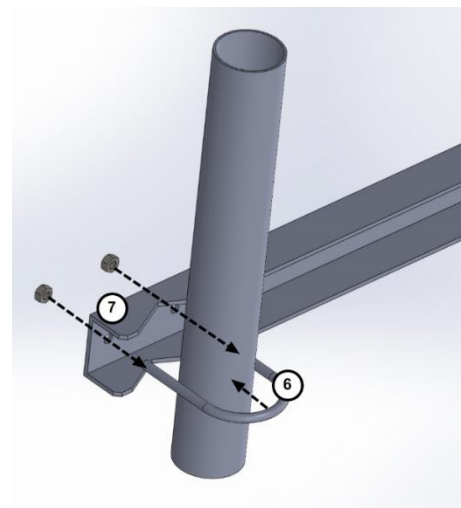
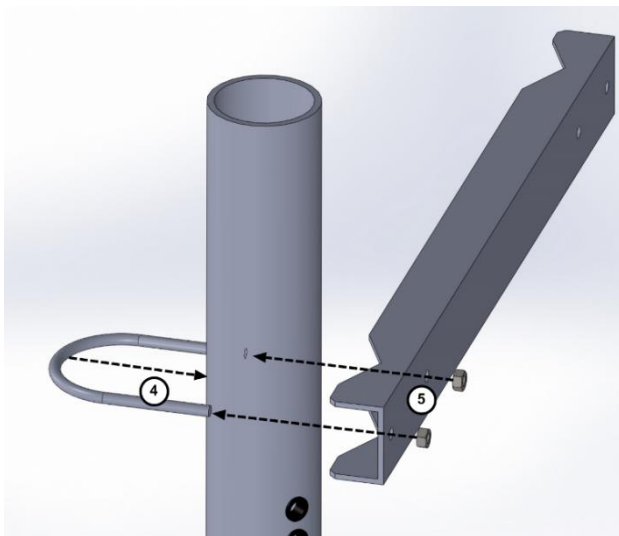


2.3.4.1. Transmitter and antenna installation

1. Attach the mast support to the ground.
2. Insert the mast into the mast support.
3. Tight the screws to fix properly the mast.

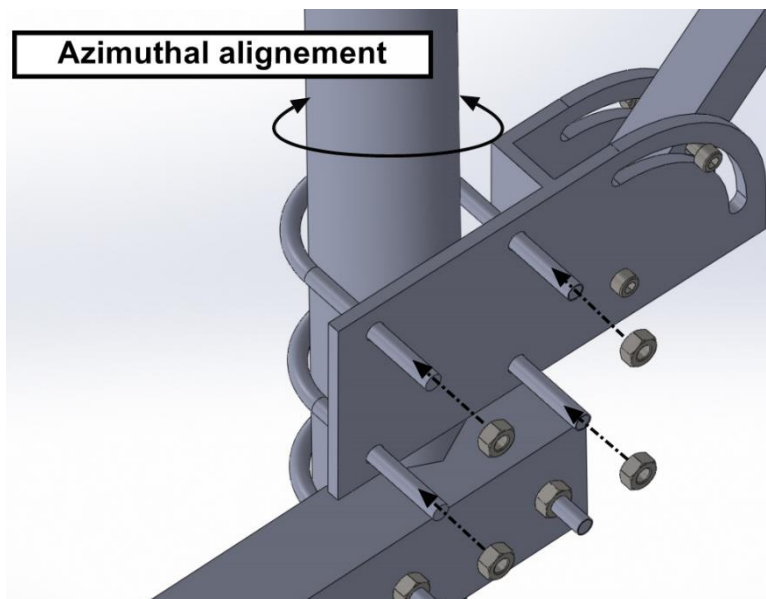
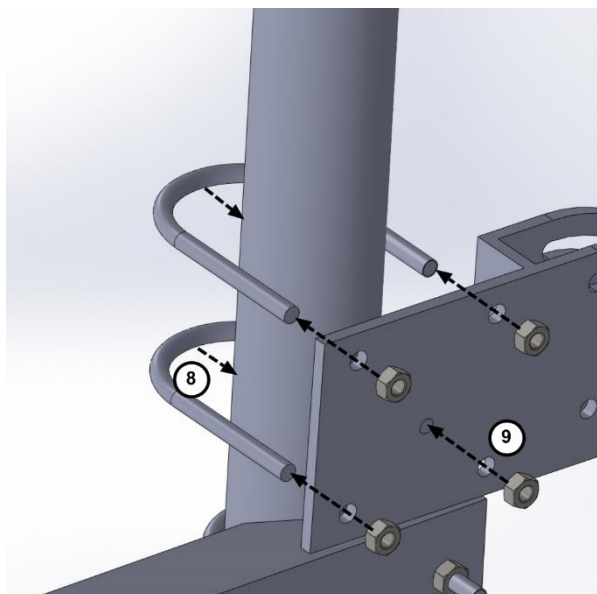


4. Slide the stirrup through the mast until it gets to the end position.
5. Insert the V-shaped part in the stirrup extremities with the mast in between and tighten the nuts.
6. Insert the stirrup extremities in the V-shaped part with the tubular metallic part in between to fix it.
7. Tight the 2 nuts.



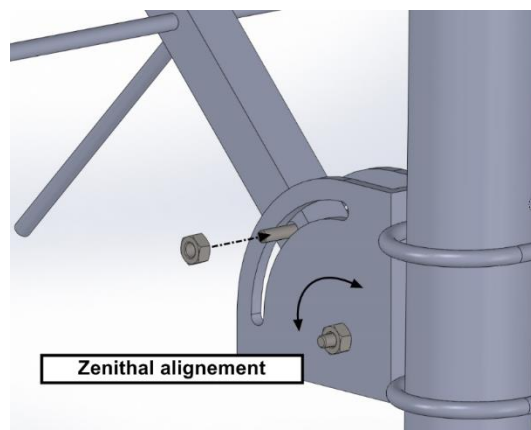
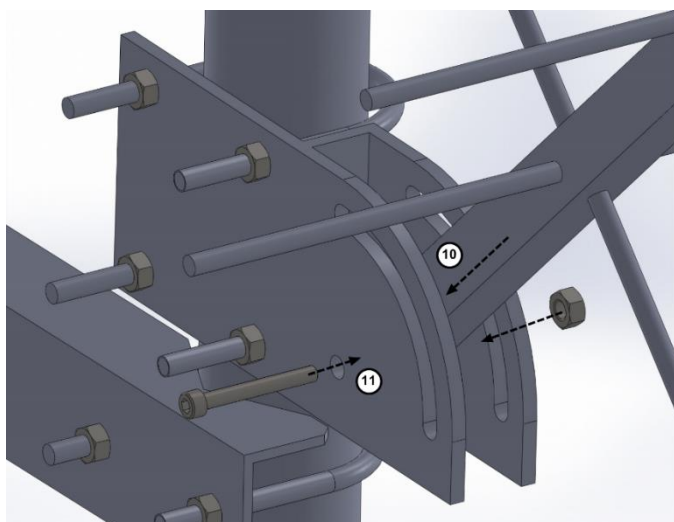
8. Insert the YAGI antenna support in the stirrups with the tubular metallic part in between. Orientate the support to the right angle on the azimuthal plan.

9. Tight the 4 nuts.



10. Insert the YAGI antenna into its support. Orientate the antenna to the right polar angle.

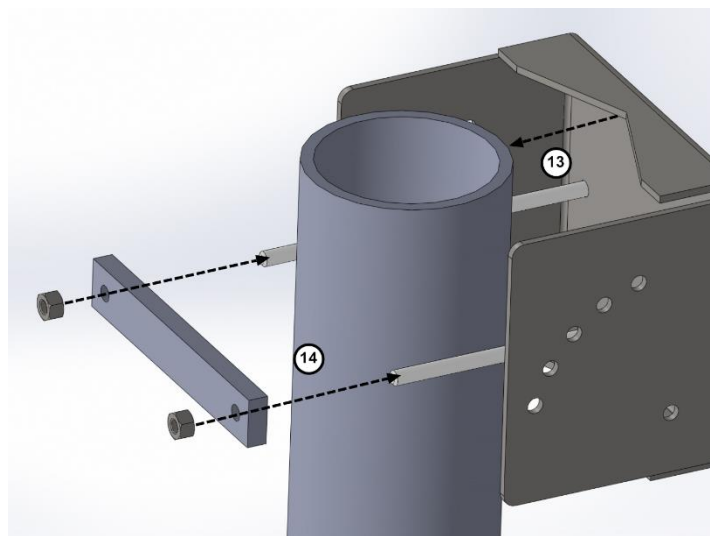
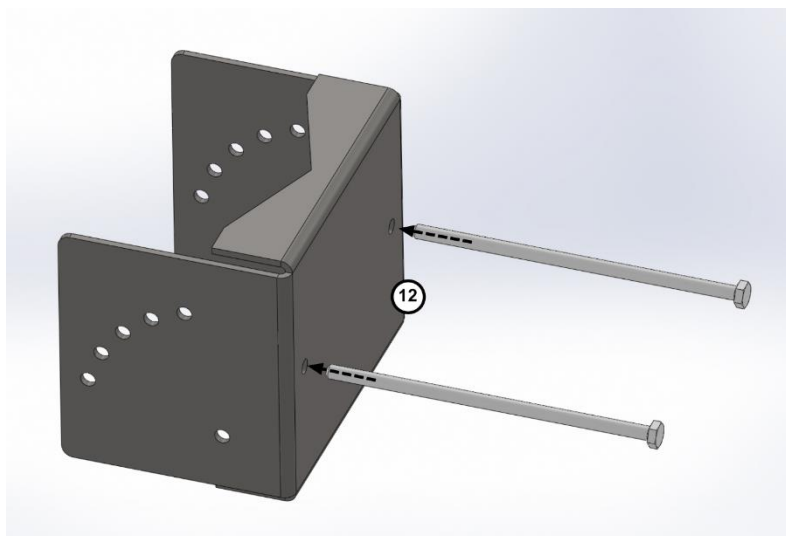
11. Insert the screw in both the YAGI antenna support and the Antenna and tighten the nut to the opposite side.



12. Insert the 2 white screws into the V-shaped part.

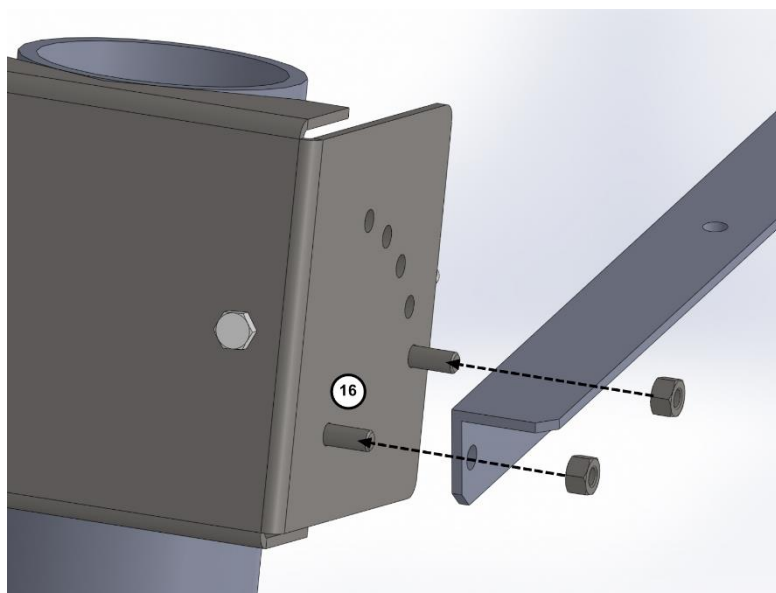
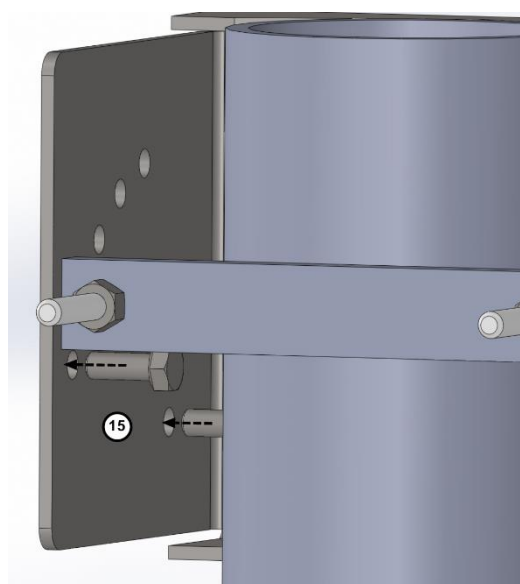
13. Put the white screws around the mast.

- 14.** Insert the fixing flats into the white screws until it gets in contact with the mast and tight the 2 nuts.



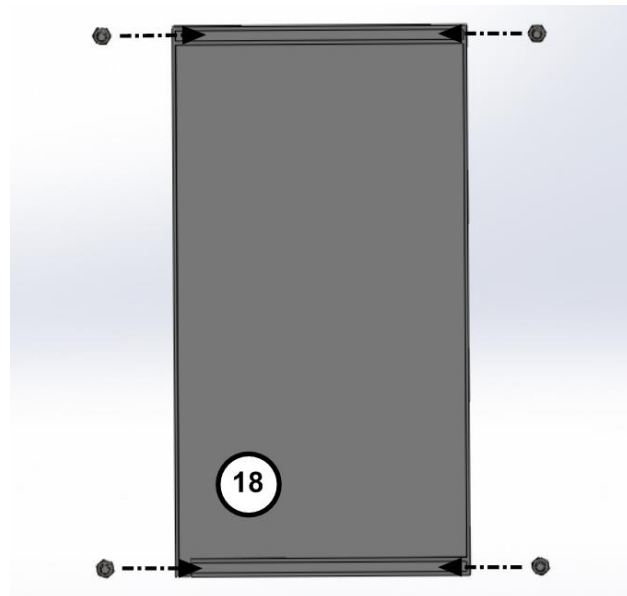
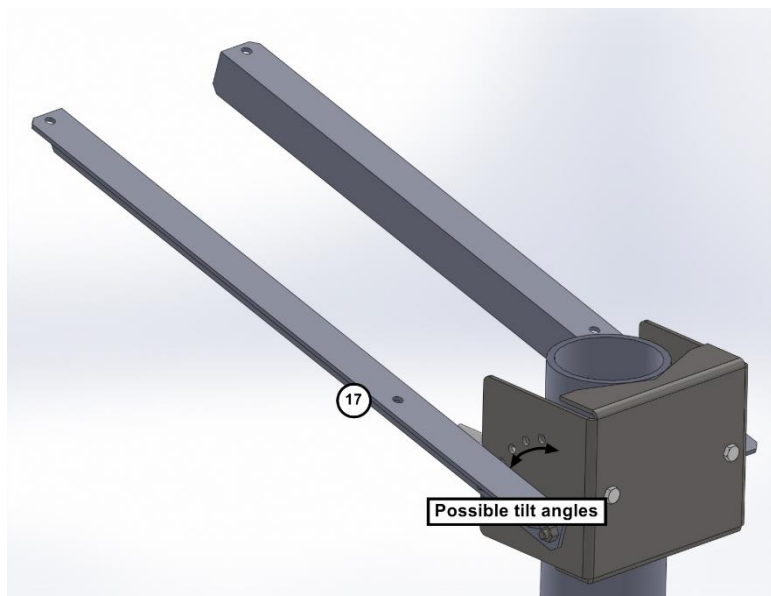
- 15.** Insert the screws in the holes of the V-shaped part according to the tilt angle wished for the solar panel (step 17).

- 16.** Insert the panel brace in the screws and tighten the bolts strongly.



- 17.** Repeat steps 22 and 23 with the second panel brace.

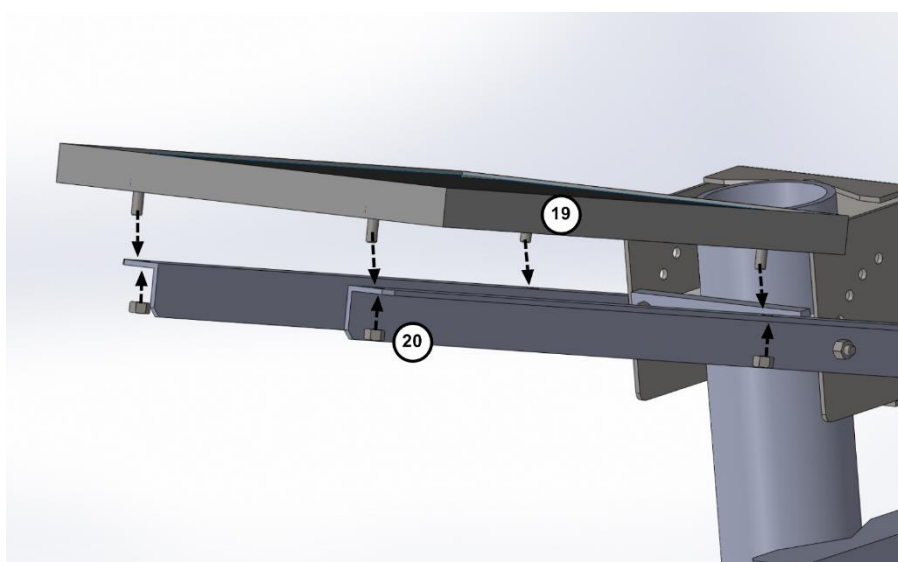
18. Insert the screws in the solar panel slides.



19. Insert those screws in the panel braces.

20. Tight the bolts to fix the solar panel properly.

21. YAGI antenna assembled.



22. Connect the transmitter RF Output to the antenna with a RG-8 cable (not provided).

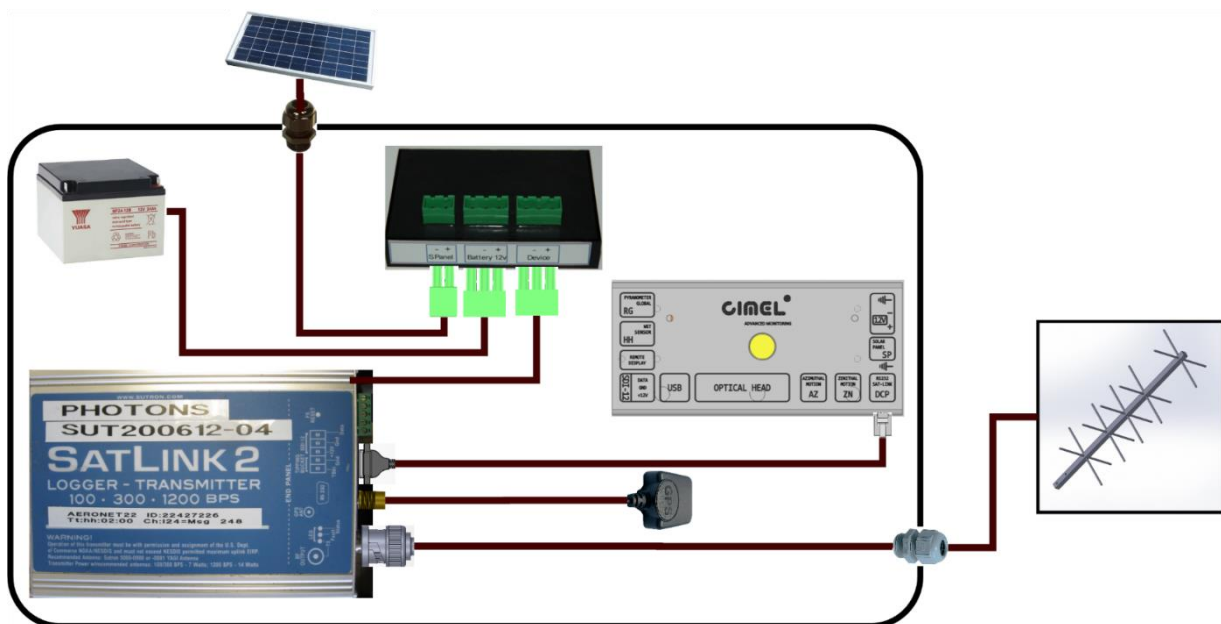
Connect the photometer DCP output to the transmitter RS232 input with the appropriate cable and adaptor.

Power the transmitter using the regulator, the 12 V batteries, and the solar panel.

Connect the GPS device to the transmitter GPS antenna input (optional)

Note: It is advisable to buy the cable once the distance there will be between the transmitter and the antenna is approximately known.

Note 2: Check the LED status for a few minutes after having powered the system. If the green LED is flashing every 5s, the satellite is correctly set. Otherwise, check the Sutron manual to know where the malfunctioning is coming from.



2.3.4.2. Transmitter configuration with the CU

The satellite transmitter configuration is set from the CU menus:

Go to the SETTINGS menu and set the following parameters:

- **[DCP]**
 - **DCP:** Enable the DCP communication. [OFF; ON]: **OFF**.
 - **DCP Config:** Configure the Satlink 2 through the AU. [OFF; ON]: **ON**.

- **DCP Channel:** DCP assigned channel. [0; 266]: 0.
- **DCP Type:** Type of the used satellite. [METEOSAT, GOES 100, GOES 300, GOES 1200, Japan GMS, Feng Yun FY, India INSAT]: METEOSAT.
- **DCP Power:** DCP antenna power (Watts). [1.00; 14.00]: 7.
- **DCP ID:** DCP assigned ID. [00000000; FFFFFFFF]: 00000000.
- **DCP Max:** Define the maximum number of bytes allowed to be transferred to the DCP. [150; 1292]: 625.
- **DCP Interval:** DCP transmission period. [00:00:00; 23:59:59]: 00:30:00.
- **DCP Offset:** DCP start period. [00:00:00; 23:59:59]: 00:00:00.

2.4. Control Unit firmware update

The Control Unit supports firmware upgrades thanks to the PhotoGetData software. The main purpose of the firmware upgrade is to add new features and fix issues.

Please refer to the PhotoGetData user manual to get more info.

PhotoGetData software is available on the www.cimel.fr website in the download section.

3 Control Unit navigation menu

3.1. Capacitive key functions

The **red** key is used to exit a menu or to cancel an action.

The **green** key is used to enter a menu or to validate an action.

The **yellow** and **white** keys are used respectively to go up/down in a menu or to increase/decrease an edit value.

The description of the contextual action of each key is displayed at the bottom of the screen.

3.2. Switch on / Switch off / Standby

When the CU is powered, the display is turned on automatically.

The CU turns into its sleeping mode after one minute of user inactivity. If the scenario menu is open and a scenario is running, the CU doesn't turn off the display until the current scenario is finished.

Press the yellow push button on the removable terminal block to turn on the display when the CU is in sleeping mode.

3.3. *Menu description*

The menu system is hierarchical.

The actual menu structure design is defined by the current firmware version: V2.4.6.

The menu design could be modified in the future.

The main menu is composed of the following parameters:

- SCENARIOS.
- MEASURES.
- MEMORY.
- SETTINGS.
- DATE.
- CIMEL.
- INFO.

3.4. *SCENARIOS*

The SCENARIO menu varies according to the photometer sensor head option. The table below lists all scenarios available according to the sensor head used. These scenarios are described in part 4.1.

| Photometer sensor head option | | | |
|-------------------------------|-----------|------------------------|--------------------------|
| Standard | Polarized | BRDF / BRDF 12 filters | Ocean color / Lake color |
| OFF | OFF | OFF | OFF |
| PARK | PARK | PARK | PARK |
| GOSUN | GOSUN | GOSUN | GOSUN |
| TRACKSUN | TRACKSUN | TRACKSUN | TRACKSUN |
| ORIGIN | ORIGIN | ORIGIN | ORIGIN |
| SUN | SUN | SUN | SUN |
| SKY | SKY | SKY | SKY |
| BLACK | BLACK | BLACK | BLACK |
| HYBRID | HYBRID | HYBRID | HYBRID |

| | | | |
|---------------|-----------------|---------------|---------------|
| ALMUCANTAR | ALMUCANTAR | ALMUCANTAR | ALMUCANTAR |
| PPLAN | PPLAN | PPLAN | PPLAN |
| LTRACK SUN | POL. ALMUCANTAR | CIRCLE | PRS |
| SKY CALIBRATE | POL. PPLAN | LTRACK SUN | LTRACK SUN |
| BCLSUN | POL. HYBRID | SKY CALIBRATE | SKY CALIBRATE |
| BCLSKY | LTRACK SUN | BCLSUN | BCLSUN |
| CROSS | SKY CALIBRATE | BCLSKY | BCLSKY |
| CURVECROSS | BCLSUN | CURVECROSS | CURVECROSS |
| 3 SUN | BCLSKY | 3 SUN | 3 SUN |
| GOMOON | CROSS | GOMOON | GOMOON |
| TRACKMOON | CURVECROSS | TRACKMOON | TRACKMOON |
| MOON | 3 SUN | MOON | MOON |
| LTRACK MOON | GOMOON | LTRACK MOON | LTRACK MOON |
| CROSS MOON | TRACKMOON | CROSS MOON | CROSS MOON |
| 3 MOON | MOON | 3 MOON | 3 MOON |
| | LTRACK MOON | | |
| | CROSS MOON | | |
| | 3 MOON | | |

The SCENARIO menu allows the manual launch of an individual scenario. Select and validate a scenario. Choose one of the 3 actions:

Run (yellow button): launch the entire scenario.

Next (green button): change the filter.

Abort (red button): quit the scenario.

Measured values are displayed in real-time on the screen.

Note 1: A scenario cannot be launched in manual mode if an automatically started scenario is running. If the SCENARIO menu is accessed while an automatic scenario is running, the current action of the CU will be displayed (GOSUN, SUN...).

Note 2: If a scenario launched in manual mode is running and the auto mode is active, the next automatic scenario will be inserted in a stack and will be executed after the current manual one.

3.5. MEASURES

Sensors included in the CU measure the additional monitoring parameters listed below. Values are displayed in real time and updated every 5 seconds:

- **Battery:** Voltage of the external battery.
- **lbattery:** Consumption by the electronic box.
- **Vsolar:** Voltage of the solar panel.
- **Isolar:** Charging current.
- **Vcoin, Vcpu, Vgsm, Vradio:** Internal power supplies.
- **Vrg:** Pyranometer.
- **Wetting:** Measure of the wet sensor. [wet; dry]
- **Temp.int:** Temperature inside the CU.
- **Hum.int:** Humidity inside the CU.
- **Temp.ext:** Temperature on the connector panel board.
- **Hum.ext:** Humidity on the connector panel board.
- **Pressure:** Current atmospheric pressure on the connector panel board.

3.6. MEMORY

The produced data are stored in a non-volatile flash device in the CU.

A backup of the non-volatile flash memory is done in K8 binary format every morning when the sun air mass is -8 (sun still set).

The PC displays the internal Photometer SD card as a mass storage disk.

Here is a list and description of the parameters in the MEMORY menu:

- **State:** Display the SD card size and the free space available on it.
- **FORMAT:** Format the SD card. It will be formatted in the FAT32 file system.
- The procedure to format flash memory is explained in part 5.2.3.
- **SAVE:** Save the flash memory content on the SD card. The generated file is a backup of all of the internal non-volatile flash in binary.
- **EXPORT ASCII:** ASCII files are created from binary data.

3.7. SETTINGS

List and description of the parameters in the SETTINGS menu (default value in bold). These parameters are common to all photometer types except when mentioned.

- **Auto:** Enable or disable automatic measurement. The internal scheduler is executed automatically [OFF; ON]: **OFF**.
- **Moon:** Enable or disable moon measurement. The moon menus are invisible in the SCENARIO menu if this setting is OFF. [OFF; ON]: **OFF**.
- **P. Moon:** Period between two Group L scenarios. [2min; 15min]: **3min**.
- **Country:** Country identification. [0; 255]: **0**.
- **District:** District identification. [0; 255]: **0**.
- **Number:** Number identification. [0; 9999]: **0**.
- **Latitude:** Latitude of the current electronic box. [-90.00°; +90.00°]: **0.0000°**.
- **Longitude:** Longitude of the current electronic box. [-180.00°; +180.00°]: **0.0000°**.
- **Altitude:** Altitude of the current electronic box. [0m; 6000m]: **0m**.
- **Turbo:** Enable or disable the Turbo mode. [OFF; ON]: **OFF**.
- **P. Turbo:** Period between two Group A scenarios. [2min; 6min]: **3min**.
- **Cloud:** Enable cloud mode. [OFF; ON]: **OFF**.
- **P. Bclsun:** Bclsun scenario period. [30s; 360s]: **30min**.
- **Bclsky:** Amount of SKY in a BCLSKY scenario. [1; 1000]: **10**.
- **P.bclsky:** Delay between SKY in a BCLSKY scenario. [00:00:20; 00:06:00]: **[00:00:20]**.
- **AZ offset:** Azimuth robot offset. [-180°; +180°]: **0°**.
- **ZN offset:** Zenith robot offset. [-180°; +180°]: **0°**.
- **RG:** Enable external Global Radiation measurement. [OFF; ON]: **OFF**.
- **RG sens:** Global radiation sensitivity ($\mu\text{V/W/m}^2$). [5.00; 50.00]: 10.00 ;
- [DCP]
 - See chapter 2.3.4.2 for detailed information.
- [GSM]
 - **GSM Roaming:** allow modem roaming for GSM/GPRS communication. [OFF; ON]: **OFF**.
 - [CSD]
 - **CSD:** Enable CSD communication. [OFF; ON]: **OFF**.
 - **H0:** Enable CSD communication between 0h00 and 0h59. [OFF; ON]: **OFF**.
 - **H1:** Enable CSD communication between 1h00 and 1h59. [OFF; ON]: **OFF**.
 - ...
 - **H23:** Enable CSD communication between 23h00 and 23h59. [OFF; ON]: **OFF**.
 - [GPRS]
 - **ACT:** Select the modem network ACcess Technology. [AUTO, 2G, 3G,4G]: AUTO.
 - **APN:** Access Point Name provided by the network operator to

access the internet. This setting must be modified by PhotoGetData.

- **USER:** Username provided by the network operator to access the internet. This setting must be modified by PhotoGetData.
- **PASS** Password provided by the network operator to access the internet. This setting must be modified by PhotoGetData.
- [FTP]
 - See chapter 2.3.3.3.1 for detailed information.
- [HTTP]
 - See chapter 2.3.3.4.2 for detailed information.
- [SEA]
 - **ASea (SEAPRISM / CE318-TV12):** Azimuthal angle from the sun for the sky & sea measurements. [-180°; +180°]: **-90°**.
 - **ZSea (SEAPRISM / CE318-TV12):** Polar angle for the sky & sea measurements. SKY measurements will be done at the horizontal + Zsea degrees and SEA measurements at the horizontal - Zsea degrees. [0°; +180°]: **40°**.
 - **PNM:** Number of executed PRS scenarios. [1; 11]: **1**.
 - **NMSea (SEAPRISM / CE318-TV12):** Number of sea measurements. [3; 15]: **11**.
 - **NMSky (SEAPRISM / CE318-TV12):** Number of Sky measurements. [3; 15]: **3**.
 - **AHL (SEAPRISM / CE318-TV12):** Maximum angle on the left side. [-270; 0]: **-270°**.
 - **AHR (SEAPRISM / CE318-TV12):** Maximum angle on the right side. [0; +270]: **+270°**.
 - **AT1, AT2:** If the current time in the day is between AT1 and AT2, the sign of aSea angle is inverted. [0; 24]: **0**.
 - **AD1, AD2:** If the current day of the year is between AD1 and AD2, the sign of aSea angle is inverted. 1 if the January 1st and 365 is December 31th. This functionality doesn't take care of the leap year. [1; 365]: **0**.
 - **TT1, TT2, and PTD:** Not used actually.

To save new settings, exit from the menu. If a parameter is changed, a dialog message appears and asks to confirm the modifications.

3.8. DATE

The CU date and time can be set manually via the "DATE" menu. After the modification, exit from this menu. A dialog message appears and asks to confirm the modification.

3.9. CIMEL

Here is a list and description of the parameters in the CIMEL menu:

- **TSV:** displays True Solar Time.
- **ROBOT:** displays the robot's azimuthal and polar mechanical switch values
- **INHEAD:** When the AU is connected to an optical head, this menu acquires and displays the optical internal temperature and humidity.
- **SET ROBOT:** This menu permits the robot movements through the UA.
- [MODEM]
 - **GSM TEST:** Test the modem antenna reception quality.
 - **FTP Test:** Execute a test connection to an FTP server. A SIM card is required and the server information must be indicated by the user. See chapter 2.3.3.3.1 for detailed information.
 - **HTTP Test:** Upload a K8 file to an HTTP(s) server. A SIM card is required and the server information must be indicated by the user. See chapter 2.3.3.4.2 for detailed information.
 - **VERSION:** Firmware and hardware version of the modem.
 - **FOTA:** enter this menu to update the modem firmware through the AirVantage website. Please refer to the "CE318-T Sierra Fota.pdf" for the update procedure.
 - **Network:** Last modem registration type:
 - **0:** Not registered.
 - **1:** Registered to the network.
 - **2:** Searching for registration.
 - **3:** Registration denied.
 - **4:** Registration error.
 - **5:** Registered to the network, roaming.
 - **Level:** Last modem signal strength.
 - **0:** -113 dBm or less. Very bad level.
 - **1:** -111 dBm
 - **2 to 30:** -109 to -53 dBm.
 - **31:** -51 dBm or greater. Very good level.
 - **Error:** The last error encountered during the last GPRS communication.
- **GPS INFO (1):** enter this menu to enable automatic GPS acquisition. The acquisition starts when the State information is set to "Wait GPS..." If the GPS is active, a (G) suffix is added at the end of the time on the root menu.
- [DCP]
 - **DCP TEST:** enter this menu to test the communication between the AU and the Satlink 2.
- **Password:** not used menu.

(1): The first time, the GPS may take up to 15 min to get the GPS information.

Coordinates are checked daily at 01:00 True Solar Time. The coordinates are automatically updated if the photometer has been moved over one-tenth of a degree in longitude or/and latitude.

3.10. INFO

This menu displays information about the instrument.

- Software: current firmware version of the instrument.
- Photometer: Instrument type (TS9, TU9...)
- CPU: Version of the main CPU electronic board.
- Connector: Version of the connector panel electronic board.

4 General description of the scenarios and their sequence

4.1. Scenario description and sequencing

Scenarios may be launched either automatically via the scheduler or in manual mode via the SCENARIO menu (see part 3.5).

OFF: launch OFF scenario.

PARK: Launch PARK scenario. The photometer optical head is going to park at the nadir position.

GOSUN / GOMOON: launch GOSUN / GOMOON scenario. The photometer is going to the theoretical position of the sun/moon.

TRACK SUN / TRACK MOON: The track scenario consists of tracking the SUN / MOON using the 4-quadrant sensor.

LTRACK SUN / LTRACK MOON: The LTRACK scenario consists of tracking the SUN / MOON permanently. It also measures signal on both channels.

ORIGIN: launch ORIGIN scenario. The photometer goes to its ORIGIN position which is +7.5° on both azimuthal and polar axes compared to the PARK position.

SUN: The SUN scenario consists of measuring the sun irradiance for all the wavelengths. SUN gains are used. Measurements are done in the following order:

Filters used and their sequence (i for InGaAs channel)

| Standard / Polarized | BRDF | BRDF 12 filters | ocean color / <u>lake color</u> |
|----------------------|----------|-----------------|---------------------------------|
| 1020 nm | 1020 nm | 1020 nm | 1020 nm |
| 1640i nm | 1640i nm | 1640i nm | 865 nm |

| | | | |
|--------------------|--------------------|--------------------|------------------------|
| 870 nm | 870 nm | 870 nm | 779 nm / <u>709 nm</u> |
| 675 nm | 675 nm | 675 nm | 665 nm |
| 440 nm | 440 nm | 440 nm | 620 nm |
| 500 nm | 550 nm | 500 nm | 560 nm |
| 1020i nm | 1020i nm | 555 nm | 1020i nm |
| 937 nm | 937 nm | 1020i nm | 510 nm |
| 380 nm | 380 nm | 937 nm | 490 nm |
| 340 nm | 740 nm | 782 nm | 442 nm |
| Sensor head T (°C) | Sensor head T (°C) | 740 nm | 412 nm |
| | | 702 nm | 400 nm / <u>681 nm</u> |
| | | 415 nm | 937 nm |
| | | Sensor head T (°C) | Sensor head T (°C) |

MOON (only in Standard and polarized): Same sequence than the SUN measurements. SKY gains are used to measure.

BCLSUN: The BCLSUN scenario consists in launching in continue TRACK/SUN scenario with a time interval defined in SETTINGS menu with **P.bclsun** parameter.

3 SUN / 3 MOON: The 3 SUN / 3 MOON scenario consists in repeating 3 times a SUN / MOON scenario. Temperature is recorded once at the end of the scenario.

SKY: The SKY scenario consists in measuring the sky radiance for several wavelengths. SKY or AUREOLE (AUR) gains are used and the measures are done in the following order:

| Filters used and their sequence (i for InGaAs channel) | | | | |
|--|-----------------------------|--------------|-----------------|---------------------------------|
| Standard | Polarized | BRDF | BRDF 12 filters | ocean color / <u>lake color</u> |
| 1020 nm AUR | 1020 nm AUR | 1020 nm AUR | 1020 nm AUR | 1020 nm AUR |
| 1640i nm AUR | 1640i nm AUR | 1640i nm AUR | 1640i nm AUR | 865 nm AUR |
| 870 nm AUR | 870 nm AUR | 870 nm AUR | 870 nm AUR | 779 nm / <u>709 nm</u> AUR |
| 675 nm AUR | 675 nm AUR | 675 nm AUR | 675 nm AUR | 665 nm AUR |
| 440 nm AUR | 440 nm AUR | 440 nm AUR | 440 nm AUR | 620 nm AUR |
| 500 nm AUR | 500 nm AUR | 550 nm AUR | 500 nm AUR | 560 nm AUR |
| 380 nm AUR | 380 nm AUR | 380 nm AUR | 555 nm AUR | 1020i nm AUR |
| 1020 nm SKY | 340 nm AUR | 740 nm AUR | 782 nm AUR | 510 nm AUR |
| 1640i nm SKY | 1020 nm SKY | 1020 nm SKY | 740 nm AUR | 490 nm AUR |
| 870 nm SKY | 1020 nm SKY POL IR 0-1-2-3 | 1640i nm SKY | 702 nm AUR | 442 nm AUR |
| 675 nm SKY | 1640i nm SKY | 870 nm SKY | 415 nm AUR | 412 nm AUR |
| 440 nm SKY | 1640i nm SKY POL IR 0-1-2-3 | 675 nm SKY | 1020 nm SKY | 400 nm / <u>681 nm</u> AUR |
| 500 nm SKY | 870 nm SKY | 440 nm SKY | 1640i nm SKY | 1020 nm SKY |
| 380 nm SKY | 870 nm SKY POL IR 0-1-2-3 | 550 nm SKY | 870 nm SKY | 865 nm SKY |

| | | | | |
|--------------------|----------------------------|--------------------|--------------------|---------------------|
| Sensor head T (°C) | 675 nm SKY | 1020i nm SKY | 675 nm SKY | 779 nm / 709 nm SKY |
| | 675 nm SKY POL VIS 0-1-2-3 | 380 nm SKY | 440 nm SKY | 665 nm SKY |
| | 440 nm SKY | 740 nm SKY | 500 nm SKY | 620 nm SKY |
| | 440 nm SKY POL VIS 0-1-2-3 | Sensor head T (°C) | 555 nm SKY | 560 nm SKY |
| | 500 nm SKY | | 1020i nm SKY | 1020i nm SKY |
| | 500 nm SKY POL VIS 0-1-2-3 | | 782 nm SKY | 510 nm SKY |
| | 380 nm SKY | | 740 nm SKY | 490 nm SKY |
| | 380 nm SKY POL UV 0-1-2-3 | | 702 nm SKY | 442 nm SKY |
| | 340 nm SKY | | 415 nm SKY | 412 nm SKY |
| | 340 nm SKY POL UV 0-1-2-3 | | Sensor head T (°C) | 779 nm / 709 nm SKY |
| | Sensor head T (°C) | | | Sensor head T (°C) |

BCLSKY: The BCLSKY scenario consists in performing sky and 3 Black measurements. The number of sky measurements is defined by NBCLSKY in the settings menu, which by default is 10.

BLACK: The black scenario consists in measuring the electronic background of the device. Light path is closed on the two channels by positioning the filter-wheel between two filters.

Important note: The signal measured is the dark current. It is subtracted to the full signal measured. It is also an indicator for a possible electronic failure if too big.

Measures are done in the following order:

- AUREOLE gain, silicon channel (canal 1)
- AUREOLE gain, InGaAs channel (canal 2)
- SKY gain, silicon channel
- SKY gain, InGaAs channel

SKY CALIBRATE: The SKY CALIBRATE scenario consists in performing 3 SKY and 1 BLACK scenario.

HYBRID (Standard, Polarized): The scenario is a combination of the Almucantar / Principal Plane scenario to optimize the range of scattering angle.

NASA AERONET has defined hybrid scenarios to maximize scattering angle range, symmetry about the sun and minimize the time of a measurement sequence. The exact scans would vary according to solar zenith angle (SZA) but designed to maximize the scattering angle according to greatest distance from the PP meridian, meaning that the angle between the Sun, the Zenith and the Photometer is 90° for any given scattering angle. The scattering angle will be limited near the horizon by a 75-degree zenith angle.

This cut-off angle needs to variable set in parameters. Considering the spherical rectangular triangle, it is easy to show that¹:

$$\tan PAZ = \frac{\tan \Theta}{\sin SZA}$$

And

$$\cos PZA = \cos SZA \cos \Theta$$

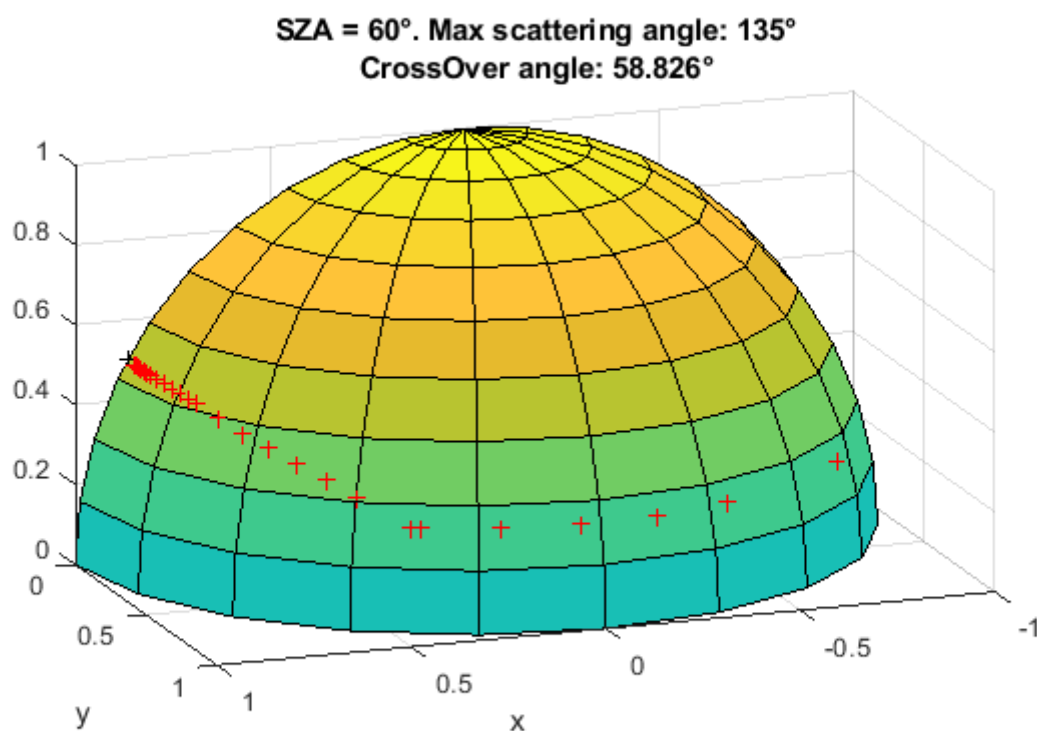
Where

- Θ is the scattering angle
- PAZ is the Photometer Azimuth Angle
- PZA is the Photometer Zenith Angle
- SZA is the Solar Zenith angle

These equations will be used for PZA below 75°. In other cases, the almucantar scenario will be performed.

An example is given below for a SZA = 60°:

¹ See https://en.wikipedia.org/wiki/Spherical_trigonometry



The black cross indicates the SUN position. The red crosses are the successive positions of the photometer.

| ⊙ | Azimuth | Zenith |
|---------|---------|---------|
| 3.0000 | 3.4630 | 60.0453 |
| 3.5000 | 4.0398 | 60.0617 |
| 4.0000 | 4.6163 | 60.0805 |
| 5.0000 | 5.7686 | 60.1258 |
| 6.0000 | 6.9198 | 60.1810 |
| 7.0000 | 8.0696 | 60.2463 |
| 8.0000 | 9.2177 | 60.3214 |
| 10.0000 | 11.5084 | 60.5013 |
| 12.0000 | 13.7900 | 60.7203 |
| 14.0000 | 16.0611 | 60.9778 |
| 16.0000 | 18.3200 | 61.2734 |
| 18.0000 | 20.5653 | 61.6062 |
| 20.0000 | 22.7959 | 61.9757 |

| | | |
|----------|----------|---------|
| 25.0000 | 28.3001 | 63.0538 |
| 30.0000 | 33.6901 | 64.3411 |
| 35.0000 | 38.9566 | 65.8218 |
| 40.0000 | 44.0953 | 67.4790 |
| 45.0000 | 49.1066 | 69.2952 |
| 50.0000 | 53.9948 | 71.2528 |
| 58.8260 | 62.3479 | 75.0000 |
| 60.0000 | 63.7035 | 75.0000 |
| 70.0000 | 75.2761 | 75.0000 |
| 80.0000 | 86.9685 | 75.0000 |
| 90.0000 | 98.8994 | 75.0000 |
| 100.0000 | 111.2406 | 75.0000 |
| 120.0000 | 138.8002 | 75.0000 |

ALMU (Standard, BRDF) / ALMUP (Polarized): The **ALMU**cantar technique consists in measuring the sky radiance in aerosol channels, keeping a constant polar angle equal to the zenith solar angle with varying azimuthal angle.

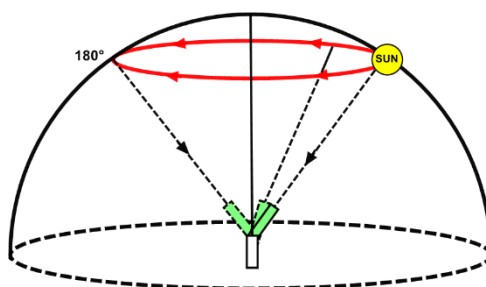
In the ALMU scenario, azimuthal angles vary from 0° to +180° for an almucantar right and 0° to -180° for an almucantar left using:

- SUN gain on the sun
- AUREOLE gain between $\pm 3^\circ$ to $\pm 6^\circ$ *
- AUREOLE and SKY gain for $\pm 6^\circ$ *
- SKY gain above $\pm 6^\circ$
- The last data is the sensor head temperature.

* The Photometer performs two measurements at $\pm 6^\circ$, one with AUREOLE gain and one with SKY gain.

In the **ALMU**cantar **Polarized** scenario, azimuthal angles vary from 25° to +160° for an almucantar right and -25° to -160° for an almucantar left using SKY gain only.

Below is a visual description of the Almucantar and Polarized Almucantar.





| Standard | Polarized | BRDF | BRDF 12 filters | ocean color / lake color |
|----------|-----------------------------|----------|-----------------|--------------------------|
| 1020 nm | 1020 nm SKY POL IR 0-1-2-3 | 1020 nm | 1020 nm | 1020 nm |
| 1640i nm | 1640i nm SKY POL IR 0-1-2-3 | 1640i nm | 1640i nm | 865 nm |
| 870 nm | 870 nm SKY POL IR 0-1-2-3 | 870 nm | 870 nm | 779 nm / <u>709 nm</u> |
| 675 nm | 675 nm SKY POL VIS 0-1-2-3 | 675 nm | 675 nm | 665 nm |
| 440 nm | 440 nm SKY POL VIS 0-1-2-3 | 550 nm | 440 nm | 620 nm |
| 500 nm | 500 nm SKY POL VIS 0-1-2-3 | 380 nm | 500 nm | 560 nm |
| 380 nm | 380 nm SKY POL UV 0-1-2-3 | 740 nm | 550 nm | 510 nm |
| | 340 nm SKY POL UV 0-1-2-3 | 1020i nm | 1020i nm | 490 nm |

| | | | | |
|--|--|--|--------|------------------------|
| | | | 782 nm | 442 nm |
| | | | 740 nm | 412 nm |
| | | | 702 nm | 400 nm / <u>681 nm</u> |
| | | | 415 nm | |

PP / PPP: The **P**roincipal **P**lan technique also consists in measuring the sky radiance in the aerosol channels. Unlike the almucantar, a constant azimuthal angle is kept with varying polar angle to make measurements.

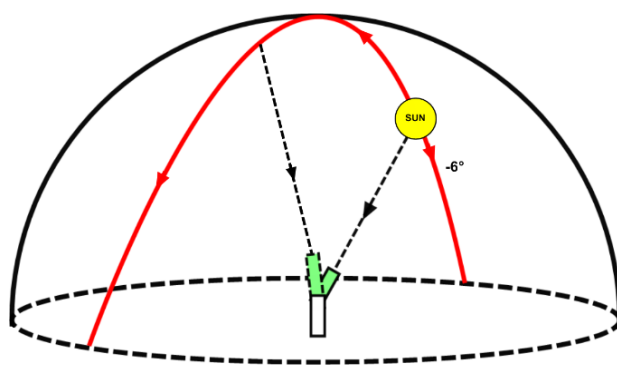
In the PP scenario, polar angles vary from -6° to $+150^{\circ}$ using:

- AUREOLE gain between -6° to -2°
- SUN gain on the sun
- AUREOLE gain between 2° to 6° *
- AUREOLE and SKY gain for 6° *
- SKY gain above 6°
- The last data is the sensor head temperature.

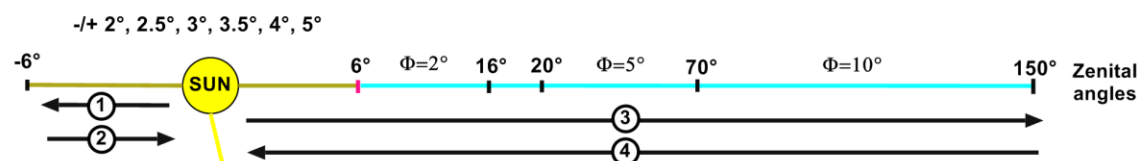
* The Photometer performs two measurements at 6° , one with AUREOLE gain and one with SKY gain.

In the **P**roincipal **P**lane **P**olarized scenario, polar angles vary from -85° to $+175^{\circ}$ using SKY gain only.

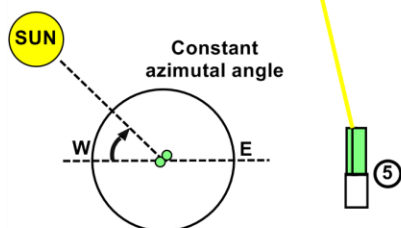
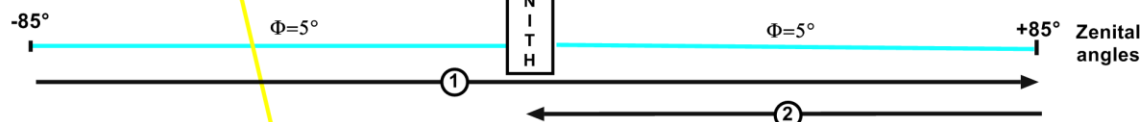
Below is a visual description of the Principal Plan and Polarized Principal Plan.



PRINCIPAL PLAN



POLARISED PRINCIPAL PLAN



MEASURES

- AUREOLE Gain used to measure
- SKY and AUREOLE Gain used to measure
- SKY Gain used to measure
- Φ Steps in between 2 measurements in degrees

SEQUENCE

- ① First direction of measurement
- ② Return to the sun position
- ③ Second direction of measurement
- ④ Return to the sun position
- ⑤ Filter changing

Filters used and their sequence (i for InGaAs channel)

| Standard | Polarized | BRDF | BRDF 12 filters | ocean color / lake color |
|----------|-----------------------------|----------|-----------------|--------------------------|
| 1020 nm | 1020 nm SKY POL IR 0-1-2-3 | 1020 nm | 1020 nm | 1020 nm |
| 1640i nm | 1640i nm SKY POL IR 0-1-2-3 | 1640i nm | 1640i nm | 865 nm |
| 870 nm | 870 nm SKY POL IR 0-1-2-3 | 870 nm | 870 nm | 779 nm / <u>709 nm</u> |
| 675 nm | 675 nm SKY POL VIS 0-1-2-3 | 675 nm | 675 nm | 665 nm |
| 440 nm | 440 nm SKY POL VIS 0-1-2-3 | 550 nm | 440 nm | 620 nm |
| 500 nm | 500 nm SKY POL VIS 0-1-2-3 | 380 nm | 500 nm | 560 nm |
| 380 nm | 380 nm SKY POL UV 0-1-2-3 | 740 nm | 550 nm | 510 nm |
| | 340 nm SKY POL UV 0-1-2-3 | 1020i nm | 1020i nm | 490 nm |
| | | | 782 nm | 442 nm |
| | | | 740 nm | 412 nm |
| | | | 702 nm | 400 nm / <u>681 nm</u> |
| | | | 415 nm | |

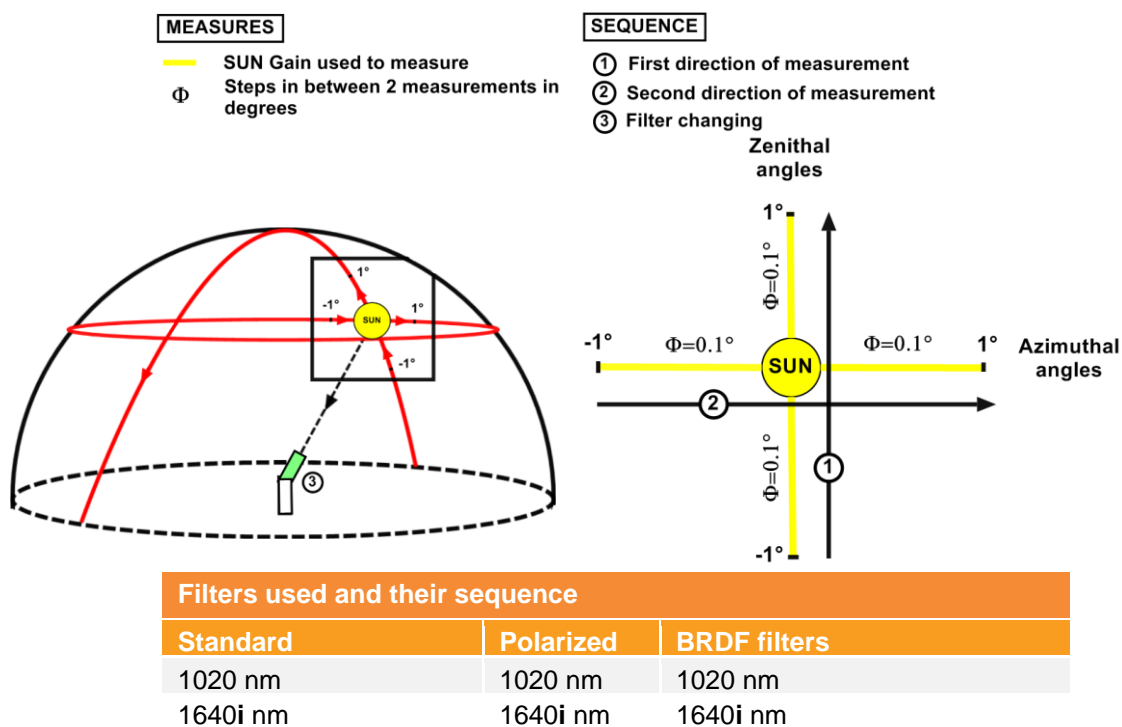
CROSS SUN / MOON: The Cross Sun / Moon scenario consists in measuring sun or moon irradiance in 2 bands for several angles close to the sun / moon, using a cross scheme.

In Cross Sun / Moon scenario:

- Polar angles vary from -1° to 1° (by 0.1° increments) using SUN / SKY gain with constant azimuthal angle
- Azimuthal angles vary from -1° to 1° (by 0.1° increments) using SUN / SKY gain with constant polar angle.

For each pointing position, the scenario also acquires service data from the 4-quadrant detector: X difference, Y difference and Total. This information may be used to check the correct alignments of the 4-quadrant optical axis with each measurement optical axis.

Below is a visual description of the Cross Sun / Moon.



CURVATURE CROSS: Scenario validation in progress. Description not available yet.

CIRCLE (only with BRDF/CE318-TU photometers): The CIRCLE scenario consists in measuring at the constant polar with varying azimuthal angles from 0 to 360° with 5° steps using SKY gains.

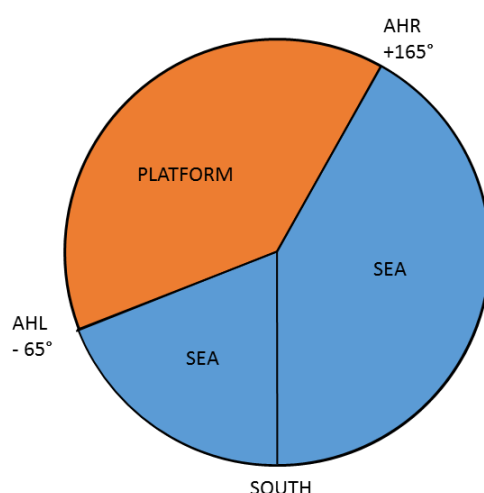
| Filters used and their sequence | |
|---------------------------------|--------------------------|
| BRDF | BRDF 12 filters |
| 1640 nm (InGaAs channel) | 1640 nm (InGaAs channel) |
| 870 nm | 870 nm |
| 675 nm | 675 nm |
| 440 nm | 440 nm |
| 550 nm | 500 nm |
| 740 nm | 550 nm |
| | 782 nm |
| | 740 nm |
| | 702 nm |
| | 415 nm |

BRDF (only with BRDF photometers): The BRDF scenario consists in launching successive CIRCLE scenarios, starting from a polar angle of 5° and finishing with a polar angle of 60°.

Filters used and the sequence is the same than CIRCLE scenario.

PRS (only with SEAPRISM / CE318-TV12 photometers): The Sea Prism scenario consists in making M measures on the sea and N on the sky (see NMSea, NMSky parameters). This scenario is executed 8 times one for each filter.

It is important to notice that AHL and AHR parameters impose spatial restrictions in Sea measurements. Indeed, ideally the photometer would have a field of view of 360° to make sea measurements. In practice, the photometer is usually installed on an off-shore platform or on a jetty. Then the field of view is reduced and AHL and AHR enable to set this reduced field of view to only measures the sea radiance.



| Filters used and their sequence |
|---------------------------------|
| ocean color / lake color |
| 1020 nm |
| 870 nm |
| 779 nm / <u>709 nm</u> |
| 665 nm |
| 620 nm |
| 560 nm |
| 510 nm |
| 490 nm |
| 442 nm |
| 412 nm |
| 400 nm / <u>681 nm</u> |

SUNP (Polarized): The SUN Polarized scenario consists in measuring the Sun directly on all polarizers with all filters.

| Filters used and their sequence |
|---------------------------------|
| Polarized |
| 1020 nm SUN POL IR 0-1-2-3 |
| 1640i nm SUN POL IR 0-1-2-3 |
| 870 nm SUN POL IR 0-1-2-3 |
| 675 nm SUN POL VIS 0-1-2-3 |
| 440 nm SUN POL VIS 0-1-2-3 |
| 500 nm SUN POL VIS 0-1-2-3 |
| 937 nm SUN POL IR 0-1-2-3 |
| 380 nm SUN POL UV 0-1-2-3 |
| 340 nm SUN POL UV 0-1-2-3 |

Note 1: This scenario is only used to check the polarizers.

MOONP (Polarized): The MOON Polarized scenario consists in measuring the Moon directly on all polarizers with all filters except 937, 380 and 340nm.

| Filters used and their sequence |
|---------------------------------|
| Polarized |
| 1020 nm SKY POL IR 0-1-2-3 |
| 1640i nm SKY POL IR 0-1-2-3 |
| 870 nm SKY POL IR 0-1-2-3 |
| 675 nm SKY POL VIS 0-1-2-3 |
| 440 nm SKY POL VIS 0-1-2-3 |
| 500 nm SKY POL VIS 0-1-2-3 |

4.2. Group of measurement scenarios

In auto mode, the photometer follows a schedule and automatically launches both individual scenarios and group of measurement scenarios.

The following groups of scenarios are used:

| Group name | Measures |
|----------------|--|
| Group A | 3 SUN; |
| Group B | 3 SUN; HYB; 3 SUN; HY |
| Group C | 3 SUN; HYB; 3 SUN; HYBP ; 3 SUN; ALMU; 3 SUN; ALMUP ; 3 SUN; PP; 3 SUN; PPP |
| Group D | 3 SUN; CRO; BLACK |
| Group E | 3 SUN; ALMU; 3 SUN; ALMUP |
| Group F | 3 SUN; SUNP ; HYB; 3 SUN; HYBP ; 3 SUN; ALMU; 3 SUN; ALMUP ; 3 SUN; PP; 3 SUN; PPP |
| Group L | 3 MOON; MOONP |
| Group P | 3 SUN; SPR |
| Group S | 3 SUN; ALMU; PP; BRDF; BLACK; |

Note 1: In **bold**, measures that are done only with the polarized photometers. By default, only HYBP is done. ALMUP and PPP have to be activated in PW on the CU.

Note 2: the group S is only done by the BRDF photometers.

Note 3: the group P is only done by SEAPRISM photometers.

Note 4: SUNP and MOONP have to be activated in PW on the CU.

4.3. Day and night measurement schedule in Auto mode

4.3.1. Standard (CE318-TS9) and polarized (CE318-TP9)

The photometer follows a daily schedule of automatic actions. Some actions are triggered by the time of the day and some by the air mass which is related to the thickness of atmosphere the sun light has been through to get to the photometer (Langley times). The Langley times depend on both the site where the photometer is located and the date. They are automatically calculated and set in the photometer sequence list each day at 1AM.

Moreover night time measurements can be done. It is important to notice that **night time measurements are not activated by default**.

To activate night time measurements and to choose the measurement period, go in the SETTINGS menu on the CU. (See part 3.7)

- switch **Moon** setting to **ON**

- choose a value between 2 and 15 min in **P.moon** setting (default 3mn)

Automatic actions done by the photometer in Auto mode (day and night time):

| Air mass | Equivalent zenith angle | Group |
|--------------|-------------------------|---------|
| Air mass 7.0 | 81.8° | Group A |
| Air mass 6.5 | 81.15° | Group A |
| Air mass 6.0 | 80.40° | Group A |
| Air mass 5.5 | 79.52° | Group A |
| Air mass 5.0 | 78.46° | Group A |
| Air mass 4.5 | 77.16° | Group A |
| Air mass 4.0 | 75.52° | Group E |
| Air mass 3.8 | 74.74° | Group A |
| Air mass 3.6 | 73.87° | Group A |
| Air mass 3.4 | 72.89° | Group A |
| Air mass 3.2 | 71.79° | Group A |
| Air mass 3.0 | 70.53° | Group C |
| Air mass 2.8 | 69.07° | Group A |
| Air mass 2.6 | 67.38° | Group A |
| Air mass 2.4 | 65.37° | Group A |
| Air mass 2.2 | 62.96° | Group A |
| Air mass 2.0 | 60° | Group B |
| Air mass 1.7 | 53.97° | Group B |

| | Afternoon times | Group |
|-------|-----------------|---------|
| 09H00 | 15H00 | Group C |
| 09H15 | 14H45 | Group D |
| 09H30 | 14H30 | Group A |
| 09H45 | 14H15 | Group A |
| 10H00 | 14H00 | Group C |
| 10H15 | 13H45 | Group A |
| 10H30 | 13H30 | Group A |
| 10H45 | 13H15 | Group A |

| | | |
|-------|-------|--------------------------|
| 11H00 | 13H00 | Group C / Group F |
| 11H15 | 12H45 | Group A |
| 11H30 | 12H30 | Group A |
| 11H45 | 12H15 | Group A |
| 12H00 | | Group C / Group F |

Note: If air masses measurements times come after 9H00 or before 15H00, they are skipped. The defined times scheduler gets the priority.

An empty period without any measurements may exist between air mass 1.7 and 9H00 in the morning and between 15H00 and air mass 1.7 in the afternoon. If it is the case, the following scheduler is executed:

| | Afternoon times | Group |
|-------|-----------------|---------|
| 07H30 | 15H15 | Group A |
| 07H45 | 15H30 | Group A |
| 08H00 | 15H45 | Group C |
| 08H15 | 16H00 | Group A |
| 08H30 | 16H15 | Group A |
| 08H45 | 16H30 | Group A |

Night time measurements are executed if:

- The moon phase is between the first and last quarter
- Moon air mass is higher than 7
- Sun air mass is below -7. Sun air mass below -7 means that the sun is already set and far enough so that it is not lightening too much the sky.

| | Group |
|---|---------|
| Between 2 and 15 min; default value 3 min | Group L |

4.3.2. BRDF (CE318-TU9) and BRDF 12 filters (CE318-TU12)

The BRDF Photometer executes **Group S** scenario every day from sun air mass 5 in the morning to sun air mass 5 in the evening. (A group S scenario is around 2h long).

The group S scenario automatically starts at a round True Solar Time minute if no other scenario is running.

Note 1: The Almucantar is executed only if the sun zenith is between air mass 4.0 and air mass 1.5.

Note 2: A PARK, GOSUN and 3SUN are executed between each zenith angle change.

4.3.3. SEAPRISM (CE318-TV12)

The SEAPRISM photometer executes **group P** scenario every day from sun air mass 5 in the morning to sun air mass 5 in the evening. The group P scenario automatically starts at every round hour and half hour True Solar Time.

Before air mass 5 and after air mass 5 the SEAPRISM photometer executes the STANDARD scheduler.

4.3.4. Polarized (CE318-TP9)

After each 3 MOON scenario, the Polarized photometer can execute a MOONP scenario.

Note 1: The “Pol moon” setting has to be activated in PW of the CU.

4.4. Execution time of scenario

| Name | Standard | Polarized | BRDF | BRDF12 | Seaprisim |
|-------------------------------|----------|-----------|-------|--------|-----------|
| 3SUN | 01:20 | 01:20 | 01:20 | 01:25 | 01:25 |
| 3LUN | 01:20 | 01:20 | 01:20 | 01:25 | 01:25 |
| Curv cross | 00:30 | 00:30 | 00:30 | 00:30 | 00:30 |
| Almucantar (Left + Right) | 01:00 | 01:00 | 01:00 | 01:00 | 01:00 |
| Principal Plane | 00:40 | 00:40 | 00:40 | 00:40 | 00:40 |
| Hybrid (Left + Right) | 01:00 | 01:00 | 01:00 | 01:00 | 01:00 |
| Pol Almucantar (Left + Right) | N/A | 02:00 | N/A | N/A | N/A |
| Pol Principal Plane | N/A | 02:00 | N/A | N/A | N/A |
| Pol Hybrid (Left + Right) | N/A | 02:00 | N/A | N/A | N/A |
| BRDF | N/A | N/A | 00:50 | 00:50 | N/A |
| PRS | N/A | N/A | N/A | N/A | 00:15 |
| Cross SUN | 00:40 | 00:40 | 00:40 | N/A | N/A |
| Cross MOON | 00:40 | 00:40 | 00:40 | N/A | N/A |
| BLACK | 00:04 | 00:04 | 00:04 | 00:02 | 00:02 |
| SUN | 00:20 | 00:20 | 00:20 | 00:25 | 00:25 |
| SKY | 00:10 | 00:35 | 00:10 | 00:20 | 00:15 |
| MOON | 00:20 | 00:20 | 00:20 | 00:25 | 00:25 |
| SUNP | N/A | 00:35 | N/A | N/A | N/A |
| MOONP | N/A | 00:20 | N/A | N/A | N/A |

These times are given for information purpose only. All SKY measurements are for one filter only. Total time depend of number of filters activated in PW of the CU. All SKY measurement starts with a tracking. The time of the tracking is not included in all time in the array. This one could add a delay of 10s maximum.

5 On-site maintenance

5.1. *Weekly check preventive maintenance*

Before making any preventive maintenance, switch the CU in manual mode (see part 3.7).

Here is a procedure that should be done every week in order to prevent the occurrence of measurement, electronic or mechanical problems on the photometer. If correctly done this procedure will avoid most of the problems that may occur:

1. Check all the connections, especially the ones on the battery (rust). Check the sensor head cable. Check that the AZ and ZN cables are not wrapped around the robot.
2. Check that the communication between the acquisition PC and the photometer is still OK. If used, check that the satellite transmitter is still running and does not have any errors by checking the led status.

If a problem is encountered, please refer to the troubleshooting part.

3. Check that the wet sensor functions correctly. Clean it lightly with demineralized water and a non-abrasive tissue.

→ Go in the MEASURES menu and look at wetting parameter. (See part 3.4)

If wet, “wet” is displayed, if not “dry” is displayed. In order to test the sensor if it is not raining, wet it with water and wait around 20s, the value of wetting should go from “dry” to “wet”.

If a problem is encountered, please refer to the troubleshooting part.

4. Check that the robot is correctly levelled

→ Check that the level spirit of the robot is well centered.

If not, please check step 18 of the installation part to solve the problem.

5. Check the voltage of external batteries and the DCP battery if used

→ Check the photometer external battery measuring the voltage of the battery terminals. The voltage should be over 12 Volts.

→ Same process for the DCP battery if used

Check the batteries general state. There must be no rust, leak and so on.

6. Disassemble the collimator from the sensor head. Check each channel inside the collimator for possible obstruction. If necessary, clean it with dry air or very carefully with a bottlebrush. It should be perfectly clean.
7. Check the four-quadrant sensor. If dirty clean it with a cotton swab.

Warning: Never clean the 2 main lenses on the front plate, except after a dust event when they can be cleaned with dry air.

The effect of the increasing dirt on the lenses due to time deposition can be corrected at the data processing stage. Cleaning them will distort the calculations.

8. Checking if the GOSUN and the TRACK are correct.

→ Launch a GOSUN scenario and look at the position of the sun spot compared to the target on the collimator base.

If a large shift is visible on the azimuthal axis, please watch step 14 in the installation part.

→ Launch a TRACK scenario and look if the sun spot is perfectly centered on the target on the collimator.

If a problem is encountered, please refer to the troubleshooting part.

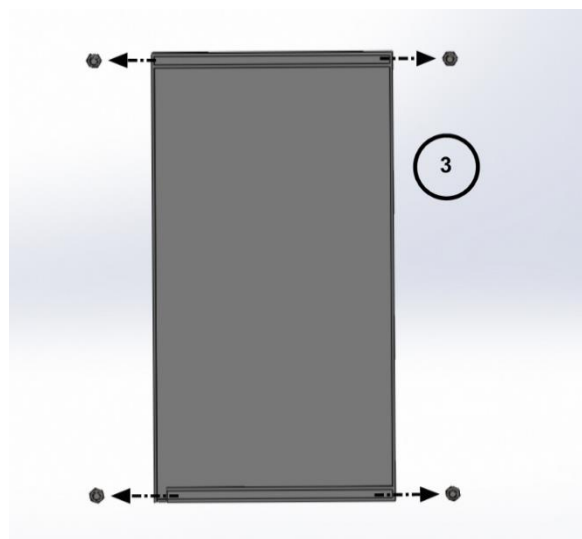
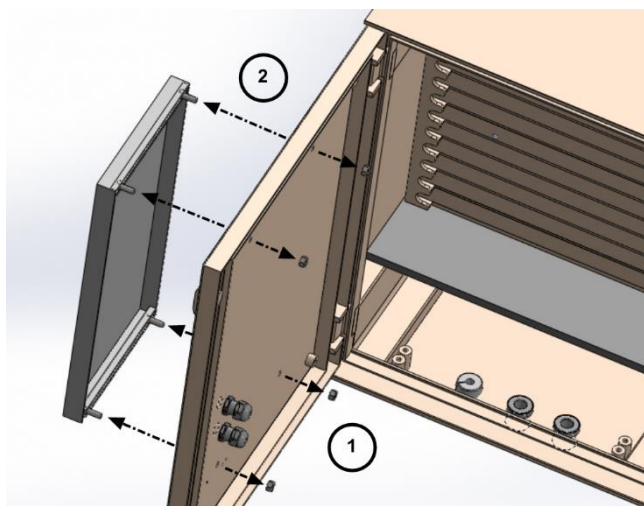
5.2. *Corrective maintenance*

5.2.1. Solar panel and wet sensor replacement

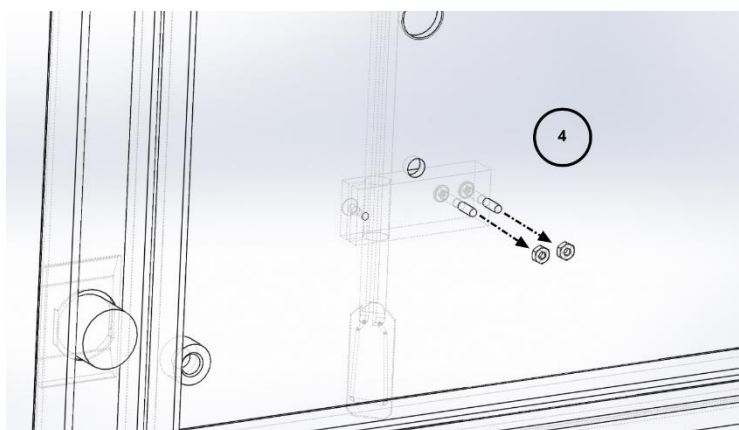
The wet sensor and the solar panel on the case are already mounted. They might be replaced in case of breakdown.

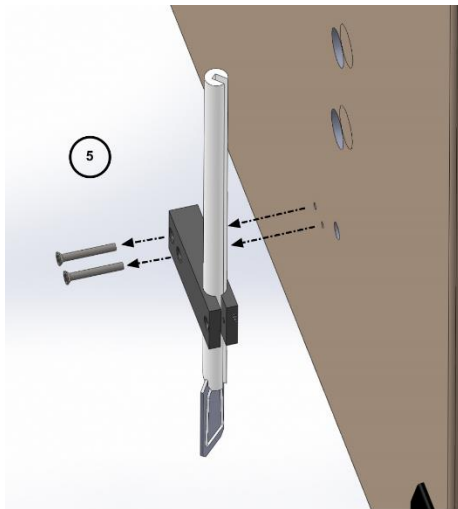
1. Loosen the 4 nuts.
2. Withdraw the solar panel with its wire cautiously from the protection case.
3. Get back the 4 screw which are inserted in the solar panel slides and replace the solar panel.

Note: To replace the wet sensor, the solar panel needs to be uninstalled.



4. Loosen the 2 nuts maintaining the probe clamp
5. Withdraw the screw and the wet sensor with its wire from the protection case
6. Slide the wet sensor to get it back and replace it.



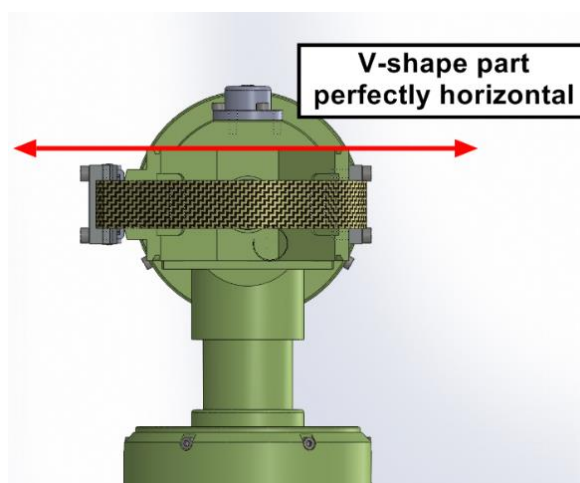
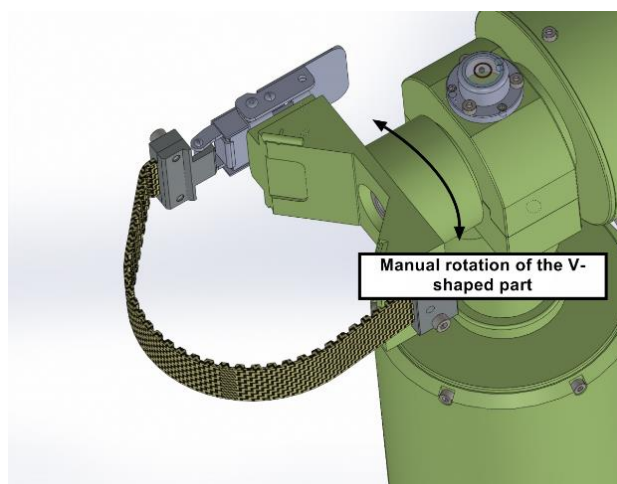
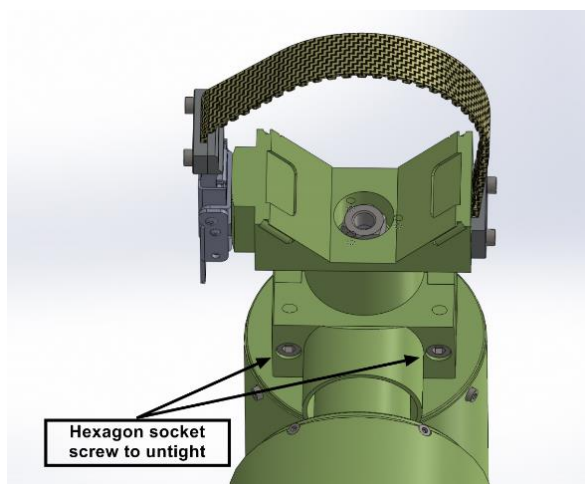


5.2.2. Robot levelling adjustment

After a PARK scenario, even if the spirit level is well-centered, it might happen that the V-shape part of the robot is not perfectly horizontal. You can check with a leveler.

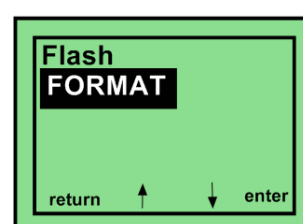
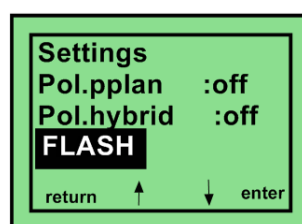
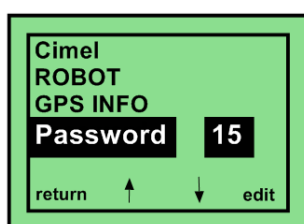
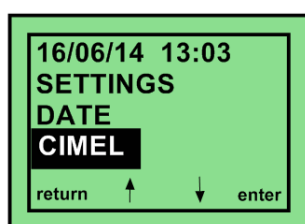
If the case happens:

1. Loosen the 2 hexagon socket screws.
2. Rotate the robot horizontal axis so that the V-shaped part is perfectly horizontal. Check with the leveler.
3. Tighten the screws and check if the V-shape part is perfectly horizontal after having launched a PARK scenario.



5.2.3. Flash memory formatting

Flash memory can be formatted via a hidden menu by following this procedure:



Select CIMEL, set Password to 15, press twice return to get in the hidden Settings menu, select FLASH, then FORMAT and validate with the green button

5.3. *Cleaning*

5.3.1. Optical parts

- Use canned air to remove any dust particles. Hold the canned air in an upright position, and use short bursts to blow away dust from the optical surfaces. Be careful not to use excessive pressure, and maintain a safe distance to prevent damage to the optics.
- Should dust be difficult to remove this way, carefully use rubbing alcohol and microfiber clothes

5.3.2. Other parts

- Use distilled water or rubbing alcohol with a sponge on every dirty surfaces

5.3.3. Drying

- Ensure that all cleaned surfaces, including the optics, are completely dry before putting the photometer back into service. This prevents malfunctions due to residual moisture.

6 *Factory calibration and maintenance*

6.1. *Sensor head calibration and maintenance*

6.1.1. Calibration

Cimel recommends its customers to calibrate the photometers every 12 to 24 months.

The calibration consists in a SKY calibration using an integrating sphere and a SUN calibration by inter-comparison or using Langley plots method.

The calibration process also includes:

- verification of filters and replacement if necessary
- verification of detectors and replacement if necessary
- Verification of acquisition chain
- verification of sun tracking setting and replacement if necessary

6.1.2. Maintenance

The sensor head internal humidity is dried by a desiccant bag. This value is reported in all GROUP statuses data. If that value become higher than 50%, with an increase

of 1% per week during several weeks, the desiccant bag must be replaced. Cimel is using a Clariant DESI PAK ref B001603.

To obtain full measurement quality, the desiccant bag should be placed near the tracking sensor:



Note: The internal sensor head humidity variation is very slow and needs few hours to be stabilized to the lowest value after replacement.

6.2. Robot maintenance

Cimel recommends its customers to make maintenance on the robot every 36 to 48 months.

It consists in:

- Replacement of micro switches
- Replacement of transmission belts
- Full cleaning of transmission gears, greasing of transmission gears and aging.

6.3. Clock battery replacement (2032 battery)

CAUTION: RISK OF EXPLOSION IF BATTERY IS REPLACED BY AN INCORRECT TYPE. DISPOSE OF USED BATTERIES ACCORDING TO THE INSTRUCTIONS.

When the battery is low, use a gripper with insulated branches to extract the battery from the CE7101B card and replace it with a similar new one.

Recycle your batteries in a local battery drop-off bin or at your local recycling centre.



Revision V4.14 May 2024

7 Troubleshooting

7.1. *Communication and data transfer is down*

7.1.1. Using serial port transfer protocol

The possible causes that may interrupt the communication between the PC and the photometer are:

- A power cut happened and the PC restart has not been executed properly.
- The serial wire is not correctly plugged or KO.
- The serial port is down.
- PhotoGetData is not well configured.
- DCP parameter is set to ON (conflict created).

Procedure to follow:

- Check that the computer is switched on.
- Check that PhotoGetData is launched.
- Check in the configuration menu that the right port COM is selected.
- Check that the serial cable is well plugged on both computer and photometer side.
- Test manually the data transfer by clicking on **get records** in PhotoGetData.
- Make sure that the DCP parameter is set to OFF.

If the manual test is working:

- Check that the automatic data transfer is well configured.

If the communication is still not working:

- Try another cable.
- Try another port COM on the acquisition computer if possible

If this procedure does not solve the problem, please contact CIMEL technical support.

7.1.2. Using satellite transmitter

The possible causes that may interrupt the communication between the photometer and the satellite are:

- The battery voltage is too low to transfer the data to the satellite.
- The satellite transmitter is no more finding the satellite.
- The emitter antenna is not correctly set.

- GPS antenna is missing, not correctly positioned or damaged.

Procedure to follow:

- Check that the DCP voltage battery is over 12V.
- Check that the cable is OK and correctly plugged between the transmitter and the photometer.
- Check the transmitter functioning status LED and up to the status, follow the transmitter documentation.
- Check that the GPS plugged on the transmitter have a good view of the sky.

If this procedure does not solve the problem, please contact CIMEL technical support.

7.2. Robot errors

The possible causes that may lead to robot errors:

- The cables are wrapped around the robots.
- The battery is low.
- The switches are damaged.

Procedure to follow:

- Check if the cables are wrapped around the robots.
- Unplug and plug again the azimuth (AZ) and zenith (ZN) cables.
- Launch a PARK scenario.

If the PARK is not well executed after having done the procedure, the mechanical switches might be damaged or broken. To check that, follow the procedure:

- Go to ROBOT in the CIMEL menu.
- Look at the SAE (switch angle engagement) values for AZ and ZN.
- These values should be between 70 and 90.

Note: For CU firmware equal or above V2.4.0, SAE values for both axes are automatically stored into the CU data. Please refer to the "Photometer ASCII files description" for detailed information.

If it is not the case, please contact CIMEL technical support.

7.3. Battery low

The possible causes that may lead to a low battery:

- The solar panel is down and the battery is not reloaded.
- A long period without any sun.
- The connections are not plugged correctly.
- Connections are rusted (marine spray).
- The battery is too old or broken.

Procedure to follow:

- Check if the cables are correctly plugged and the cables are not damaged.
- Check if the battery has no leakage and is powerful enough.

There is an electronical shutdown of the CU when the batteries voltage falls down to below than 10.5V.

When the CU is in shutdown, the batteries voltage must be upper than 11.5V to power on the CU.

If this has not solved the problem, please contact Cimel technical support.

7.4. GPRS – communication errors

To identify the possible cause of the GPRS communication error, there are two menus to help the user for a diagnostic.

The menu “CIMEL\MODEM\FTP TEST” establishes a test connection between the unit and an FTP server. The CU indicates how was finished the communication (FTP OK or FTP ERROR).

The menu “CIMEL\MODEM\HTTP TEST” uploads a K8 file containing the CU settings on an HTTP server. The CU indicates how was finished the communication (HTTP OK or HTTP ERROR). In case of error, the CU indicates the server HTTP reply code at the end.

During the communication, there are several information displayed on the CU. These information are important and could be used to resolve the encountered problem.

The CU must create a GPRS connection to the server before using the communication protocol (FTP/ HTTP). This part works the same way for the FTP and HTTP communication. The steps are:

1. Modem initialization.

2. Connect to the operator network.
3. Create a socket to the server for the communication.
4. Dialog with the server using the appropriate protocol.

In case of error, the steps 1 to 3 are identified as GPRS errors. The step 4 is an error returned by the server so refer to the chapter FTP communication error or HTTP(S) communication error.

7.4.1. GPRS errors

The possible causes that may lead to GPRS communication errors:

- SIM card is not inserted correctly.
- SIM card PIN code is activated.
- The GSM antenna is not mounted correctly or is broken.
- The GSM network signal is low.
- The SIM card APN is not filled correctly.

Procedure to follow:

- Insert the SIM card correctly into its support. Refer to the “Communication over GPRS” chapter of this manual.
- Insert the SIM card into a mobile phone and disable the SIM card PIN code.
- Test the quality of the GSM network signal. Go into CIMEL\MODEM\GSM TEST and verify the level of the “CSQ” value. This value has to be more than 10 to ensure that the quality of the network is good enough.
- Ensure that the APN provided by the SIM card operator is correct.

If this has not solved the problem, please contact Cimel technical support.

7.4.2. FTP communication errors

The possible causes that may lead to FTP communication errors:

- The FTP settings are wrongs.

Procedure to follow:

- Test all the FTP settings on a PC with FileZilla for example and verify the connection to the FTP server.
- Correct the server configuration and set up the CU with it.

If this has not solved the problem, please contact Cimel technical support.

7.4.3. HTTP(S) communication errors

The possible causes that may lead to HTTP(S) communication errors:

- The HTTP(S) settings are wrong.
- The HTTPS communication always fails to upload data.

Procedure to follow:

- Try to connect to the HTTP(S) server using a web navigator on a PC.
- Correct the server configuration and set up the CU with it.
- Check the configured server port. Usually, 80 port HTTP and 443 for HTTPS.
- To communicate with a secured HTTP server, be sure that the CU board is able to use secured connection. Refer to the “HTTP / HTTPS over GPRS” chapter.

If this has not solved the problem, please contact Cimel technical support.

8 Frequently Asked Questions (FAQ)

1. How often should the calibration process be made?

The photometer should go through the calibration process every 12 to 24 months. Depending on the quality of the measurements, the season, and the meteorological phenomenon that occurs, the calibration process can be forwarded or postponed up to 3 months.

2. What does the calibration process consist in?

The calibration consists in a sky calibration by inter-comparison with an integrating sphere and a sun calibration by inter-comparison with master photometers.

3. What is the best place to put the photometer?

The photometer should be positioned in a place sheltered from the wind if possible and with an open sky, meaning that it will be able to track the sun without any obstacle from sunrise to sunset. If possible, a RS232 link will be installed for transfer data to a PC. The cable length should not exceed 100m.

4. Can I replace components myself?

Components can be replaced by the owner after diagnosis has been established by CIMEL technical support. Never try to replace a component by yourself without CIMEL approval. However, the sensor head should never be disassembled as it will unset the sky and sun calibrations.

5. What are the first things to do when I notice that the photometer is down?

The first things to do when the photometer is down is to put back the photometer in manual mode and launch a PARK scenario, until the first investigations and diagnosis can be done.

6. What are the main outputs of the photometer?

The main output of the photometer is the calculation of the optical depth (AOD) which is an important atmospheric parameter as it is linked to the aerosol concentrations in the sky. Others output values are calculated if the instrument is in the AERONET network or similar networks.

7. What happens when the wet sensor is activated?

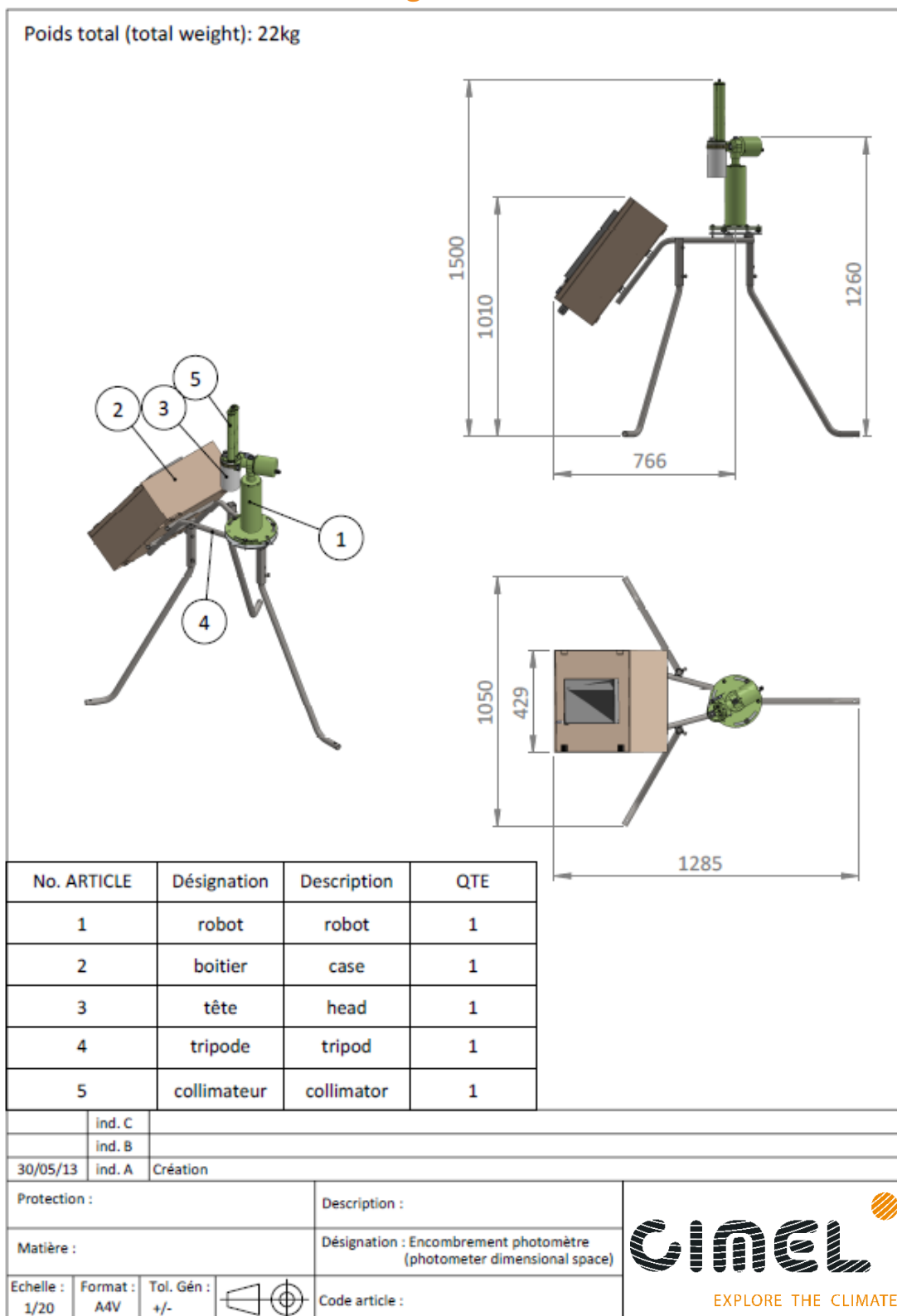
As soon as the wet sensor is activated, the photometer stops its measures and goes to the ORIG position to avoid water accumulation on the sensor head lenses and inside the collimator.

9 Technical specifications

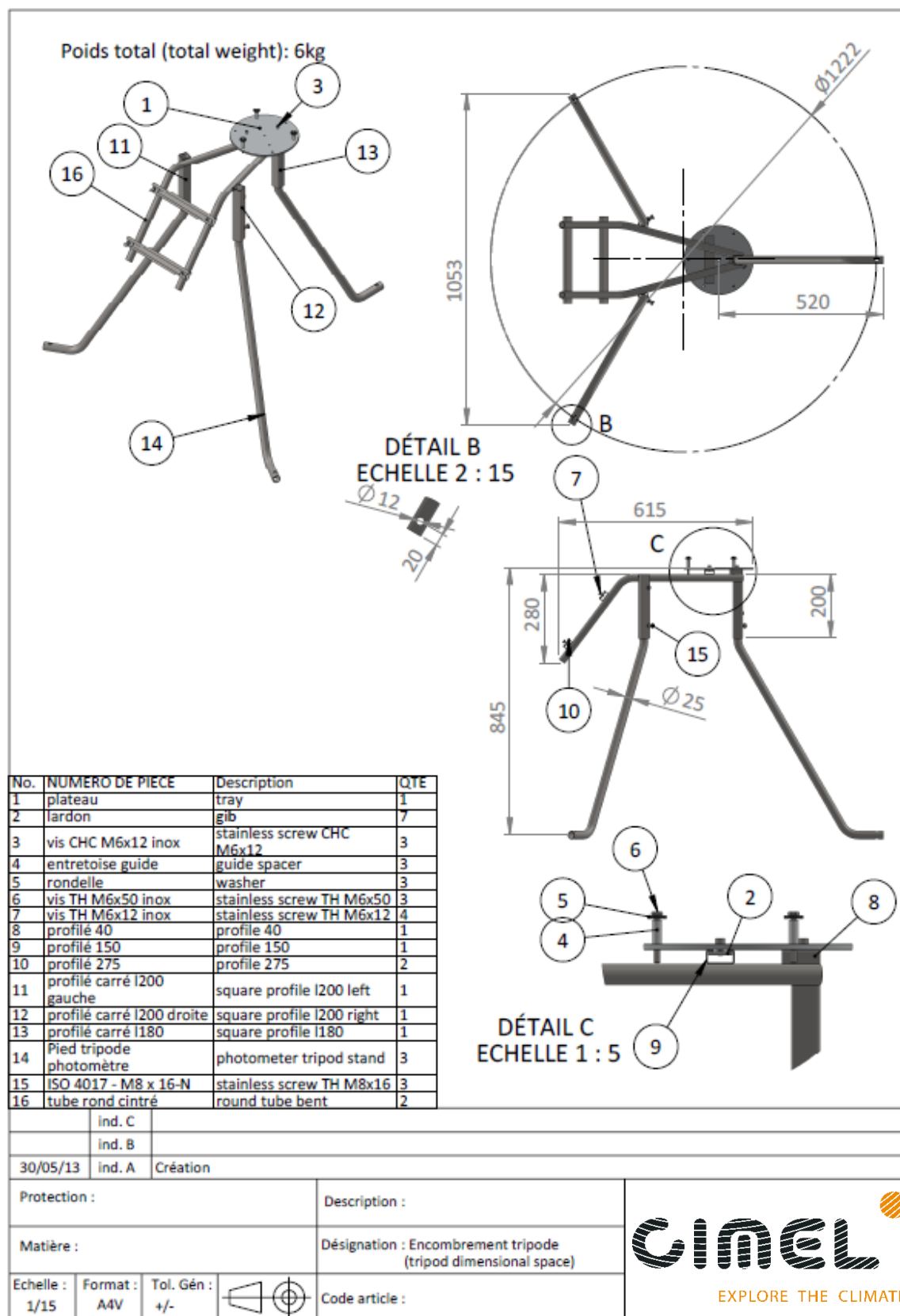
9.1. General

| Specification | value |
|---------------------------------------|----------------------------------|
| Irradiance precision | < 0.1% |
| Field of view | 1.3° |
| Minimal scattering angle from the sun | 2° |
| Spectral range | 340 to 1640 nm |
| Optical filter drift | < 1% / year |
| Automated mount | Azimuth and zenith motors |
| Sky angular scanning | Whole sky : Azimuth: 0 – 360° |
| Mechanical precision spot | 0.003° |
| Solar tracking precision | 0.01° |
| Power consumption | < 2W |
| Interferential filter bandwidth | < 30 nm |
| Total weight without support | 25 kg |
| Power supply | Autonomous through solar panel |
| Mode | Sun, Sky, Lunar |
| Memory | 8 GB on SD card (up to 32 GB) |
| Solar and moon scanning | 4 quadrant sensor |
| Temperature | -20 to 50° C |
| Humidity | 0 to 100 % |
| RS232 (up to 100 m cable) | 9600 baud/s |
| Numeric count dynamic | 0 to 2 097 152 |

9.2. Dimensional drawings



Revision V4.14 May 2024

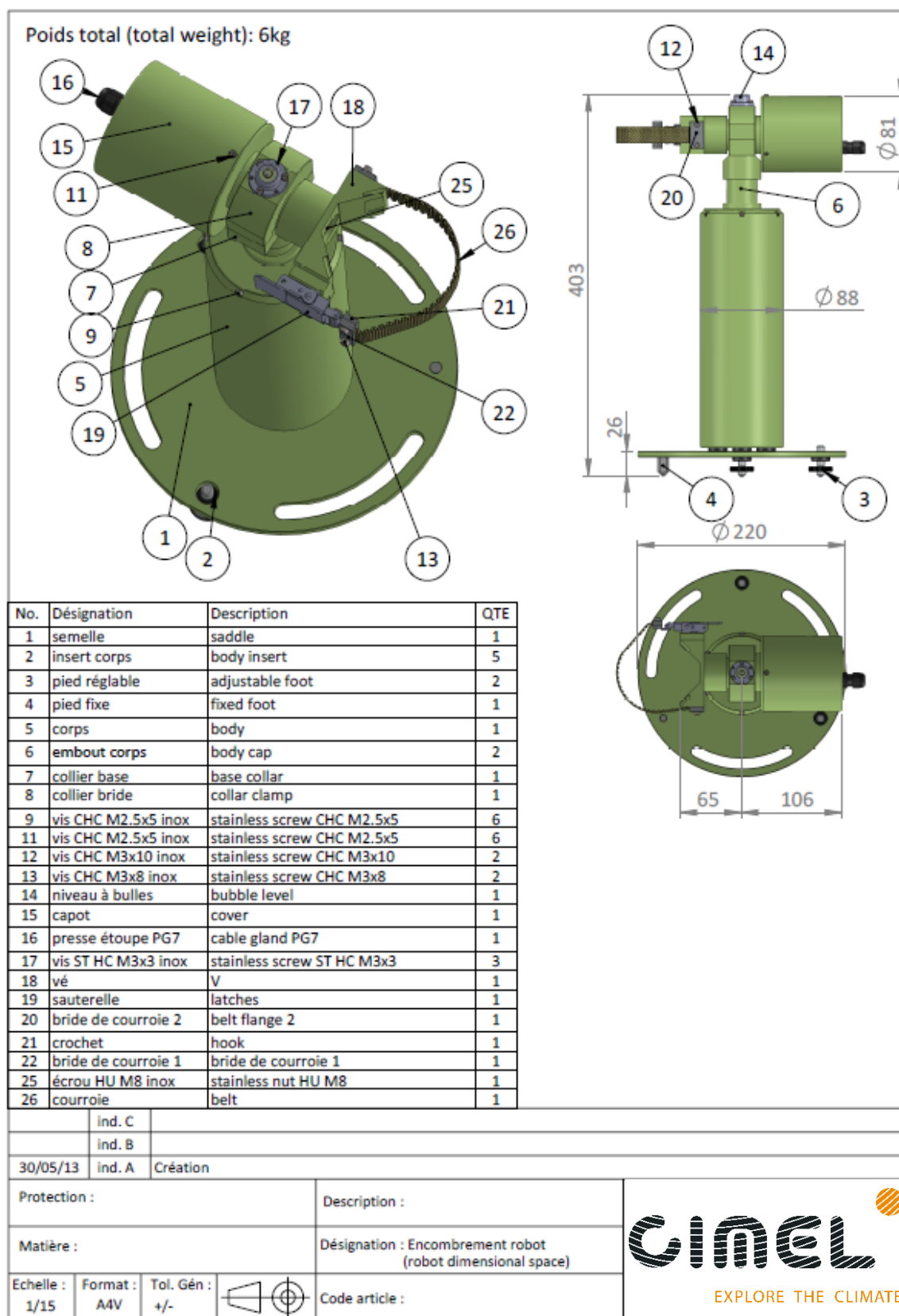


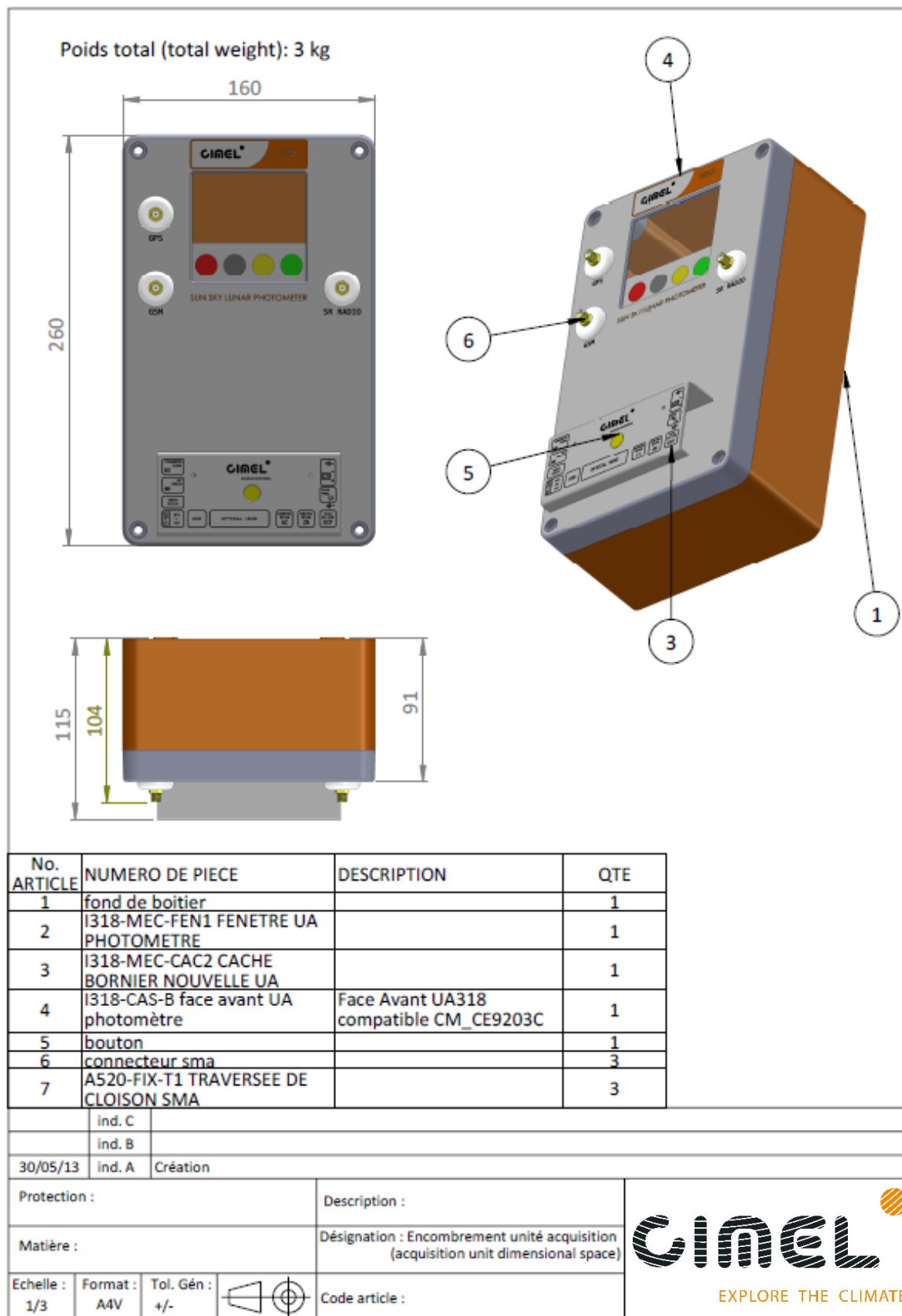
Poids total (total weight): 8kg

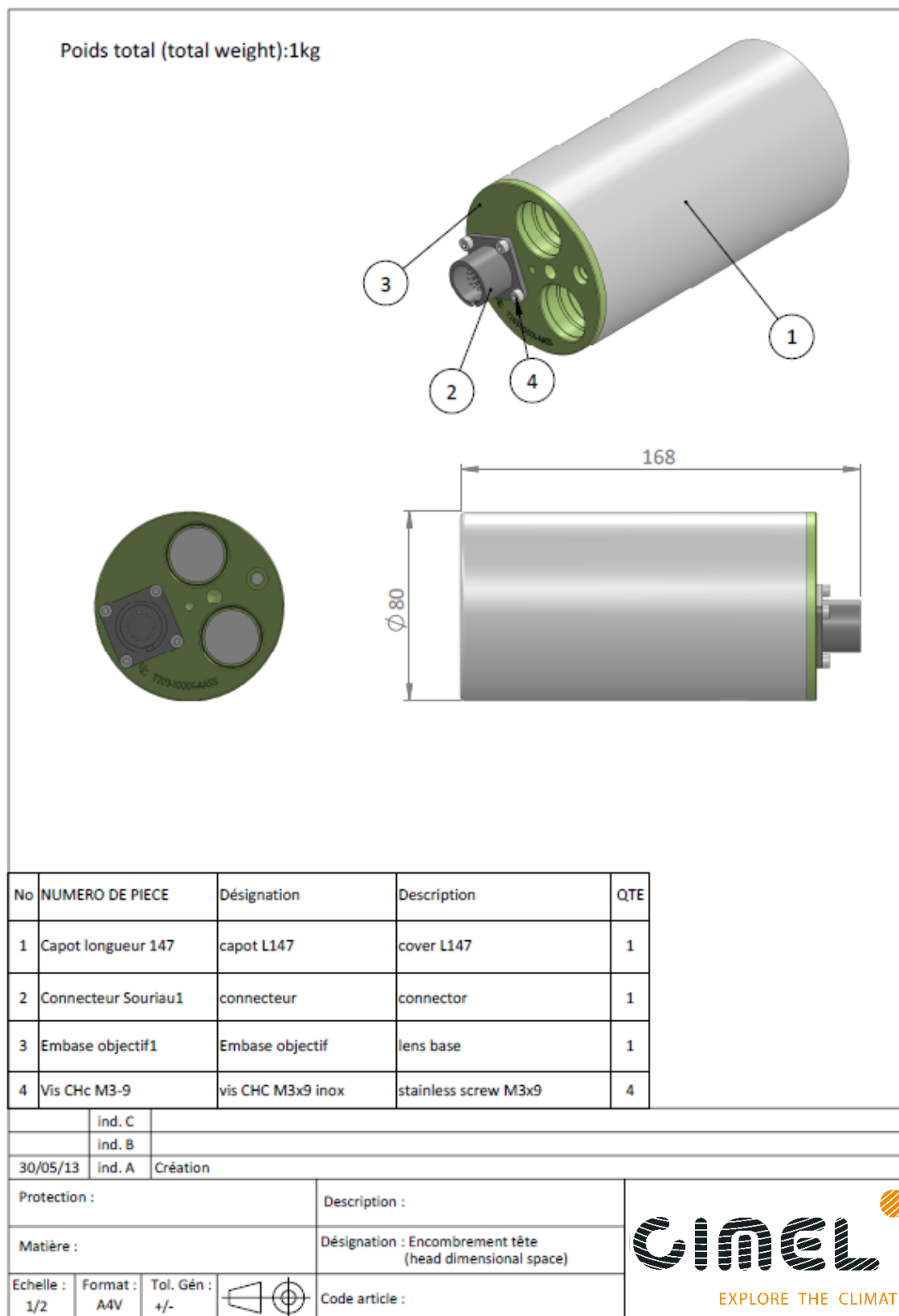
| No. | Désignation | Description | QTY |
|-----|---------------------|---------------------------|-----|
| 1 | boîtier | enclosure | 1 |
| 2 | panneau solaire | solar panel | 1 |
| 3 | vis CHC M6x16 inox | stainless screw CHC M6x16 | 4 |
| 4 | écrou Hu M6 inox | stainless nut Hu M6 | 4 |
| 5 | presse étoupe PG9 | cablе gland PG9 | 2 |
| 6 | sonde humectation | leaf wetness sensor | 1 |
| 7 | pince sonde | sensor clamp | 1 |
| 8 | presse étoupe PG21 | cablе gland PG21 | 2 |
| 9 | bouchon | cork | 1 |
| 10 | plaque | slab | 1 |
| 11 | mousse 1 | foam sheet 1 | 2 |
| 12 | mousse 2 | foam sheet 2 | 1 |
| 13 | mousse 3 | foam sheet 3 | 1 |
| 14 | batterie | battery | 2 |
| 15 | unité d'acquisition | acquisition unit | 1 |

| | | |
|------------------|-----------------|--|
| | ind. C | |
| | ind. B | |
| 30/05/13 | ind. A | Création |
| Protection : | | Description : |
| Matière : | | Désignation : Encombrement boîtier (case dimensional space) |
| Echelle : 1/8 | Format : A4V | Tol. Gén : +/- |
| | | |
| Code article : | | |

EXPLORE THE CLIMATE







Revision V4.14 May 2024

Poids total (total weight): 0.36 kg

| No. ARTICLE | Désignation | Description | QTE |
|-------------|---------------------|---------------|-----|
| 1 | lunette avant | front bezel | 1 |
| 2 | Embout sky avant | front end sky | 2 |
| 4 | tube | tube | 2 |
| 5 | tube pilier | pillar tube | 1 |
| 6 | embout sky avant | rear end sky | 2 |
| 7 | lunette arrière | rear bezel | 1 |
| 10 | axe de montage | mounting axis | 1 |
| 11 | bouton de manoeuvre | knob | 1 |

| | | |
|------------------|-----------------|--|
| | Ind. C | |
| | Ind. B | |
| 30/05/13 | Ind. A | Création |
| Protection : | | Description : |
| Matière : | | Désignation : Encombrement collimateur (collimator dimensional space) |
| Echelle : 1/2 | Format : A4V | Tol. Gén : +/- |
| | | Code article : |

CINEL
EXPLORE THE CLIMATE

Poids total (total weight): 1.4 kg x 2

100

139

54

| | | |
|------------------|-----------------|--|
| | Ind. C | |
| | Ind. B | |
| 30/05/13 | Ind. A | Création |
| Protection : | | Description : |
| Matière : | | Désignation : Encombrement batterie (battery dimensional space) |
| Echelle : 1/2 | Format : A4V | Tol. Gén : +/- |
| | | Code article : |

CINEL

EXPLORE THE CLIMATE

10 After-Sales Service and Customer Relations

For any technical information about the instrument or for any issues please contact Cimel at:

Cimel Electronique S.A.S

172 rue de Charonne

75011 Paris

FRANCE

Phone: (+33) 143 487 933

Email: support@cimel.fr

Cimel can use Skype and Team Viewer to provide technical support. When contacting us please indicate:

- The reference and the serial number of your product.
- Your email.
- Optional: Skype and/or Team Viewer address.

In term of technical support, Cimel policy is to diagnose issues using remote maintenance. It avoids a long period without the instrument running and it avoids sending back all the material to the factory in most of the cases.












Always contact technical support before sending back the photometer.




After an instrument failure, wait a diagnosis before making any intervention on it. Never try to replace a component by yourself without CIMEL approval.

11 Annexes








11.1. Packing List

In this packing list you will find all the detached pieces for the assembly of your photometer CE318-T.

| Item visual | Description/Origin | Qty |
|---|--|-----|
| Package 1/2: Photometer | | |
|  | Control unit CE318-T (Sun Sky Lunar) with 2 antennas (GSM/GPRS, GPS/GNSS) | 1 |
|  | Sensor head equipped with an optical protection cap | 1 |
|  | Biaxial robot with its 3 m cables (2 axes Azimuthal and Zenithal) | 1 |
|  | Double collimator | 1 |
|  | 3 m cord for sensor head CE318-T | 1 |
|  | Set of 2 batteries 6V/8Ah, with its serial connection cord and its connection cord to the control unit | 1 |
|  | Power supply block 100 ~ 240 V AC, 12 V DC output for photometer (temporary use) | 1 |
|  | 3 m cord for permanent connection to a PC (PC/DCP/RS232), equipped with a DBP connector on PC side | 1 |
|  | 1.5 m cord for temporary connection to a PC, equipped with USB-A and USB-B connectors | 1 |
|  | Fastening collar for the CE318 head cord | 1 |
|  | Optical cleaning cloth | 1 |

| | | |
|---|---|----------|
|  | USB Stick with: Software & Documentation | 1 |
|  | Fly case for the transportation of the whole instrument except infrastructure | 1 |
| Package 2/2: Tripod Infrastructure | | |
|  | Tripod infrastructure with protection enclosure and built-in solar panel, and rain detector (resistive) with 3 m cable equipped with RJ11 plug | 1 |

Additional equipment for TU12 / TU9 models

| | | |
|---|---|----------|
|  | Polycrystalline Solar panel 12 V, 20 W, with frame and mast mount, with 3 m cable equipped with a Phenix plug | 1 |
|  | Protection enclosure for CE318 control unit with frame and mast mount | 1 |
|  | Resistive rain detector with a standard 3 m cable equipped with a RJ11 connector | 1 |
|  | Directional GSM/GPRS antenna with 5 m cable and SMA plug with tubular arm to support the antenna and mounting support for mast | 1 |
|  | Lightning rod with mounting support for mast | 1 |
|  | Grounding braid (25m roll) | 1 |
|  | Grounding rod | 1 |

11.2. AERONET network (FAQ)

11.2.1. What is the AERONET network?

The AERONET (AErosol RObotic NETwork) program is a ground-based remote sensing federation of networks established by NASA and PHOTONS. Data acquired by all the photometers are gathered by the central system and a large number of quality insured products are made available for public access.

11.2.2. How to enter it?

To enter the network, a request must be sent to AERONET.
See AERONET website: <https://aeronet.gsfc.nasa.gov/>.

11.2.3. What to do when there is a “Bad sun tracking”?

If the photometer is declared in AERONET “bad sun tracking” warning flags may be emitted. They will be emitted on this website:

http://aeronet.gsfc.nasa.gov/cgi-bin/weekly_report_v2

The possible causes that may lead to a bad sun tracking are:

- The sun spot is too far from the target after a GOSUN scenario (see step 11 and 16 in the installation part).
- The external battery is too low.
- The sensor head cord is damaged.
- The four quadrants sensor is too dirty.
- The four quadrants sensor is broken.
- The collimator is not correctly assembled to the sensor head.
- The collimator is deformed.
- The robot base is not horizontal.

Procedure to follow:

- Make sure that the sun spot after a GOSUN scenario is not too far away from the target on the collimator.
- Check the battery voltage, it must be over 12V.
- Clean the four-quadrant sensor with a cotton swab.
- Check visually the external state of the sensor.
- Check if the collimator is correctly assembled.
- Check the spirit level.

If this procedure does not solve the problem, it means that the sensor head cord is probably damaged.

Please contact Cimel technical support for any damaged sensor head cord or if the procedure is not solving the problem.

11.2.4. What to do when there is a “InGaAs / silicon discrepancy”?

If the photometer is declared in AERONET network, “InGaAs / Silicon discrepancy” warning flags may be emitted. They will be emitted on this website:

http://aeronet.gsfc.nasa.gov/cgi-bin/weekly_report_v2

If not declared, it is difficult to detect this discrepancy easily. A measure with the 1020 nm is done either on the silicon and the InGaAs channel. Algorithms are checking the ratio in between the two measures and it should be constant.

The main cause that may lead to these discrepancies is:

- One of the channels or both channels are obstructed by something (spider web, insects...).

Procedure to follow:

- Clean the collimator with dry air or a bottlebrush and make sure that nothing is obstructing the channels.

If this procedure does not solve the problem, please contact CIMEL technical support.

11.2.5. What to do when there is a “High dark current”?

If the photometer is declared in AERONET network, “high dark current” warning flags may be emitted. They will be emitted on this website:

http://aeronet.gsfc.nasa.gov/cgi-bin/weekly_report_v2

The dark current is regularly measured when a BLACK scenario is done on both InGaAs and silicon channel with AUREOLE and SKY gain.

The dark current should always be low, and under a certain threshold.

The main cause that may lead to a high dark current:

- An electronic component is damaged, defective or not correctly plugged.

Procedure to follow:

- Make sure that all the connectors on the card inside the CU are correctly plugged.
- Check all external cables and wires especially the connections.

If this procedure does not solve the problem, please contact CIMEL technical support.

11.2.6. What to do when there is constant humidity?

If the photometer is declared in AERONET network, “constant humidity” warning flags can be emitted. They will be emitted on this website:

http://aeronet.gsfc.nasa.gov/cgi-bin/weekly_report_v2

The possible causes that may lead to a constant humidity:

- Continuous rain (4 days a week with rain the full day).
- The wet sensor is close to the sea or the ocean and the wind carries on regularly marine spray on its direction.
- Dew in the morning takes a long time to evaporate.
- The wet sensor is damage, time worn or broken. The wet sensor is quite sensitive, especially the resistive part on its head which can be deteriorated with rough meteorological conditions.

Procedure to follow:

- Try to slightly orientate the sensor to the West, it will then be exposed quicker to the morning sun and the dew will evaporate faster.
- Try to protect the wet sensor from possible marine spray.

11.2.7. What to do with a dissymmetric Almucantar?

If the photometer is declared on the AERONET network, dissymmetric almucantar warning flags can be emitted. They will be emitted on this website:

http://aeronet.gsfc.nasa.gov/cgi-bin/weekly_report_v2

The main cause of dissymmetric Almucantar is an incorrectly levelled robot.

Procedure to follow:

- Redo step 18 in the installation chapter.

11.2.8. Meanings for Icons and marks



The symbol indicates that the product should not be discarded as unsorted waste but must be sent to separate collection facilities for recovery and recycling.



The symbol indicates that the instruction manual/booklet must be read.