

Breva

REFLEXA MICRO

Field manual

Install, verify and maintain a reflexa micro unit on site.

App and firmware **0.5.5**
Edition **2026-10-24**
Full documentation **reflexamicro.geoguard.eu**



Generated from the online documentation. Screenshots marked **SIMULATOR** come from the app preview with a simulated unit; their values are placeholders. Field-test beta: check the online documentation for the latest version.

Contents

- 1. Install the field console
- 2. Install the offline map data
- 3. Site checklist
- 4. Site requirements
- 5. Assemble the unit
- 6. First installation on a TAHMO WLM board
- 7. Quick start
- 8. Install on site
- 9. Verify live on site
- 10. The field console
- 11. Station
- 12. Schedule
- 13. Live
- 14. Sessions
- 15. Maintenance
- 16. Iridium setup
- 17. Campaign (experimental)
- 18. Firmware update
- 19. Troubleshooting
- 20. Status LEDs
- 21. Glossary

Install the field console

The **field console** is the desktop app that configures a reflexa micro unit, checks an installation live, downloads the results and updates the firmware. It runs on a laptop connected to the unit by USB; it does not need internet on site. Install it at the office, before going to the field.

On the computer the app appears as **BREVA reflexa micro**: that is the name to look for in Applications, the Start menu or the applications menu.

What you need

- A laptop with **macOS** (Apple silicon), **Windows 10/11** (x64) or **Linux** (x64, Ubuntu 22.04 or newer, or another distribution with glibc 2.35 or newer).
- The app package for that system, from the USB stick delivered with the units or from the [Downloads](#) page (paste the release access key in the *Tester access* box to unlock the downloads).
- The **release access key** you received with the delivery, for updates and for downloading the map data over the internet. The app works without it; it only cannot check or download anything new.
- About 1 GB of free disk space for the app and the optional [map data pack](#).

The app carries everything it needs: the firmware of its own version, the overview map and the processing engine. No other software has to be installed, except the system components listed below.

Install

macOS:

- 1 Open the `.dmg` file (double click).

- ② Drag **BREVA reflexa micro** onto the **Applications** folder.
- ③ Eject the disk image and start the app from Applications or Launchpad.

Always start the app from Applications (or from another folder you own), never directly from the disk image: in-app updates replace the app where it is, and refuse to run from the image.

Windows:

- ① Extract the `.zip` file into a folder of its own, for example `C:\Users\<you>\BREVA reflexa micro\`. Keep only the app's files in that folder: an update replaces the whole folder.
- ② Start `brev-reflexa-micro-gui.exe`. Pin it to the Start menu or the taskbar if you like.
- ③ If Windows says the **WebView2 runtime** is missing (rare on Windows 10/11), install it from the delivery stick or from Microsoft, then start the app again.

If SmartScreen shows *Windows protected your PC*, choose **More info** →

Run anyway only for a package you got from the delivery stick or the Downloads page, and check its SHA-256 against the one listed there.

Linux:

- ① Open a terminal in the folder with the package and install it with apt, which also installs the required system libraries:

```
...
```

```
sudo apt install ./BREVA-reflexa-micro_X.Y.Z_linux-x64.deb
```

- ② Make sure your user can use serial ports (on Ubuntu and Debian: member of the `dialout` group; log out and in again after adding it):

```
...
```

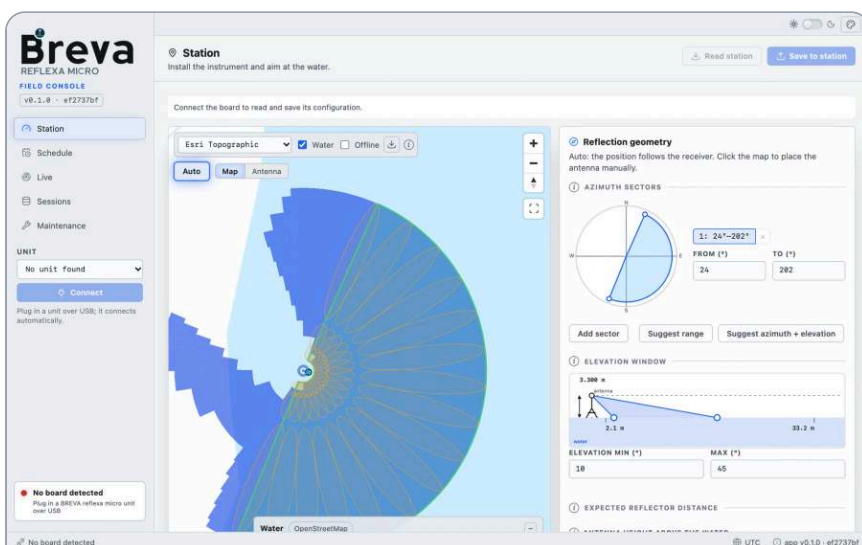
```
sudo usermod -aG dialout $USER
```

- 3 Start **BREVA reflexa micro** from the applications menu.

The release access key is kept in the system keyring (GNOME Keyring or another Secret Service): it must be unlocked, which it is after a normal desktop login.

First start

- 1 The app opens in **Normal** mode: the five pages an operator needs on site (Station, Schedule, Live, Sessions, Maintenance).
Advanced mode adds every setting and the diagnostic tools; see [The field console](#).



SIMULATOR

First start, no unit connected yet: the Station page and, in the sidebar, *No unit found*.

2

Save the **release access key**: **Maintenance** → **Updates access** (Normal mode) or **Maintenance** → **Updates** → **Release access key** (Advanced mode). Paste the key and press **Verify & save**: the app checks it with the release server before keeping it. The key is stored in the operating system's credential store and never shown again; **Remove** deletes it. Do this with an internet connection.

Updates access

The release access key lets this app download firmware, app updates and map data. Paste the key supplied by your distributor once; it is kept in this computer's credential store and is never shown again.

Verify & save
Remove

No distribution key saved. Paste the read-only key supplied by your distributor.

SIMULATOR

Maintenance → **Updates access** before the key is saved.

Updates access

The release access key lets this app download firmware, app updates and map data. Paste the key supplied by your distributor once; it is kept in this computer's credential store and is never shown again.

Verify & save
Remove

Access key saved securely on this computer.

SIMULATOR

After **Verify & save**: the key is stored; the field stays empty.

3

Install the [map data pack](#) if you want the global offline lakes on the Station page.

4

Connect a unit with its USB cable. It appears in the sidebar within a few seconds; the status bar at the bottom shows what it is doing. A unit that still runs another firmware needs the [first installation](#) once.

Tip

Install the app, save the key and install the map data before leaving for the site. On site the app needs no internet: firmware, maps already installed and the processing are all on the laptop.

Updates

At every start, when there is internet and a saved key, the app checks for a newer app, firmware and map data. If something newer exists, one dialog lists it; **Cancel** downloads nothing. Nothing is ever installed or flashed without a further confirmation.

Updates available

Firmware 0.2.1.

Download and verify now? Nothing is installed yet: installing the app (it restarts) and updating the connected unit are confirmed separately.

Cancel

Download

SIMULATOR

The startup dialog: **Download** only downloads and verifies; installing is confirmed separately.

- **App:** after the download is verified, **Install and restart (X.Y.Z)** (macOS and Windows) closes the app, replaces it in the same place and opens the new version. Save the station draft first: unsaved changes are lost on restart. Connected units are disconnected and keep running. On Linux, install the downloaded package with `sudo apt install ./<file>` in the folder **Show downloaded file** opens.

- **Firmware:** each app version carries its own firmware; update the units with the [firmware update](#) after updating the app.
- **Map data:** a newer app may expect a newer pack; the Map data card then shows **Update** (see [Map data pack](#)).

If an update check fails (no internet, key missing or expired), the app keeps working with what it has and says so.

Uninstall

- macOS: move the app from Applications to the Bin.
- Windows: delete the app's folder.
- Linux: remove it with the software manager, or find the package name with `apt list --installed | grep -i reflexa` and `sudo apt remove` it.

Before uninstalling, remove the release access key (**Remove** in the Updates access card) and the map data pack (**Remove...** in the Map data card) if the computer will be handed over.

Install the offline map data

The **map data pack** holds the global offline lakes: HydroLAKES, 1.4 million lakes and reservoirs of 10 ha and more. With it the Station page highlights mapped water and can suggest reflection sectors anywhere, without internet. It is optional: without it the app uses its bundled overview map and any OpenStreetMap water it has cached, and the water panel says *Global offline lakes not installed*.

File	reflexamicro-water-hydrolakes-v1-9ef63498.sqlite.gz
Download size	679 MiB
Free space needed	about 820 MB (the pack is unpacked into the app's data folder)
Licence	CC BY 4.0, Lehner, Messenger et al. (Sources)

Install it once per computer, at the office, after [installing the field console](#). The pack is listed on the [Downloads](#) page.

Install

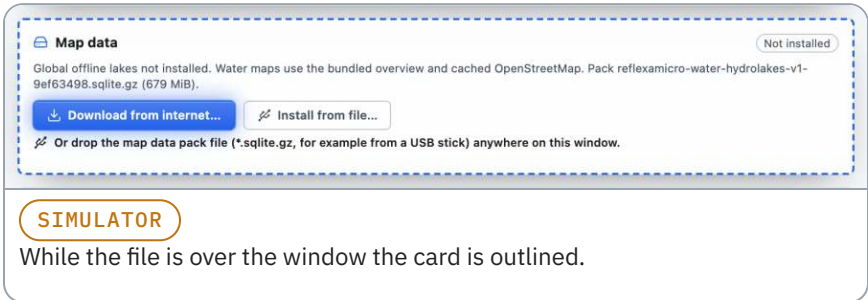
The **Map data** card is in **Maintenance** (Normal mode) or in **Maintenance** → **Updates** → **Map data** (Advanced mode). Both show the same state and offer the same actions.

From a USB stick: The usual way with a delivery: the pack is on the stick that comes with the units.

- 1
- Insert the stick and open **Maintenance** in the app.

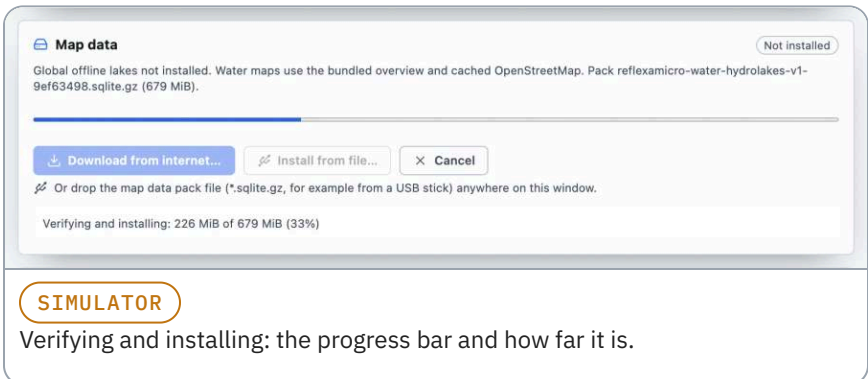
2

Drag the `.sqlite.gz` file from the stick onto the app window (the card is outlined while the file is over the window), or press **Install from file...** and choose it.



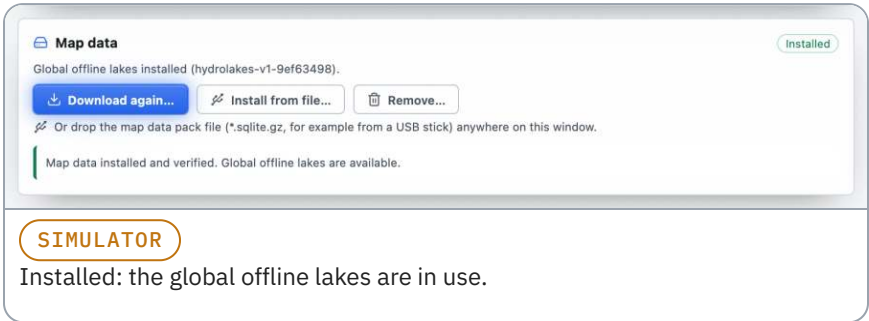
3

Wait for the progress bar: the app checks the file's size and checksum, unpacks it and only then uses it. From a fast drive it takes seconds, from a slow stick a few minutes.



4

The card shows **Installed**. The stick can be removed.



To prepare a stick yourself, download the pack from the Downloads page and copy the `.sqlite.gz` file to any stick (FAT32 is fine: the file is under 4 GB).

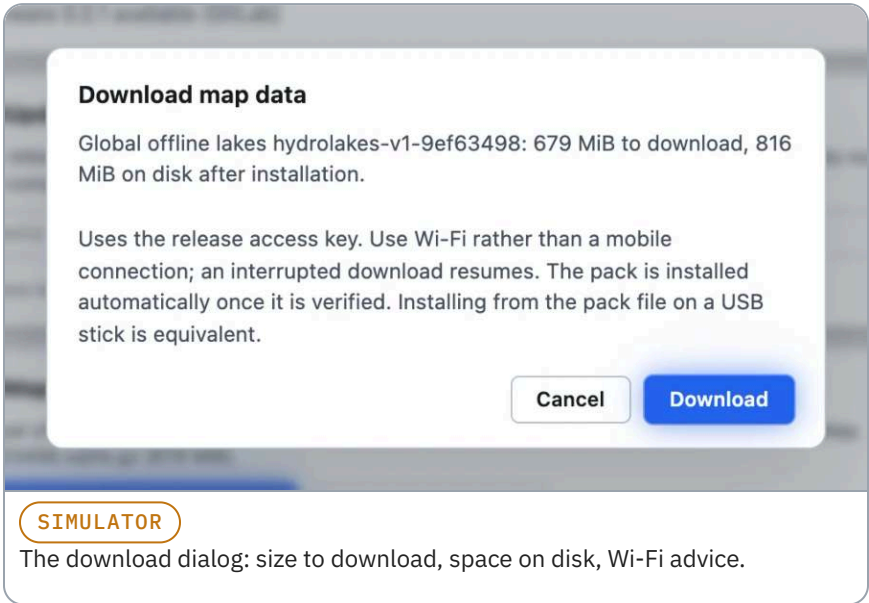
Over the internet: Needs the release access key saved in the app (see [Install the field console](#)). Prefer Wi-Fi.

1

In the Map data card press **Download from internet...**

2

The dialog shows the size (679 MiB); confirm. Nothing is downloaded before you confirm.

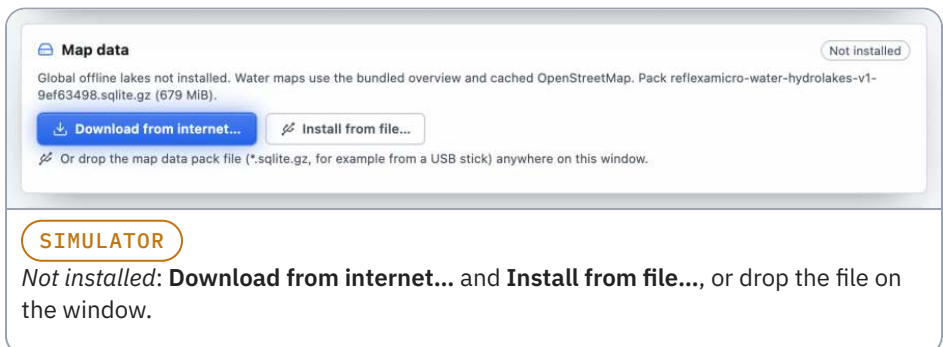


3

When the download is verified the pack is installed automatically.

Cancel stops the download; the part already downloaded is kept and the button becomes **Resume download...**

States of the card



State	Meaning
Not in-stalled	The app uses its overview map and cached OpenStreetMap water.
Installed	The global offline lakes are in use.
Update	This app version expects a newer pack: install it from a stick or with Update from internet.... The installed pack keeps working until then.
Damaged	The installed files do not match; install the pack again.

A wrong, damaged or incomplete file is refused with the reason and changes nothing. The startup update check may mention that a newer pack is expected, but never downloads it without your confirmation.

Remove

Remove... deletes the installed pack and any interrupted download. The app then goes back to the overview map.



Tip

Map data is per computer, not per unit: install it on every laptop that will be used to set up stations.

Site checklist

What to bring

- ☐ reflexa micro unit (installed with reflexa micro firmware: [first installation](#)), battery charged, solar panel and cabling
- ☐ mounting bracket, clamps or bolts for a wall, pole or bridge
- ☐ laptop with the field console installed and charged (power bank for long runs)
- ☐ data-capable USB-C cable (and a spare)
- ☐ map data pack on a USB stick (optional, for offline lake shores)
- ☐ tape measure for the antenna height above the water (optional: an estimate by eye is enough)
- ☐ phone or camera for photos; notebook
- ☐ the configuration file saved from the last visit, if any

Steps

1. Choose the spot: open water in front, no wall, railing, tree or building between 5° and 45° of elevation toward the water, nor around the reflection zones on the water: the map’s terrain shadow does not show buildings or trees ([site requirements](#)).
2. Mount the unit firmly; the antenna must not move.
3. Measure the antenna height above the water with a tape if it is easy, otherwise estimate it by eye ([antenna height](#)).
4. Connect the unit; check the status bar is green and the clock valid.
5. Station: position *Auto*, sectors toward the water, elevation 5°–45°, antenna height, search range *Auto*; **Save to station**.
6. Schedule: preset and Iridium sending; save.
7. Live: satellites in every sector, mostly green; first arcs *pass* ([verify live](#)).
8. Maintenance: **Check modem (no traffic)**; check the battery.
9. Watch the LEDs for 30 seconds after disconnecting: a short green flash every 5 s means running ([status LEDs](#)).

What to record

Item	Value
Site name, date, time (UTC)	
Position (from the receiver)	
Antenna height: measured or estimated	
Photos: unit, mount, each sector	
Firmware and app versions (status bar)	
Configuration JSON exported from the app (Files & profiles)	
First accepted arcs: RH, sigma	
Weather, waves, wind	

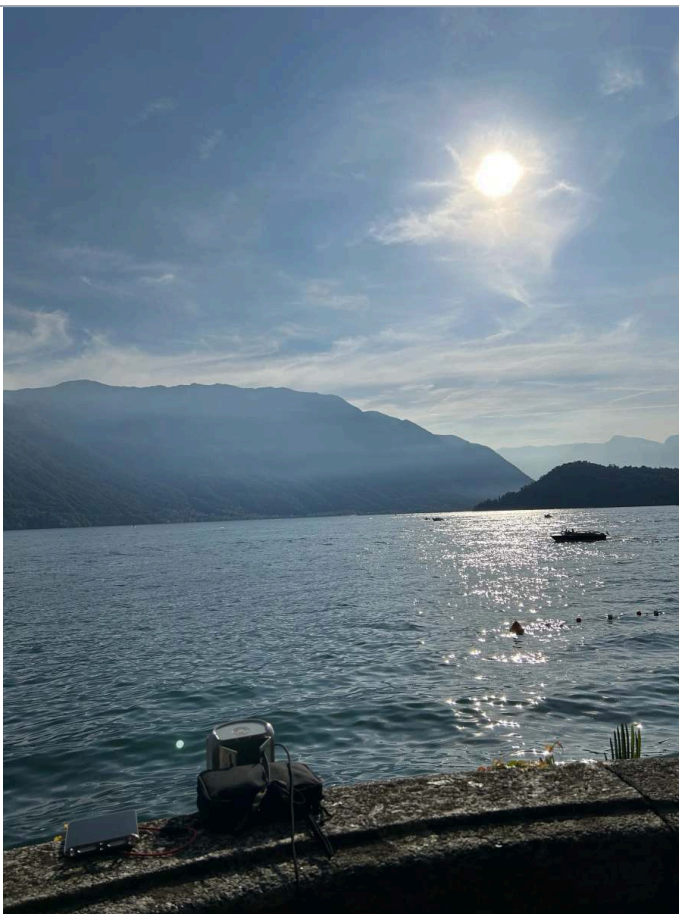
Item	Value
Iridium: modem check, first message received	

Site requirements

Where it works

Good sites, in order of preference:

1. A **lake or reservoir** with open water in front of the antenna across a wide azimuth range.
2. A **wide river** or a canal seen along its length, or from a bridge.
3. The **sea** in sheltered places (waves and tides make it harder).

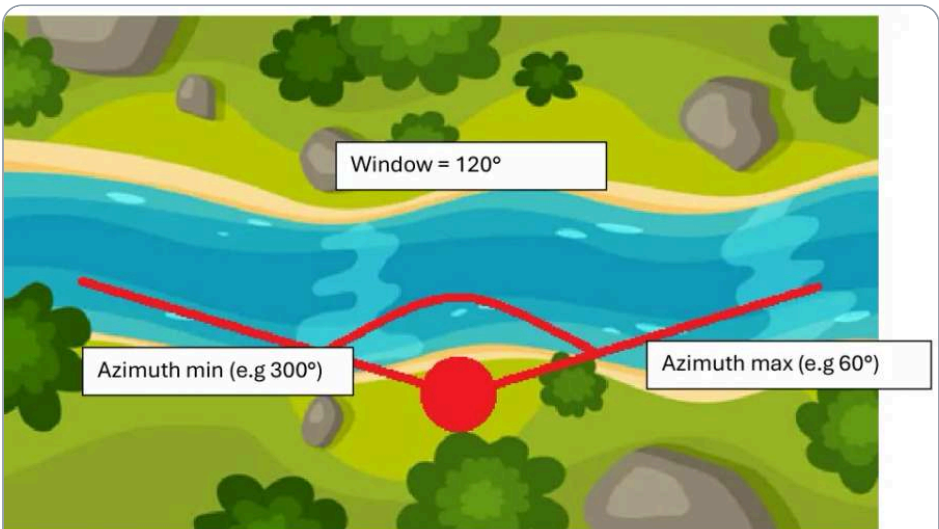


Test installation at a good site: the unit on a lake-side wall facing wide, open water.

Requirements (rules of thumb)

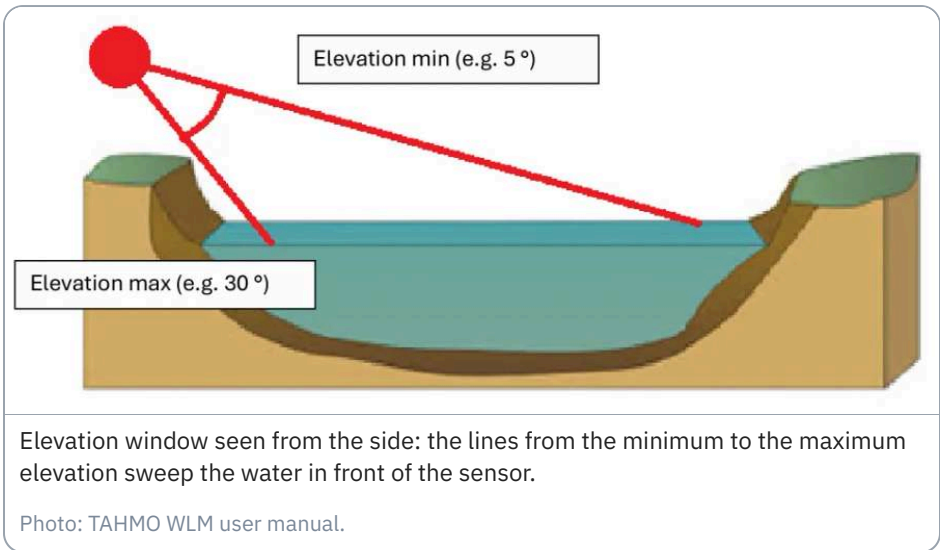
- Open water covering the [footprint](#) for the chosen elevations: tens of metres for a 2–5 m antenna height.
- A reasonably flat reflecting surface. For ground sites the literature asks for slopes below about 4% within 50 m; for water the issue is waves and wind.

- An unobstructed view toward the water between about 5° and 45° of elevation: no wall, railing, tree or building in the sector.
- No other strong reflectors in the sector (metal roofs, cars, quays); they produce a second peak in the periodogram.
- A stable mount, and a rough idea of the antenna height ($\pm$ a few metres) to check the first results.
- 1–10 m above the water is the most comfortable range; more height means a larger, farther footprint (needs more open water) and faster oscillations.
- The azimuth window with open water should be as wide as possible: TAHMO recommends at least 90°, and wider is always better. The window is set by its minimum and maximum azimuth and its minimum and maximum elevation.
- The unit sits with its **lid toward the water**: the azimuth window must be on the lid side. The solar panel should face the sun.



Azimuth window seen from above: the minimum and maximum azimuth enclose the water (here 120°).

Photo: TAHMO WLM user manual.



Useful satellite passes

A satellite that only crosses the sector is not enough. A measurement comes from a pass that **sweeps a range of elevation** inside the window while its reflection stays on the water: the C/N0 must go through at least two full oscillations (interference fringes) for the periodogram to give a height, and every extra fringe makes the peak sharper. The unit rejects shorter arcs (*fail*, geometry).

- **Rising and setting satellites** are the useful ones: they sweep the low elevations, where the elevation changes the reflection fastest.
- A satellite that stays high, or skims the edge of the sector, changes elevation little while it is over the water: it gives no arc.
- The minimum sweep depends on the antenna height and on the elevation: starting from 5°, about 7° for an antenna 1.5 m above the water and about 4° for 3 m; higher in the sky the same number of fringes needs more degrees.

The Live page shows, for each active arc, how much of the window it has swept; the predicted tracks show which satellites will rise or set through your sectors in the next hours.

Obstructions on the reflected path

The receiver seeing the sky is not enough either: the reflected signal must reach the water and come back to the antenna. A house, a tree, a railing or a boat between the antenna and the reflection zone, or around it, blocks or disturbs the reflected path even when the direct signal arrives clean.

The field console shades in black the part of the footprint hidden by the terrain. That shading is **indicative**: it comes from a terrain elevation model, which has no buildings or vegetation and does not judge the first 100 m around the antenna. Look at the reflection zones on site, in every sector, and narrow the sectors or the elevation window where something stands in the way.

Signs of a poor site

Visible in the [Live](#) page:

- satellites in the sectors that never appear, or appear only with weak (red) signal: the sector is obstructed;
- arcs that close with “fail” for geometry or peak-to-noise reasons;
- periodograms with several peaks of similar size: more than one reflector.

Not sure whether a site works? A [Campaign](#) run tells you, without a computer, whether and in which directions it produces usable reflections.

Assemble the unit

Use this guide when you receive a unit as a kit or have to open one up: the board, the enclosure, the bracket, the battery and the solar panel are put together once, in a workshop, before the unit goes to the site. A unit that arrives assembled does not need it: continue with [First installation on a TAHMO WLM board](#) or, if reflexa micro is already installed, with the [Quick start](#).

The steps and photos follow the assembly manual of the TAHMO WLM (water level monitor) system, rewritten for reflexa micro. Positions of holes and parts are shown in the photos: check them against your kit before you drill.



The result: the unit on its bracket, clamped on a pole, with the solar panel above it.

Photo: TAHMO WLM assembly manual.

What is in the kit



Everything laid out. From the left: the WLM board, the RockBLOCK Iridium modem with its antenna, the battery cell, plastic spacers and screws, the two enclosure halves with the cable gland, the stainless-steel bracket and hose clamps, the solar panel with its cable and bracket, and a bag of bolts, washers and nuts.

Photo: TAHMO WLM assembly manual.

Besides the kit you need:

- a drill with a **6 mm** and a **3.5 mm** bit;
- a screwdriver and a spanner for the bolts;
- a soldering iron and solder (not needed if you use the screw terminal for the solar cable);
- insulating tape;
- a data-capable USB-C cable.

Caution

Keep the battery **out** of the unit until the step that fits it. Work on a clean table: drilling swarf inside the enclosure, or on the board, causes faults that are hard to find later.

Prepare the enclosure

- 1 Remove one knockout.** Punch out one of the two round knockouts on the side of the enclosure. This is where the solar-panel cable will enter through the cable gland.



One knockout removed.

Photo: TAHMO WLM assembly manual.

2

Drill the holes in the base. Drill the two holes marked in green with the **6 mm** bit, and bore out the holes marked in red to **3.5 mm**.



Green: 6 mm. Red: 3.5 mm.

Photo: TAHMO WLM assembly manual.



Drilling the base. Clamp or hold the enclosure firmly and remove the swarf afterwards.

Photo: TAHMO WLM assembly manual.

3

Screw the spacers in. Fit the spacers that will carry the board.



Spacers fitted.

Photo: TAHMO WLM assembly manual.

4

Mount the bracket on the back of the enclosure with two bolts, washers and nuts.



Bolts seen from inside the enclosure.

Photo: TAHMO WLM assembly manual.



The bracket fitted on the back.

Photo: TAHMO WLM assembly manual.

Caution

Think about the orientation **before** you tighten: the lid is the side that must face the water, and the bracket decides how the enclosure sits on the pole or wall. The bracket slots allow a pole or a wall mount; the hose clamps pass through the slots.

- 5** **Insert the plugs** supplied in the kit so that the enclosure is watertight.



Plugs inserted.

Photo: TAHMO WLM assembly manual.

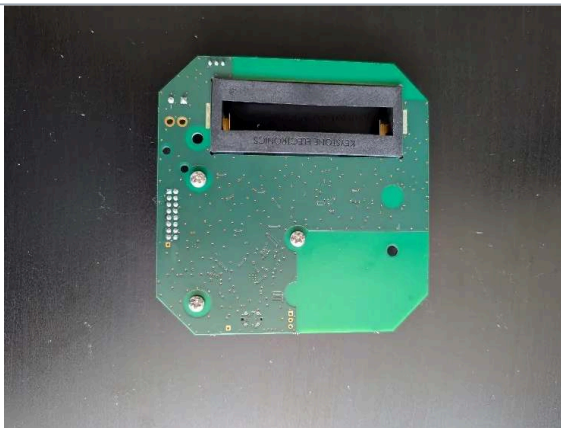
Prepare the board

- 6 Fit the plastic spacers on the board, **loosely**: you must still be able to wiggle them.



Board, top side.

Photo: TAHMO WLM assembly manual.



Board, underside.

Photo: TAHMO WLM assembly manual.



A plastic spacer: loose now, tightened in the next step.

Photo: TAHMO WLM assembly manual.

7

Mount the RockBLOCK (the Iridium modem) on its connector on the board, then tighten the spacers.



RockBLOCK mounted and held by the spacers.

Photo: TAHMO WLM assembly manual.

8

Connect the solar-panel cable. Solder the extension cable to the board. Alternative: clamp it in the **screw terminal**.



The red solar cable on the board.

Photo: TAHMO WLM assembly manual.

Caution

Check the polarity against the markings next to the terminal before soldering or clamping. The board protects the battery and the solar input against reverse polarity and shows a wrong connection with an LED, but do not rely on the protection to forgive a careless connection.

Optional: charging over USB

To charge the battery over USB, connect the pads marked **USB Charge** on the board with a drop of solder. The board then draws up to 500 mA from any USB port. Without the solder bridge, USB carries data only. There is no LED that shows USB charging.



The USB Charge pads (arrow).

Photo: TAHMO WLM assembly manual.

Close the unit

- 9 Mount the board in the enclosure with two bolts.



Board mounted; the cable leaves through the knockout.

Photo: TAHMO WLM assembly manual.

10

Fit the cable gland. Wrap a little tape around the thread of the gland so that it grips in the enclosure, pull the cable through it, and screw the gland into the enclosure.



Tape on the gland thread.

Photo: TAHMO WLM assembly manual.



Gland fitted, cable through.

Photo: TAHMO WLM assembly manual.

11

Seal the cable. Wrap a little tape around the cable where it passes through the gland, to increase its diameter, then tighten the gland.



The cable leaving the gland.

Photo: TAHMO WLM assembly manual.



Gland tightened.

Photo: TAHMO WLM assembly manual.

Caution

The gland is the main place where water gets in. The cable must fill the gland snugly: if the nut turns easily without gripping the cable, add tape. Let the cable hang in a loop below the gland so that water runs off the loop instead of along the cable into the enclosure.

12 Screw on the antenna and fit the battery.



Antenna on, battery in its holder.

Photo: TAHMO WLM assembly manual.

Caution

Insert the battery with the + and – marks of the holder matching the cell. Keep the unit switched off (toggle switch off) while you work.

13

Close the lid and tighten the screws evenly, so that the gasket seals all around.



Lid closed.

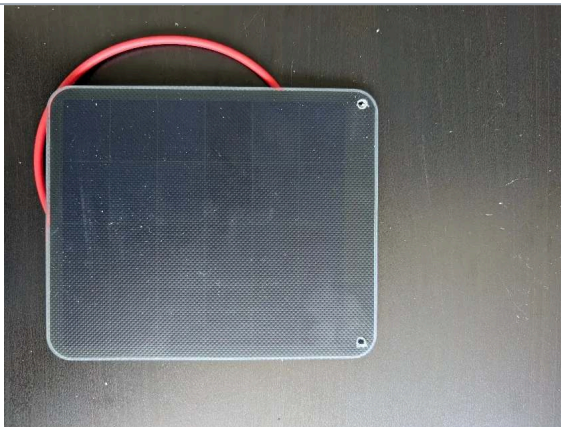
Photo: TAHMO WLM assembly manual.

Assemble the solar panel

The solar panel is a 5 V panel; the board limits the charging current to 500 mA.

1

Drill the two mounting holes (3.5 mm) as shown, unless your panel already has them.

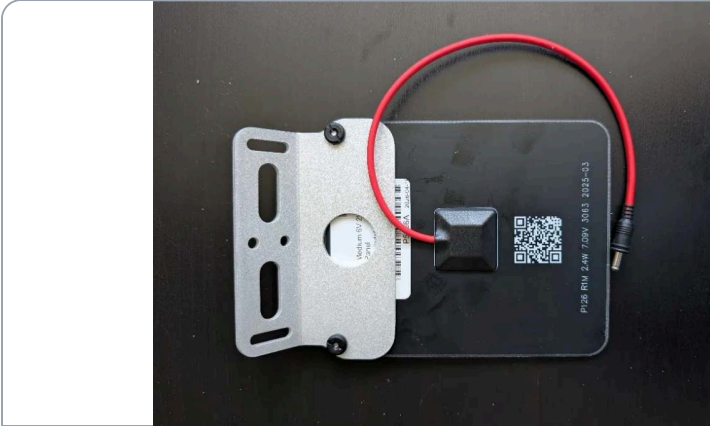


Rear of the panel.

Photo: TAHMO WLM assembly manual.

2

Fit the bracket with bolts and nuts. The orientation of the bracket depends on how the panel will be mounted: the panel must face the sun (south in the northern hemisphere, north in the southern one).



Bracket fitted.

Photo: TAHMO WLM assembly manual.

Install reflexa micro on the board

Boards come with TAHMO's own firmware. The unit becomes a reflexa micro unit when the reflexa micro firmware is installed: follow [First installation on a TAHMO WLM board](#). Then take the unit to the site: [Install on site](#).

Note

Photos and assembly steps: TAHMO WLM assembly manual (TAHMO, with the WLM design by TU Delft). See [Sources](#).

First installation on a TAHMO WLM board

A new TAHMO **WLM** board arrives with TAHMO's own firmware. To make it a reflexa micro unit, reflexa micro's firmware has to be installed once. After that, every update is done from the field console without touching the board ([Firmware update](#)).

Field console 0.5.10 or newer

The guided first installation (detection of the board in BOOTSEL, the backup of the original firmware, the install and the check) needs field console 0.5.10 or newer.

Before you start

- The board is assembled with its battery ([Assemble the unit](#)), if you received it as a kit.
- The field console is installed on your computer ([Install the field console](#)).
- You have a **data-capable** USB-C cable.
- The unit has not been installed on site yet: this is a workshop job, done at a desk.

Put the board in BOOTSEL

The board has to be started in its bootloader (BOOTSEL) by hand. You need the **BOOT** button next to the USB-C connector and the **toggle switch** that switches the unit on and off.

- 1 **Connect the USB cable** to the board and to the computer.

- 2 **Switch the unit off** with the toggle switch.
- 3 **Press and hold the BOOT button**, next to the USB connector.
- 4 **Switch the unit on** with the toggle switch, while you keep holding BOOT. The board now shows up on the computer as a USB drive named **RP2350**.
- 5 **Release the BOOT button**.

The USB cable stays plugged in during the whole procedure: the power is cycled with the toggle switch.



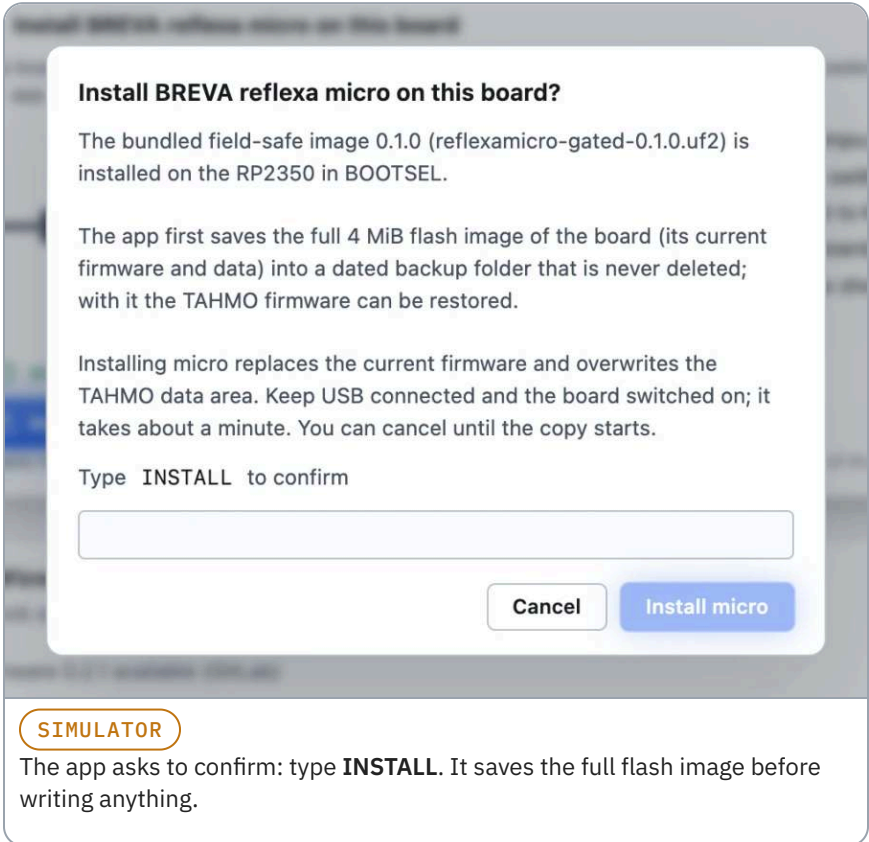
If no **RP2350** drive appears, switch the unit off, wait a few seconds and repeat from step 2, keeping BOOT pressed until the drive is there. Check also that the cable carries data: a charge-only cable powers the board but shows no drive.

Install reflexa micro

- 1 Start the field console and open **Maintenance**. It detects the RP2350 bootloader and offers **Install micro** (with the version it carries).

2

Before it changes anything, the app **saves the full flash image** of the board, which is the original TAHMO firmware with everything stored in the flash, on your computer. Keep this file: it is what lets you put the board back as it was.



3

The app installs the reflexa micro firmware and checks it.

Install BREVA reflexa micro on this board

TAHMO WLM firmware

This board runs the TAHMO WLM firmware (Tiger). It cannot be switched into the RP2350 bootloader by the app: do it by hand, then install micro. The app saves the full flash image first, so the TAHMO firmware and its data can be restored.

- ✓ Check the image (RP2350 ARM Secure, flash window, SHA-256)
- ✓ Find exactly one RP2350 bootloader and its volume
- ✓ Read the chip id of the board (picotool)
- ⌚ Save the full 4 MiB flash image (the current firmware and its data)
- ⌚ Copy the micro image to the bootloader volume
- ⌚ Wait for the BREVA reflexa micro unit to start
- ⌚ Check the new firmware identity

✕ Cancel

SIMULATOR

Each step turns green when done: here the full flash image is being saved.

4

The unit **restarts**: the green LED blinks. The app finds a reflexa micro unit without a configuration.

Install BREVA reflexa micro on this board

TAHMO WLM firmware

This board runs the TAHMO WLM firmware (Tiger). It cannot be switched into the RP2350 bootloader by the app: do it by hand, then install micro. The app saves the full flash image first, so the TAHMO firmware and its data can be restored.

- Check the image (RP2350 ARM Secure, flash window, SHA-256)
- Find exactly one RP2350 bootloader and its volume
- Read the chip id of the board (picotool)
- Save the full 4 MiB flash image (the current firmware and its data)
- Copy the micro image to the bootloader volume
- Wait for the BREVA reflexa micro unit to start
- Check the new firmware identity

BREVA reflexa micro 0.1.0 (ef273b7f) is running on DF552BE39561B19D (/dev/cu.usbmodem2101). It is the chip that was in BOOTSEL (DF552BE39561B19D). The original flash image (4 MiB) is saved in /preview/backups/DF552BE39561B19D/20261024T101500Z_original_to_0.1.0.

The unit is not configured yet: open the Station page to set it up.

Open Station

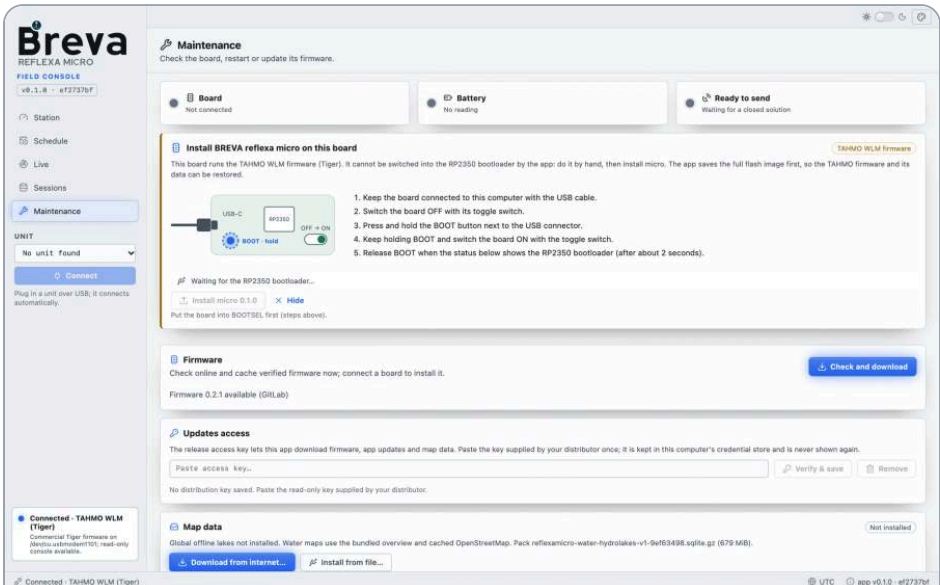
Show backup folder

Close

SIMULATOR

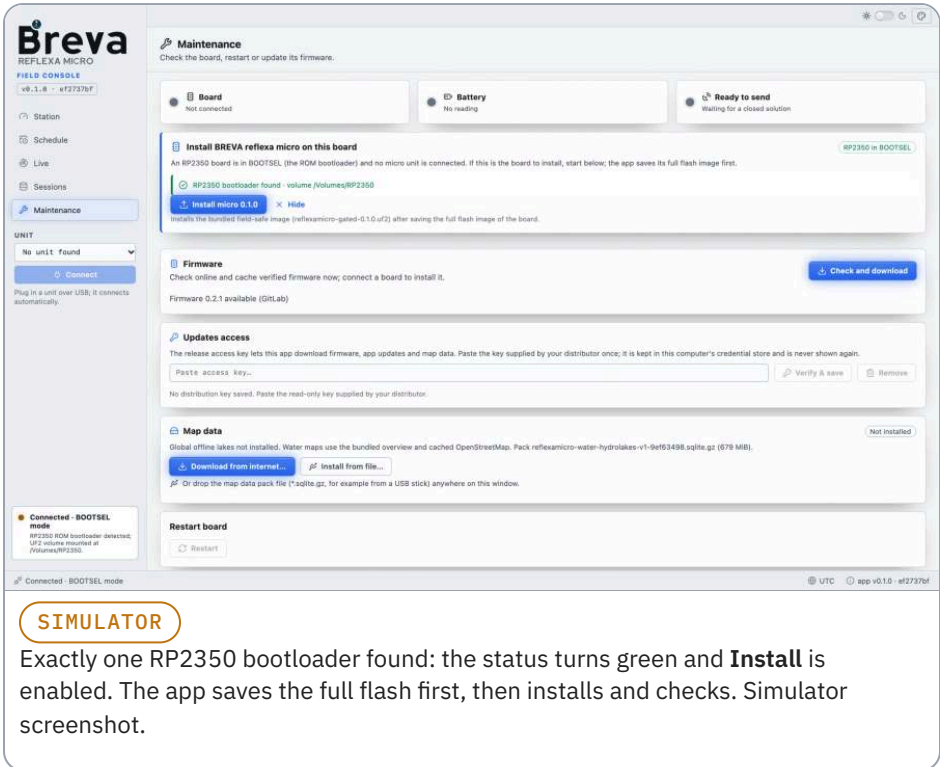
Done: the firmware runs on the board, the original flash image is saved; **Open Station** continues with the set-up.

[Status LEDs](#) explains the patterns: a reflexa micro unit that has not been configured yet blinks red once every 5 seconds. That is expected at this point.



SIMULATOR

Maintenance: the app recognises a TAHMO WLM board and shows how to put it in BOOTSEL; the status waits for the bootloader. Simulator screenshot.



After the installation

The app shows the **Station** page of a new, unconfigured unit. Continue with the [Quick start](#): set the position, aim at the water, save to the station, set the [Schedule](#), then mount the unit and [verify live](#).

Going back to TAHMO's firmware

The original TAHMO firmware can be restored in two ways:

- from TAHMO's firmware image `wlm-firmware.uf2`, published with the TAHMO WLM documentation: put the board in BOOTSEL as above and copy the file to the **RP2350** drive. The board restarts with TAHMO's firmware and needs TAHMO's own set-up again;

- from the **full flash backup** saved by the app in the first step, which restores the board exactly as it was, including its settings. A full flash image is written back with Raspberry Pi's `picotool`, not by copying a file: ask the support team.

In both cases the board goes back to TAHMO behaviour (configuration with TAHMO's console, TAHMO data format) and is no longer a reflexa micro unit until reflexa micro is installed again.

Note

Procedure from the TAHMO WLM documentation (flashing steps) and the TAHMO WLM user and assembly manuals. See [Sources](#).

Quick start

This page is the short path. Each step links to the full guide or to the help page of the app screen you are on.

Before you go

You need:

- a reflexa micro unit (charged battery, solar panel connected for long installations);
- a computer with the field console installed (macOS, Windows or Linux) and a **data-capable** USB-C cable;
- optionally the [map data pack](#) (global offline lakes) on a USB stick, or Wi-Fi to download it;
- optionally a tape measure for the antenna height above the water (an estimate by eye is enough).

The [site checklist](#) is a printable one-page version of this list. For the site itself, take the field manual: these guides, the help pages of the Normal mode, troubleshooting and the checklist, offline.

Install the field console

Install the app from the USB stick or the [Downloads](#) page, then save the release access key: step by step in [Install the field console](#). The app works without Internet; online it can also download satellite orbits, OpenStreetMap water, updates and the map data pack.

macOS: Open the `.dmg` (Apple silicon) and drag **BREVA reflexa micro** to Applications.

Windows: Unzip the Windows x64 package and run the installer it contains.

Linux: Unzip the Linux package and install the `.deb` (Ubuntu 22.04 and later).

New board from TAHMO

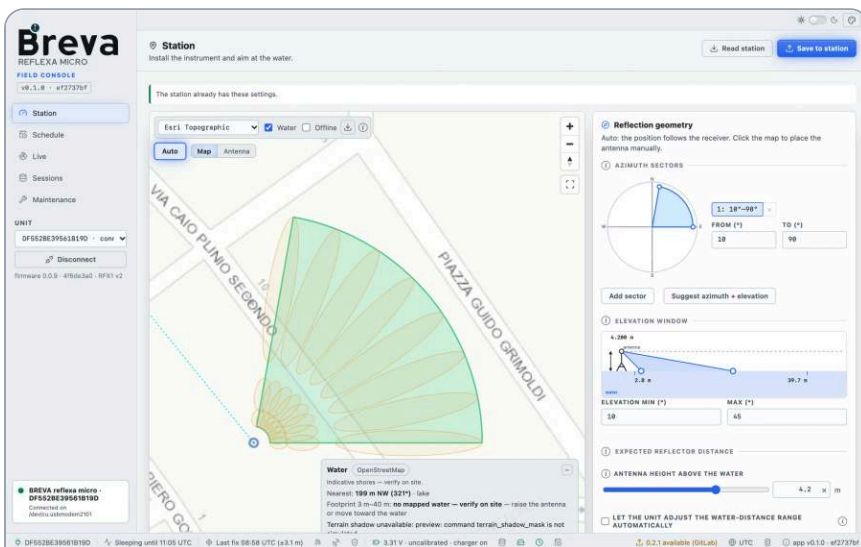
A new TAHMO WLM board runs TAHMO's firmware: install reflexa micro first, once, in the workshop. If the unit comes as a kit, [assemble it](#) before. → [First installation on a TAHMO WLM board](#)

On site

- 1 **Mount the unit** where it sees the open sky and the water between about 5° and 45° of elevation, and fix it firmly. Measure the antenna height above the water with a tape if it is easy, otherwise estimate it by eye: it is not critical. → [Install on site](#)
- 2 **Connect** the unit over USB and start the app. With one unit it connects by itself and sets the unit clock if needed. → [The field console](#)

3

Aim at the water on the **Station** page: keep the position on *Auto*, drag across the compass toward the water to draw a sector, use an elevation window of about 5° – 45° , enter the antenna height (measured, estimated by eye, or empty if unknown), keep the search range on *Auto*, then **Save to station**. → [Station](#)



SIMULATOR

Station: sector toward the water, elevation window, antenna height, then **Save to station**.

4

Schedule the sessions: the *Recommended* preset (4 × 90 min) and Iridium sending at the end of each session are a good start.

→ [Schedule](#)

Breva
REFLEXA MICRO
FIELD CONSULE
v0.3.8 : ef2737f

Station
Schedule
Live
Sessions
Maintenance

UNIT
DF552BE39561B19D - con
Disconnect
firmware 0.0.0 - 4f663ad - RF3 v2

Schedule
Choose when to record and send.
Read station Save to station

The station already has these settings.

Recording and sending preset
Choose how often and how long to record.
Ultra low power - 1 × 60 min Minimum - 4 × 45 min **Recommended - 4 × 90 min** Dense - 6 × 120 min Continuous - 1 × 1440 min

DAY TIMELINE (UTC)
New 10/28
Next planned start 12:00 UTC
Starts: 00:00, 06:00, 12:00, 18:00 UTC. Receiver on = 8.1 h/day

EXPECTED CONSUMPTION
per day: **≈ 241 mAh**
nominal battery - estimate: **≈ 12.4 days**
receiver / day: **8.1 h**
atrx / session: **≈ 11**
Receiver: 121 mAh Iridium: 0 mAh MCU: 120 mAh

Iridium
AUTOMATIC SENDING: OFF
Drag a session to shift the whole schedule. Right-click a session to disable recording or its automatic send. Sending waits for a gap between sessions and respects the battery and modem settings. Update Firmware to save exclusions or midnight sending.

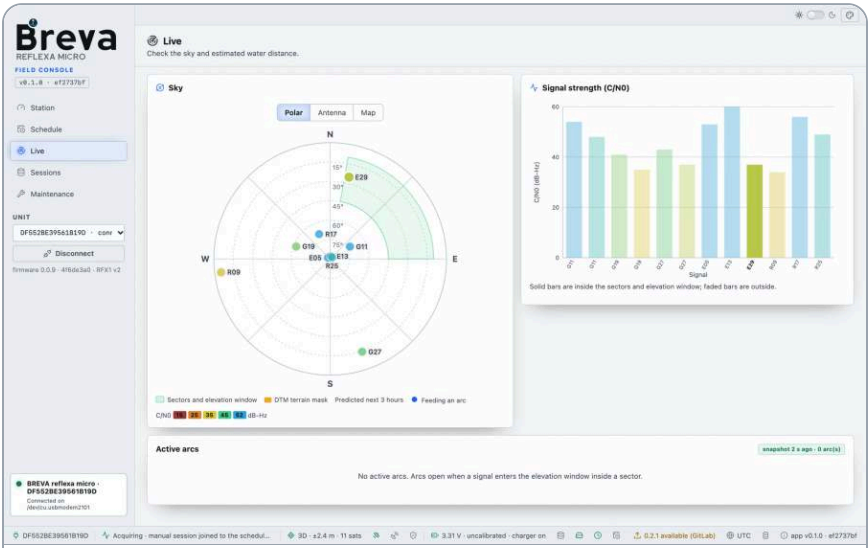
DF552BE39561B19D Sleeping until 11:05 UTC Last fix 08:58 UTC (3.1 m) 3.31 V - uncalibrated - charger on 9.2.1 available (DRLab) UTC app v0.1.0 - ef2737f

SIMULATOR

Schedule: preset, day timeline, expected consumption and Iridium sending.

5

Verify live before you leave: open **Live**, check that satellites cross every sector with good signal, and that the first arcs close with *pass* around one height. → [Verify live](#)



The screenshot shows the Brevia Live interface. On the left is a sidebar with navigation options: Station, Schedule, Live (selected), Sessions, and Maintenance. Below this is a unit selection dropdown showing 'DF552BE39561B190' and a 'Disconnect' button. The main area is titled 'Live' and contains a 'Sky' plot and a 'Signal strength (C/N0)' bar chart.

The 'Sky' plot is a circular sky plot with a polar projection. It shows several satellites (E29, E01, E13, E25, E09, E17, E11, R09, R25, R27) and their predicted paths. The plot is divided into sectors, and a green shaded area indicates the 'Sectors and elevation window'. A legend at the bottom of the plot explains the symbols: 'Sectors and elevation window' (green), 'DTM terrain mask' (yellow), 'Predicted next 3 hours' (blue), and 'Feeding an arc' (red). Below the plot, it says 'Active arcs' and 'No active arcs. Arcs open when a signal enters the elevation window inside a sector.'

The 'Signal strength (C/N0)' bar chart shows the signal strength for each satellite. The y-axis is 'C/N0 (dB-Hz)' ranging from 0 to 60. The x-axis is 'Signal' with labels for each satellite. The bars are color-coded: solid bars are inside the sectors and elevation window, and faded bars are outside. A legend at the bottom of the chart explains this: 'Solid bars are inside the sectors and elevation window; faded bars are outside.'

At the bottom of the interface, there is a status bar with various indicators: 'DF552BE39561B190', 'Acquiring - manual session joined to the sched...', '30 - 2.4 m - 11 sats', '3.31 V - uncalibrated - charger on', '0.2.1 available (BRLab)', 'UTC', and 'app v0.1.0 - ef2737bf'.

SIMULATOR

Live during a session: satellites crossing the sector and their signal strength.

6

Leave the unit running. Results arrive over Iridium after each session; the full arcs stay on the unit until you download them. → [Iridium setup](#)



Tip

Not sure whether a site works at all? Run a [Campaign](#) first: power on, walk away, read the satellite report.

Install on site

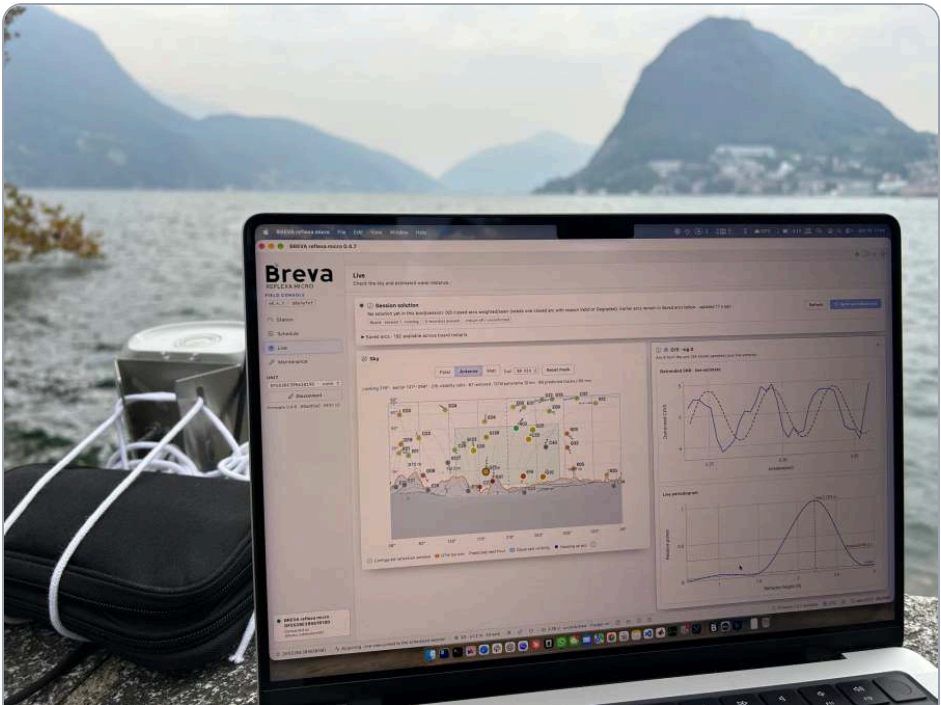
Mount the unit

- The antenna must see the open sky and, toward the water, the sector of sky between about 5° and 45° of elevation. Walls, railings, trees and buildings in that direction block or confuse the reflections ([site requirements](#)).
- Mount it as stably as possible: the measured quantity is the vertical distance from the antenna to the water, so any movement of the antenna appears as a water-level change.
- 1–10 m above the water is the most comfortable range; more height means a larger, farther footprint (needs more open water) and faster oscillations.
- Fix the enclosure with its **lid toward the water** (the azimuth window must be on the lid side) and the solar panel facing the sun. Keep large reflective surfaces, such as a parked car, out of the sector.



A unit clamped on a pole with hose clamps; the solar panel on its own bracket above.

Photo: TAHMO WLM assembly manual.



Test session: unit and laptop on a lake-side wall.

Antenna height

The antenna height above the water is **not critical**: it is only a starting point. The unit measures the real height itself, and after three accepted arcs the Station page shows the measured value.

- **If it is easy to measure**, use a tape from the antenna to the water: it gives a quick check of the first results. The unit measures from the antenna phase centre, a little below the top of the enclosure.
- **If it cannot be measured**, estimate it by eye and enter a credible value. Within a factor of two is enough: with the search range on **Auto** the unit searches from half to twice your value (a guess of 3 m covers 1.5–6 m) and widens the range by itself when reflections land on its edge.

- **If you have no idea at all**, leave the field empty: the unit then searches the widest range the elevation window allows.



Test installation: a tape from the antenna to the water to check the antenna height.

Connect the unit

- 1 Plug the unit in with a data-capable USB-C cable and start the app. With one unit, the app connects by itself; with several, choose one under **Unit** and press **Connect**.

- 2 The status bar turns green and shows the unit state.
- 3 If the unit has no valid time yet (just powered, no GNSS fix), the app sets the unit clock from the computer. A GNSS time is never overwritten.

A device listed as *Unverified RP2350 device* is not a reflexa micro unit running compatible firmware and is never used.

Configure the station

On the **Station** page (Normal mode):

- 1 Keep the position on **Auto (from receiver)**.
- 2 Drag across the compass toward the water to draw a sector (up to eight).
- 3 Use an elevation window of about 5° to 45°.
- 4 Enter the antenna height, measured or estimated by eye, or leave it empty if you have no idea. Keep the water-distance search range on **Auto**.

5

Press **Save to station**: the app shows the differences, the unit validates them, the app writes once and reads back to verify.

Review changes unit v3 ☐ Show unchanged fields

1 field(s) differ from the unit. Applying writes the draft, reads it back and compares every field.

GROUP	FIELD	ON THE UNIT	DRAFT
Reflection geometry	Elevation min	10°	5° Reset

Review the changes below, then validate and apply.

The unit validates the draft first (nothing is written if it refuses).

Keep editing Validate and apply 1 change

SIMULATOR

The review before saving: each changed field, what is on the unit and the draft.

Every control of the page is described in [Station](#). Then set the [Schedule](#) and [verify live](#).



Tip

Export the configuration (Advanced → Settings → Files & profiles) and keep it with your site notes: after a reset it restores the station in one step.

Verify live on site

- 1 Open **Live** after saving the settings. If the receiver is off, press **Start live** (cold start: about a minute to the first fix). While the page is open the receiver stays on, even past the end of a scheduled session; leaving the page releases it.
- 2 Check the **sky**: satellites should appear in every sector (green wedges), mostly with strong signal (blue/green). The useful ones rise or set through the sector, sweeping elevation; a satellite that only skims it gives no arc ([useful passes](#)).
- 3 Check the **signal strength**: open sky is typically 35–50 dB-Hz; uniformly low values point to the antenna, cable or mounting.
- 4 **Inspect a signal**: click a satellite, a bar or an arc. The oscillation should be regular, with one clear peak in the periodogram.
- 5 Wait for **closed arcs**: they should close with *pass* and cluster around one height with a small sigma, close to your estimate or measurement.



Test session: sky view with sectors (green), predicted tracks, C/N0 bars.



Arc inspector during a long pass: oscillation and provisional periodogram.

What a good installation looks like

Satellites appear in every sector, mostly green; arcs close with *pass*; accepted arcs cluster around one RH with small sigma. After three accepted arcs the Station page shows the **measured height** next to your estimate.

Signs of a problem

- Satellites in a sector never appear, or only with weak (red) signal: the sector is obstructed or points the wrong way.
- Arcs close with *fail* for geometry or peak-to-noise reasons: too short a sweep of elevation, a reflected path obstructed by buildings or trees (the map's terrain shadow does not show them), waves, or RH outside the search range (keep *Auto*, lengthen sessions).

- Periodograms with several peaks of similar size: more than one reflector in the sector (metal roofs, quays, cars).

More in [Troubleshooting](#). Every element of the page is described in [Live](#).

The field console

The help pages describe the **BREVA reflexa micro field console**, app and firmware 0.5.x. Each page matches one screen of the app; the app's ? button opens the page of the screen you are on.

The window

- **Sidebar**: the pages, the unit selector and its connection.
- **Page**: the current task.
- **Status bar** (bottom, on every page): connection, what the unit is doing (*Sleeping until 14:00 UTC, Acquiring · scheduled session until 16:40 UTC...*), position fix, receiver and modem power, battery, result queue, next session and next transmission, time zone, firmware and app versions. Hover for details, click to jump to the related page.
- Top right: light/dark theme and appearance.

Times: the unit keeps GPS Time (GPST = UTC + 18 s since 2017). The app shows UTC by default and labels every time; click **UTC** in the status bar to show GPST instead. Schedule times in the settings are always UTC.

Normal and Advanced modes

The app starts in **Normal** mode, which covers installation and routine use with five pages: **Station, Schedule, Live, Sessions, Maintenance**. **Advanced** mode (switch at the top; first revealed by holding ⌘/Ctrl + A

- D) adds Overview, every [setting_group](#), diagnostics and service actions.

Connect the unit

1. Plug the unit in and start the app. With one unit, the app connects by itself; with several, choose one under **Unit** and press **Connect**.
2. The status bar turns green and shows the unit state.
3. If the unit has no valid time yet (just powered, no GNSS fix), the app sets the unit clock from the computer. A GNSS time is never overwritten.

A device listed as *Unverified RP2350 device* is not a reflexa micro unit running compatible firmware and is never used.

Screens

Station

Position, sectors toward the water, elevation window, antenna height.

Schedule

When to record, expected consumption, when to send.

Live

Sky, signal strength, arcs and the arc inspector.

Sessions

Results, history and exports.

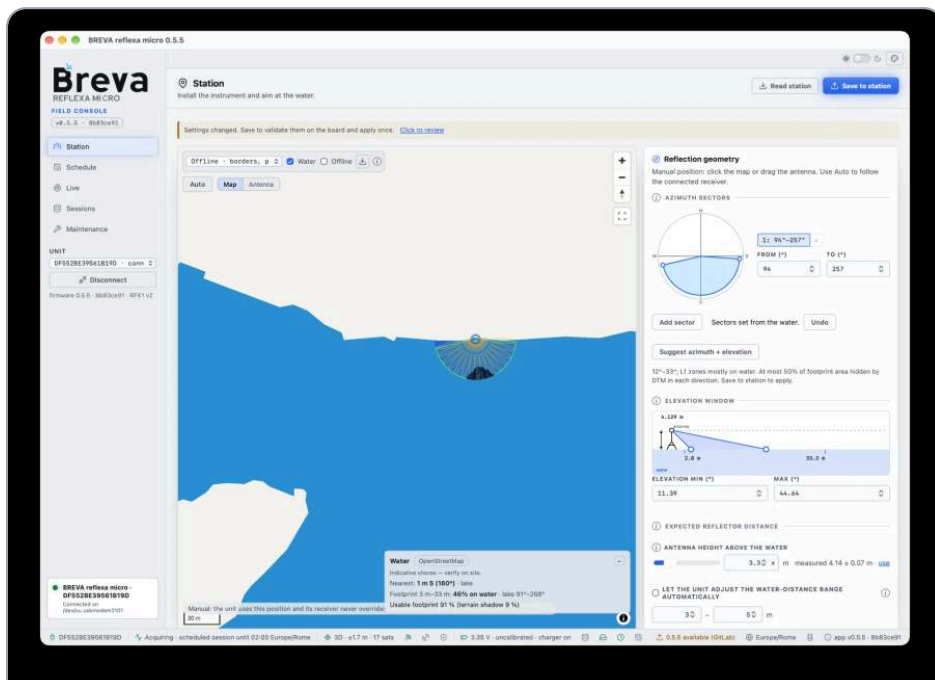
Maintenance

Unit state, firmware, restart, map data.

Advanced settings

Every setting group, validate and apply.

Station

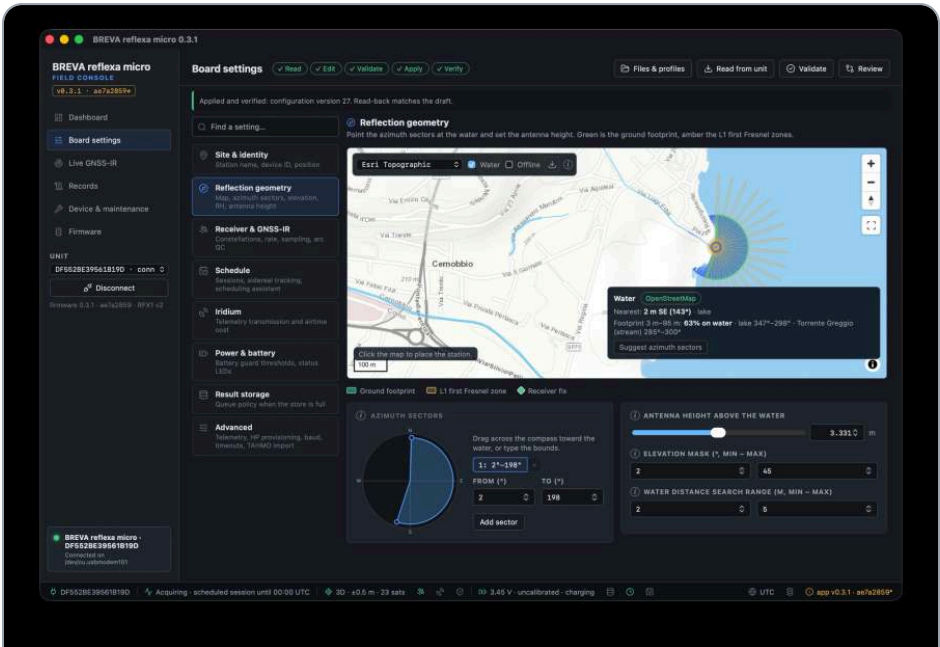


Station page at a test site: OpenStreetMap water, sector set from the water, 12° – 33° Fresnel zones mostly on water, terrain shadow 9%, measured antenna height 4.13 ± 0.15 m. The screenshot follows the page theme.

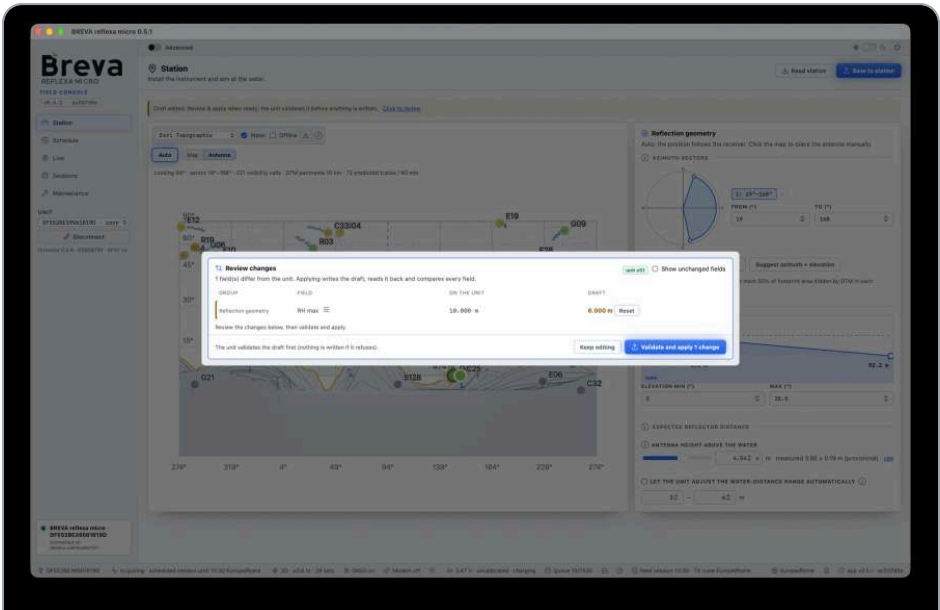
The **Station** page is where an installation starts.

- 1 **Position.** Keep **Auto (from receiver)**: the unit takes its position from its own receiver; a position within tens of metres is enough. A unit moved to a new place corrects itself. *Edit manually* lets you type latitude/longitude/height (or X/Y/Z) or click the map.

- 2 **Point at the water.** Drag across the compass toward the water to draw an azimuth sector (up to eight). The map shows the ground footprint (green) and the first Fresnel zones; water from the [map data pack](#) or OpenStreetMap is highlighted, and the panel says whether the footprint falls on water. *Suggest azimuth + elevation* proposes sectors from the mapped water.
- 3 **Elevation window.** Use about 5° to 45° (the low-cost antenna keeps the reflection visible higher than a geodetic one). The terrain profile and the black shadow on the map come from a terrain elevation model: they show where hills hide the water, not buildings or trees, and the first 100 m around the antenna are not judged. Treat them as indicative and check the reflection zones on site ([obstructions](#)).
- 4 **Antenna height above the water.** Type your measurement or an estimate by eye (within a factor of two is enough), or leave it empty (clear it with ✕) when you have no idea. Keep the water-distance search range on **Auto**. After three accepted arcs the page shows the **measured height** next to your estimate; *Use the measured height* writes it after confirmation.
- 5 Press **Save to station**: the app shows the differences, the unit validates them, the app writes once and reads back to verify.



A lake-side test site: sector toward the lake, footprint and Fresnel zones, water detected on the map.



Saving: the review lists every change before the unit validates and the app writes (light theme).

The same controls, with more options, are in Advanced → [Site & identity](#) and [Reflection geometry](#). Why the footprint matters: [How GNSS reflectometry works](#).

Schedule

Brevia
REFLEXA MICRO
FIELD CONSOLE
v0.1.0 - #2727bf

Station
Schedule
Live
Sessions
Maintenance

UNIT
DF552B2839561B19D - cony
Disconnect
firmware 0.0.9 - #F563a0 - BFX1 v2

Schedule
Choose when to record and send.

The station already has these settings.

Recording and sending preset
Choose how often and how long to record.
Ultra low power - 1 × 60 min | Minimum - 4 × 45 min | Recommended - 4 × 90 min | Dense - 6 × 120 min | Continuous - 1 × 1440 min

DAY TIMELINE (UTC)
Now 10:28
Next planned start 12:00 UTC
Starts: 00:00, 06:00, 12:00, 18:00 UTC. Receiver on = 8.1 h/day.

EXPECTED CONSUMPTION
≈ 241 mAh per day
≈ 12.4 days nominal battery - estimate
8.1 h receiver / day
≈ 11 arcs / session
Receiver: 121 mAh | Iridium: 0 mAh | MCU: 120 mAh

Iridium
AUTOMATIC SENDING
Off
Drag a session to shift the whole schedule. Right-click a session to disable recording or its automatic send. Sending waits for a gap between sessions and respects the battery and modem settings. Update firmware to save exclusions or midnight sending.

DF552B2839561B19D | Sleeping until 11:05 UTC | Last fix 08:58 UTC (±3.1 m) | 3.31 V - uncalibrated - charger on | 0.2.1 available (GRLab) | UTC | app v0.1.0 - #2727bf

SIMULATOR

Schedule page: presets, the day timeline (UTC), expected consumption and Iridium sending.

- **Preset:** Ultra low power (1 × 60 min), Minimum (4 × 45 min), Recommended (4 × 90 min), Dense (6 × 120 min), Continuous (1 × 1440 min).
- **Day timeline (UTC):** sessions as blue blocks and the current time. Drag a session to shift the whole schedule; right-click a session to disable recording or its automatic send.
- **Expected consumption:** mAh per day, estimated autonomy on the nominal battery, receiver hours per day, expected arcs per session (estimates).

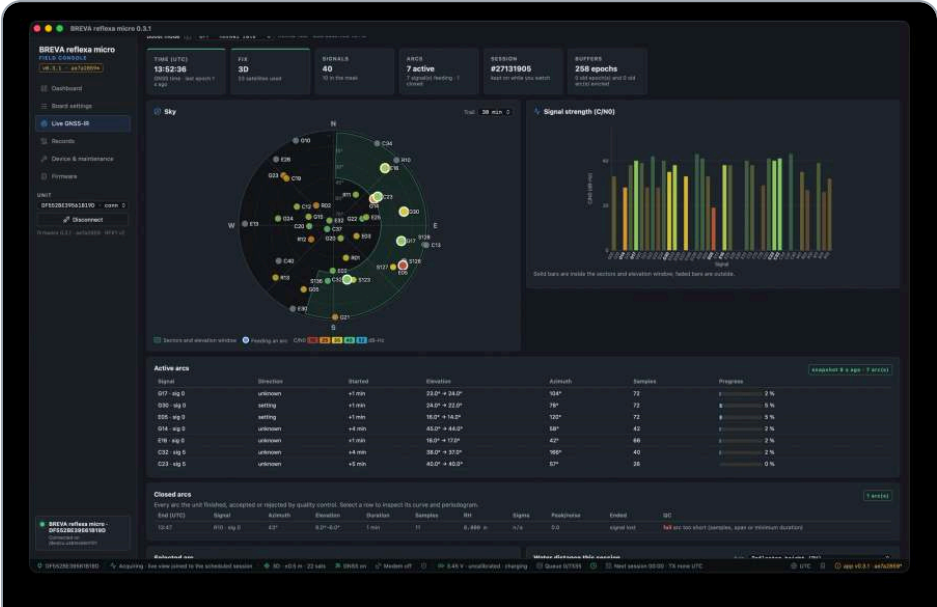
- **Iridium · automatic sending:** Off, at the end of each session, every N results, every N hours, or daily at a fixed time. Sending waits for a gap between sessions and respects the battery and modem settings (see [Iridium setup](#)).

Guidance: sessions shorter than about 45 minutes rarely complete an arc; 60–120 minutes is recommended; continuous recording gives the most arcs at the highest energy cost (and leaves no gap for satellite sending).

Every schedule option, including *Follow the satellites* and the experimental Campaign, is in Advanced → [Schedule](#).

CHAPTER 13

Live



Live during a test session: sky with sectors, C/N0 bars, active and closed arcs.

- **Active arcs:** signals rising or setting through the window and how much of the window they have swept.
- **Closed arcs:** each finished arc with its water distance (RH), sigma, peak-to-noise and *pass/fail* with the reason.
- **Inspect a signal:** click a satellite, a bar or an arc: the inspector shows C/N0 over time and against sin(elevation), the detrended oscillation, a provisional periodogram refreshed every 5 s, and the wavelet scalogram. When an edge block was trimmed, it shows the retained and rejected ranges and the reason. The unit's closed arc is authoritative.



Arc inspector: C/N0 over time and against sin(elevation), the detrended oscillation and its periodogram with one clear peak.

How to judge an installation from this page: [Verify live on site.](#)

Sessions



Sessions page: every session the unit reported, newest first.



REFLEXA MICRO
FIELD CONSOLE
v0.3.1.0 - #27370f

- Station
- Schedule
- Live
- Sessions**
- Maintenance

UNIT
DF652B83961B19D - con
Disconnect
firmware 0.0.9 - 4f6563a0 - RFX1 v2



BREVA reflexa micro -
DF652B83961B19D
Connected on
NMEA0183 (baud=9600)

Sessions

Review current and previous measurement sessions.

▶ Current board solution

Sessions

Fragments
Recover
Download all...
Send...

Session	Start	End	Arcs	RH ± σ	Status	Actions
484/47	2026-10-24 04:45:59 UTC	Running	52/88 · board 51/51	3.545 ± 0.054 m	queued	
484/29	2026-10-23 09:19:19 UTC	2026-10-23 11:16:52 UTC	6/18	3.350 ± 0.041 m	queued	
484/1	2026-10-23 08:19:19 UTC	2026-10-23 18:16:52 UTC	9/21	3.380 ± 0.033 m	archived	
482/1	2026-10-21 07:19:19 UTC	2026-10-21 09:16:52 UTC	12/24	3.419 ± 0.029 m	queued	
481/2	2026-10-20 06:19:19 UTC	2026-10-20 08:39:19 UTC	15/27	3.440 ± 0.026 m	archived	

▶ Recovery details

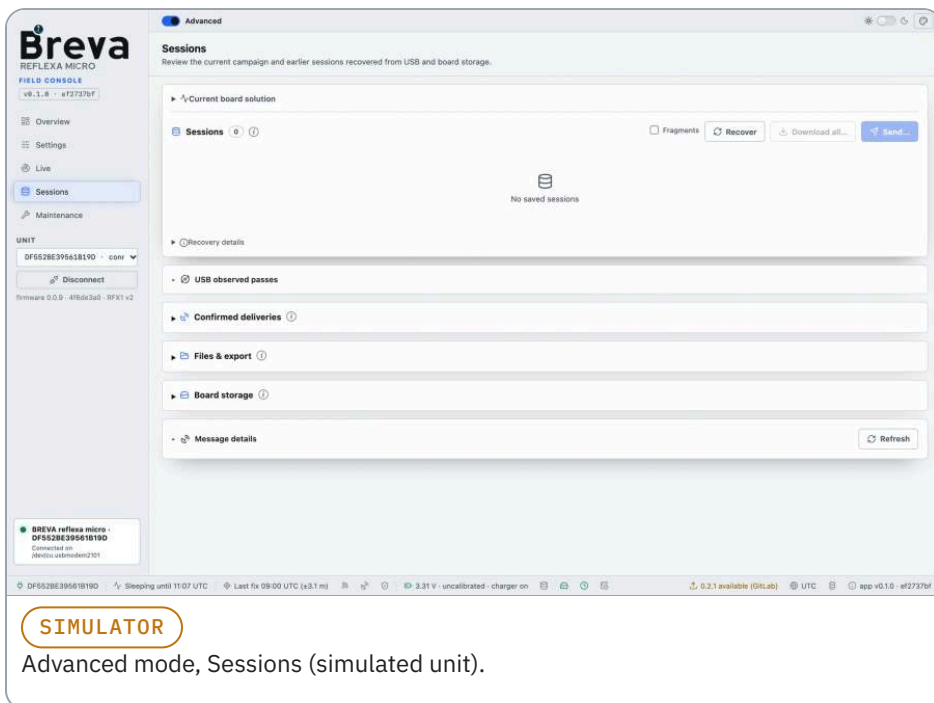
DF652B83961B19D
Sleeping until 11:06 UTC
Last fix 08:59 UTC (±3.1 m)
3.31 V · uncalibrated · charger on
0.2.1 available (GRLab)
UTC
app v0.1.0 - #27370f

SIMULATOR

Sessions with data: one running session, queued and archived ones.

Every session the unit reported, newest first: start, end, arcs, the session water distance ($RH \pm \text{spread}$) and status (*running*, *archived*). Open a session to see its arcs; export CSV/JSON. History survives app restarts and unit reboots (it is recovered from the unit and from the app's own journal). Exports carry both UTC and GPST times.

Download all (Advanced → Sessions) copies the stored results from the unit to the computer; each record is saved on disk before the unit is told to delete it, so an interruption never loses data.



Surface elevation: if the antenna height above a datum is known, **water elevation = antenna elevation – RH**.

Maintenance

Brevia
REFLEXA MICRO
FIELD CONSOLE
v0.1.0 - ef2737bf

Station
Schedule
Live
Sessions
Maintenance

UNIT
DF5828E39561819D - con
Disconnect
firmware 0.0.9 - 4f85c3a0 - BFX1 v2

Maintenance
Check the board, restart or update its firmware.

Board
Connected and responding

Battery
3.31 V · uncalibrated · charger on

Ready to send
Waiting for a closed solution

Firmware
Firmware 0.2.1 available (GitLab)
Firmware 0.2.1 available (GitLab)
[Check, download and update](#)

Updates access
The release access key lets this app download firmware, app updates and map data. Paste the key supplied by your distributor once; it is kept in this computer's credential store and is never shown again.
Paste access key... [Verify & save](#) [Remove](#)
No distribution key saved. Paste the read-only key supplied by your distributor.

Map data
Global offline takes not installed. Water maps use the bundled overview and cached OpenStreetMap. Pack reflexamicro-water-hydro-lakes-v1-9ef63498.sqlite.gz (679 MB). [Not installed](#)
[Download from internet...](#) [Install from file...](#)
Or drop the map data pack file (*.sqlite.gz, for example from a USB stick) anywhere on this window.

Restart board
[Restart](#)

Settings
[Factory defaults...](#)

SIMULATOR
Maintenance page: unit state, firmware, service actions and map data.

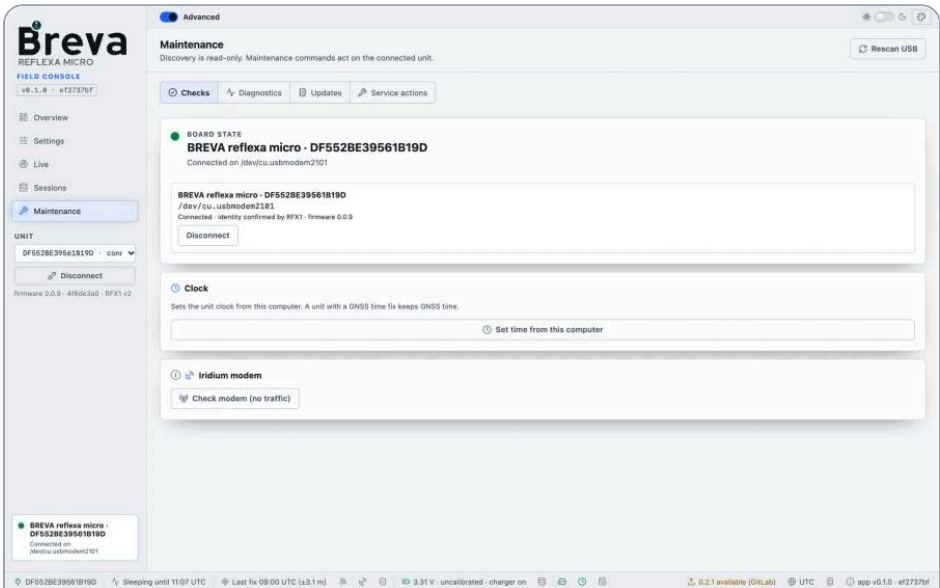
DF5828E39561819D · Sleeping until 11:06 UTC · Last fix 08:59 UTC (x3.1 mi) · 3.31 V · uncalibrated · charger on · 0.2.1 available (GitLab) · UTC · app v0.1.0 - ef2737bf

- **Board / Battery / Ready to send:** the unit state at a glance. The battery is shown as measured and *uncalibrated* (a few percent of error); a LiFePO4 cell rests at about 3.2–3.3 V for most of its capacity.
- **Firmware:** compares the unit firmware with the one bundled in the app and with the release channel; **Check, download and update** runs the [guided update](#).
- **Check modem (no traffic):** switches the modem on, measures the signal and reads the modem identity without sending anything (free).
- **Restart board; Factory defaults** (shows the differences first).

- **Map data:** install, download or remove the global offline lakes ([map data pack](#)).

Advanced mode

In Advanced mode, Maintenance has four tabs. Discovery is read-only: only the actions you press act on the unit.



SIMULATOR

Checks: board state, set the clock from the computer, check the modem without traffic.

BREVA

REFLEXA MICRO

FIELD CONSOLE

v0.3.0 - #f2737bf

Overview

Settings

Live

Sessions

Maintenance

UNIT

DF552B839561B19D - con

Disconnect

Firmware 0.0.0 - 4f6d3a0 - RFX1 v2

BREVA reflexa micro - DF552B839561B19D

Connected on /dev/ttyUSB0

Advanced

Maintenance

Discovery is read-only. Maintenance commands act on the connected unit.

Checks

Diagnostics

Updates

Service actions

Diagnostics

Read diagnostics

Read diagnostics to see protocol, storage and modem counters and the fault log.

Technical details

UPTIME

3 h 0 min

boot #12 - last restart: Power-on

GNSS POWER

off

1,284,311 bytes received

MODEM POWER

off

supercap charged - not booted

EXTERNAL WATCHDOG

gated

pending hardware verification

WATCHDOG

0 reset(s)

genuine watchdog resets only, not power interruptions - 0 scheduler overrun(s)

GNSS UART ERRORS

0

framing 0 - break 0 - overrun 0 - parity 0

UBX FRAMES

48,211

rejected 0 - dropped 0

Event log

Info and above

Pause

Clear

10:30:35

app

info

Connected to DF552B839561B19D on /dev/ttyUSB0:2301 - firmware 0.0.0 - capabilities: persistentConfig, gnssPowerControl, modem, flashQueue, sciencePipeline, liveGnssIr, statusLed, constellationMask, stationPosition, compactIridium, queueRead, IridiumControl, transmitPolicy

DF552B839561B19D

Sleeping until 11:07 UTC

Last fix 09:00 UTC (±0.1 m)

3.31 V - uncalibrated - charger on

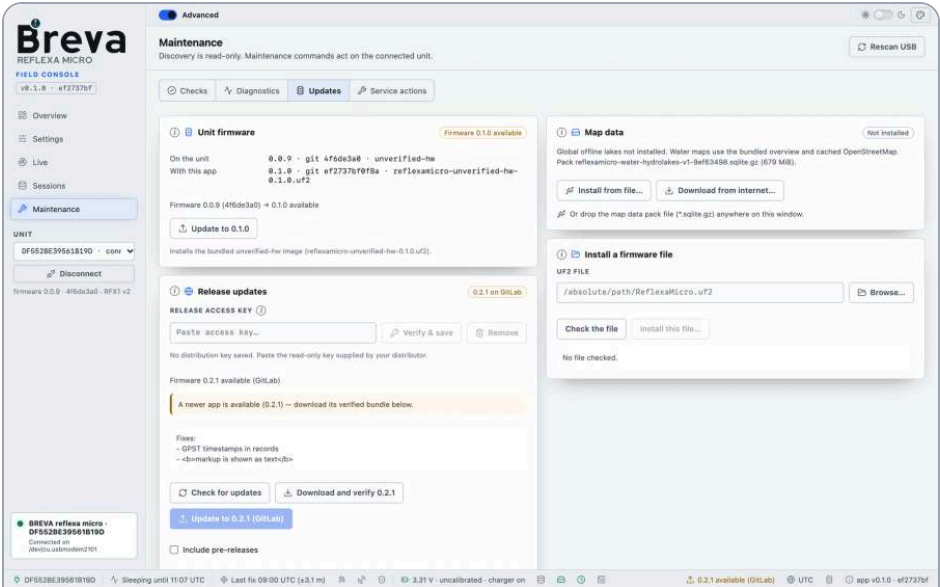
0.2.1 available (GRLab)

UTC

app v0.1.0 - #f2737bf

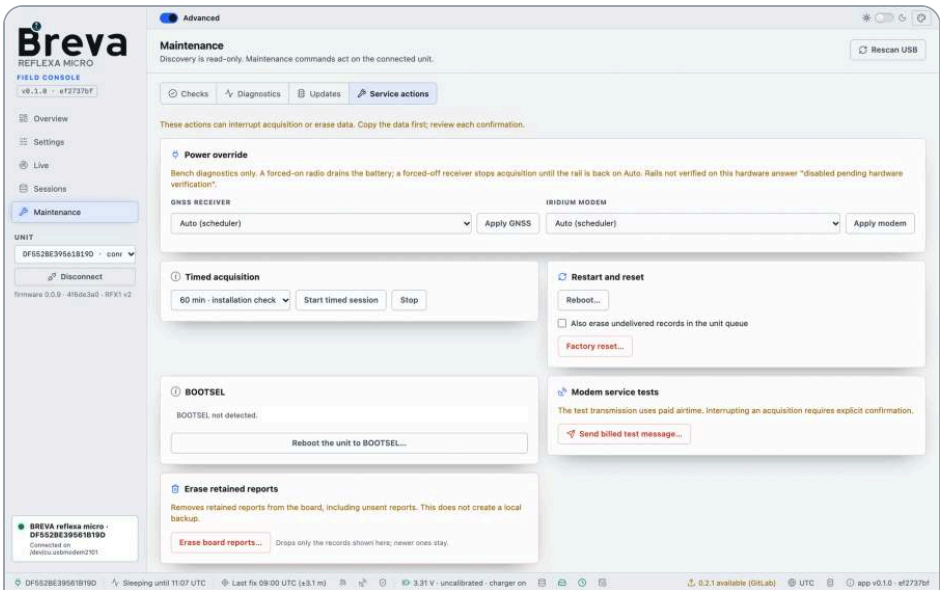
SIMULATOR

Diagnostics: read protocol, storage and modem counters, the fault log and the app event log.



SIMULATOR

Updates: unit firmware, release updates, map data and installing a firmware file.



SIMULATOR

Service actions: power override, timed acquisition, restart and reset, BOOTSEL and modem tests. These can interrupt acquisition or erase data: read each confirmation.

Iridium setup

reflexa micro sends its results through the **Iridium** satellite network with a Ground Control **RockBLOCK 9704** modem (Iridium IMT messaging). It works anywhere on Earth with a view of the sky, without a mobile network.

Account checklist for a new unit

- 1 The modem's IMEI registered in the Cloudloop account that will receive the data (subscriber activated, data pack available).
- 2 Topic 244 (RAW) provisioned for the subscriber.
- 3 A destination configured (webhook to the ingest service, MQTT, or CSV export routine).
- 4 Run **Check modem (no traffic)** once on site (Maintenance): signal bars and modem identity, no cost.

Iridium modem

Check modem (no traffic)

1. 5 V modem rail on after 150 ms
2. Modem enabled (I_EN) after 200 ms
3. Modem booted (I_BTDR) after 3.2 s
4. First JSPR response after 3.8 s
5. JSPR configured after 4.5 s
6. Signal measured after 9.5 s · 3/5 bars
7. Powering down after 9.6 s

The modem booted, answered and reported its signal. 3/5 bars. Modem off again after 11.0 s. No message was sent.

SIMULATOR

Check modem (no traffic): the modem is powered, answers and reports its signal, then is switched off. No message, no cost.

How a message travels

- 1. The unit builds a compact message from the results not yet sent and transmits it on Iridium topic 244 (RAW).
- 2. Iridium delivers it to the **Ground Control / Cloudloop** account that owns the modem (the “Thing”, identified by the modem’s IMEI).
- 3. Cloudloop shows it in *Cloudloop Data* → *All Messages* and forwards it to the configured destinations: an HTTP webhook (BREVA’s ingest service), an MQTT broker, e-mail, or a CSV export from the console.
- 4. The receiving side decodes the payload (the field console has a decoder; the server uses the same code).

Cloudloop’s payload is exactly the message the unit built (the modem’s 2-byte checksum is not included), so it can be decoded as it is.

When it sends

Chosen in [Settings](#) → [Iridium](#) (or [Schedule](#) in Normal mode):

Policy	Behaviour
Never	Nothing is sent; everything stays on the unit for USB download.
End of ses- sion (usual)	After every session, whatever it produced; a session without re- sults still sends a short “alive” message.
Every N results	When N new results are waiting.
Every N hours	At most every N hours, with whatever is waiting.
Daily at a time	Once a day at a fixed UTC time.

Rules common to all policies: the unit transmits **only between sessions** (the modem and the GNSS receiver never run together); a daily maximum; retry after a failed send (default one retry after 30 minutes);

the battery guard can hold transmissions. Sent results **stay on the unit** until they are downloaded over USB or overwritten by the running buffer.

What a message contains

Format: compact, bit-packed, versioned (format byte C1 ... C4 ; older formats stay readable). Lossless for the scientific values at their stored resolution (reflector height to 1 mm).

Block	Content	Size
Header	format, blocks present, first record sequence, record count, time, configuration version	~8 B
Window summary (default)	median/weighted water distance (mm), spread, arcs used/seen, weak and edge arcs, peak-to-noise, time span, RH search range in use if the unit moved it	~6 B
Unit health (default)	battery (10 mV steps), reset reason, boot and watchdog counters, faults, queue fill, failed sends	~6 B
Station position (after a move or restart; optional always)	latitude/longitude (~0.1 m), height, accuracy, distance moved	~11–13 B
Per-arc results (optional)	per arc: satellite, signal, RH (mm), sigma, peak-to-noise, samples, quality	~7–9 B per arc

Typical sizes: **default message ≈ 21–23 bytes** (below the 25-byte minimum billed), ≈ 34 bytes with the position, ≈ 100 bytes with ten per-arc results.

Example: a decoded message

A 40-byte message, format C3, with two records, as the decoder shows it:

Field	Value
Window	15:41–16:13 UTC (32 min), configuration version 44
Arcs	11 seen, 11 used (3 weak, 0 at the edge of the search band)
Water distance	2.276 m , spread 27 mm, median peak-to-noise 3.6
Health	battery 3.36 V, no faults, queue empty
Position	latitude, longitude (~0.1 m), 333.7 m ellipsoidal height, ±1.1 m

Costs (Cloudloop prepaid, October 2026)

Item	Price
Data packs	64 KB €27 (≈ €0.42/KB), 512 KB €191, 2 MB €689, 4 MB €1,229, 8 MB €2,160 (≈ €0.26/KB); packs expire after 24 months
Minimum billed per message	25 bytes
Monthly access fee	€15 per subscriber
Activation	€20 (plus a proration fee), 3-month minimum commitment

At €0.42/KB a default message costs about **€0.01**. Four messages a day are about €1.25 per month of airtime plus the €15 access fee. The field console computes the size and cost of the chosen configuration live.

Reading messages in the Cloudloop console

Cloudloop Data → *All Messages* lists every message with time, Thing, direction, size and the payload in hexadecimal. Paste a payload into the field console (Advanced → Maintenance → Diagnostics → **Decode a received message**) to read it. The decoder also reads TAHMO/Tiger station packets (21 bytes: battery, temperature, charger state, boot count and one reflector height per 4-hour window, 0–20 m in 16 bits).

Decode a received message

Paste the payload of a message (hex as shown in the Cloudloop console, or base64 from a webhook). The app recognises micro compact messages, earlier micro (RX) messages and TAHMO/Tiger packets.

c3351c9031afe508782020cd88900d8e0b4a0a7f055c28ca88000da47

Decode

Clear

micro compact message (C3) · 29 bytes · read as hex · IMT CRC verified

Blocks

Queue records

Message time (to the minute)

Configuration version

summary, health

9000–9003 (4 records)

2026-09-22 23:59:42 UTC

3

Window summary

Session water distance (RH)

Uncertainty (one sigma)

Arcs weighted / seen

Window

4.198 m

0.145 m

12 / 12

2026-09-23 00:00:00 UTC – 2026-09-23 18:00:00 UTC

Installation diagnostics

Arcs pointing outside the RH band

Weak arcs

Median peak-to-noise

Scatter $\sqrt{\chi^2/(n-1)}$

0 / 12

0 / 12

4.70

0.02

Unit health

Battery

Restarts

Faults

Queue

Failed sends

3.480 V (flags 0x5)

41 boots, 0 watchdog resets, last reason 1

none active (0 logged)

0 record(s) still queued, 0 overwritten in total

1

SIMULATOR

A payload pasted from Cloudloop and decoded: window summary, water distance, unit health.

Note

The app keeps the modem IMEI and firmware in memory only; it stores no account, token or secret.

Campaign (experimental)

A **Campaign** is one bounded, fully autonomous measurement run that starts when the unit is switched on. It is meant for a quick survey of a site without a computer: power on, walk away, read the satellite report.



Caution

Experimental, Advanced mode only: its behaviour may change in a future release. Every run ends with a **paid** Iridium report, even if normal sending is disabled.

How to use it

- 1 Advanced → Settings → Schedule → **Campaign — Experimental**: tick it and choose the duration (15–1440 minutes, 60 by default). Save to the unit.

Campaign

Experimental

☒ Start one campaign at power-on

DURATION FROM POWER-ON (MIN)

60

Automatic position, exploratory arcs and automatic water-distance range. The daily schedule is suspended. Reflections are not confirmed as water.

Closes and saves the results, then sends a summary, position and diagnostics via Iridium. Paid airtime applies. One retry after 30 minutes. Save, then power-cycle the board to start.

SIMULATOR

The Campaign card in Settings → Schedule, ticked, with its duration.

- 2 Switch the unit off and **remove every power source** (USB unplugged, switch off), then switch it on at the site. Every physical power-on starts a new run while Campaign is enabled.

3

Leave it. The unit:

- waits for a fresh position fix (horizontal accuracy ≤ 10 m, stable, with GNSS time; at most 5 minutes);
- records for the chosen duration with GPS, Galileo, BeiDou and GLONASS, **all azimuths**, elevation 5–25°, automatic sampling and automatic reflector-height range;
- processes and saves the results;
- switches the receiver off and sends a final Iridium report (installation diagnostics, health, position when available), with one retry after 30 minutes.

4

Afterwards, connect the app to download the records, then **disable Campaign** (otherwise the next power-on starts another run and another paid report).

The normal station settings are not changed; the daily schedule is suspended while Campaign is enabled.

If something goes wrong during the run

Event	What the unit does
Watchdog, brown-out, software reset	Resumes the run up to the original deadline (or goes straight to saving and reporting if the deadline has passed). At most two recoveries per power-on; a third reset only reports what is saved.
Requested re-boot (e.g. firmware update)	Resumes; does not count as a failure.
No fix within 5 minutes	Still sends a report (no position, no water result is invented).

Event	What the unit does
Low battery / modem blocked	Waits; the battery guard and airtime budget always win.
Report already delivered	A reset never sends it again.

Switching the power off with USB still connected is a reset, not a power-on: an unfinished run resumes instead of starting anew.

How to read the results

All-azimuth reflections are **not confirmed water**: terrain, buildings and vegetation also reflect. A Campaign tells you whether, and in which directions, the site produces usable reflections and roughly at what height. Operational measurements need a normal installation with sectors aimed at the water. Records of a Campaign are flagged `EXPERIMENTAL_CAMPAIGN` over USB; the Iridium summary does not carry that flag, so the receiving side must know which units run campaigns.

Firmware update

Maintenance → Firmware → **Check, download and update**. The app compares the unit's firmware with the one it carries and with the release channel; when the unit is up to date it can still reinstall the verified image.

Update DF552BE39561B19D to firmware 0.2.1?

The unverified-hw image of GitLab release 0.2.1 (SHA-256 verified against its manifest) replaces firmware 0.0.9 (4f6de3a0).

The unit stops acquiring, reboots into BOOTSEL, receives the image and restarts. Keep it powered and plugged in; it takes about a minute.

The app first backs up the configuration, identity, status and every stored record into a dated folder (and the full flash image when picotool is installed); the update stops if that backup fails.

The configuration and the result queue are kept. You can cancel until the copy starts.

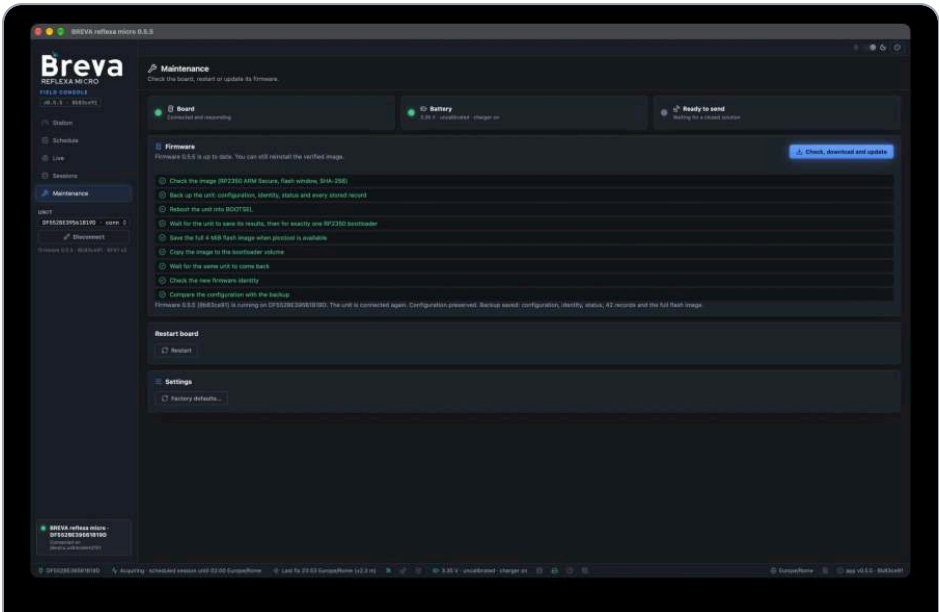
Type **UPDATE** to confirm

Cancel

Update firmware

SIMULATOR

After the download is verified the app asks to confirm: type **UPDATE**. You can cancel until the copy starts.



A completed update on a test unit: every step passed; configuration preserved; backup of configuration, identity, status, 42 records and the full flash image saved.

Note

A new TAHMO WLM board still runs TAHMO's firmware and has to be put in BOOTSEL by hand the first time: see [First installation on a TAHMO WLM board](#). This page is about updating a unit that already runs reflexa micro.

The steps

The guided update runs these steps, each shown with its result:

- 1 **Check the image:** RP2350 ARM Secure format, flash window, SHA-256.

The final line says which firmware runs on which unit, that the configuration was preserved and what was backed up. Results stay on the unit.

 **Firmware**

Firmware 0.2.1 available (GitLab)

↓ Check, download and update

✓ Check the image (RP2350 ARM Secure, flash window, SHA-256)

✓ Back up the unit: configuration, identity, status and every stored record

✓ Reboot the unit into BOOTSEL

✓ Wait for the unit to save its results, then for exactly one RP2350 bootloader

✓ Save the full 4 MiB flash image when picotool is available

✓ Copy the image to the bootloader volume

✓ Wait for the same unit to come back

✓ Check the new firmware identity

✓ Compare the configuration with the backup

Firmware 0.1.0 (ef2737bf) is running on DF552BE39561B19D. The unit is connected again. Configuration preserved. Backup saved: configuration, identity, status, 12 records (no raw flash image: picotool not available).

SIMULATOR

Done: every step green and the final line with firmware, unit and backup.

Recovery

If something fails, the app says at which step and what to do. The unit always has a way back: holding the **BOOT** button while switching it on enters the bootloader ([the procedure](#)), and the update can be repeated.

Symptom	What to do
Stuck in BOOTSEL	Power-cycle without holding BOOT, or run the firmware update.
Update failed after the copy	Hold BOOT while power-cycling, then update again.
Unit unconfigured after a reset	Load the saved configuration, review and save.

Symptom	What to do
Status bar: compatibility warning	The firmware lacks features this app uses; update it.

 Tip

Keep the app and the firmware on the same version: every app release carries the matching firmware image.

Troubleshooting

Symptom	What to do
Unit not listed	Try another cable (it must carry data) or another port; check that the unit is not in BOOTSEL.
<i>Connection closed: USB link lost</i>	Replug the unit; the app reconnects by itself when it is the only unit.
State <i>ambiguous</i>	Two units (or a unit and a BOOTSEL device) are attached: disconnect one.
<i>Unverified RP2350 device</i>	Not a reflexa micro unit running compatible firmware; it is never used. Run the firmware update if it is your unit.
Stuck in BOOTSEL	Power-cycle without holding BOOT, or run the firmware update.
Update failed after the copy	Hold BOOT while power-cycling, then update again .
Save result <i>mismatch</i> or <i>unknown</i>	Press Read from unit , compare, then apply again deliberately. The app never resends by itself.
Unit unconfigured after a reset (1 red blink)	Load the saved configuration, review and save.
Sector without satellites	Obstructed or wrong direction: check the sky view in Live and the terrain profile on Station .
Arcs always <i>fail</i>	Session too short, obstruction, strong waves, or the water outside the RH search range: keep the range on <i>Auto</i> , lengthen the sessions, check the site .

Symptom	What to do
Measured height far from your estimate	An estimate by eye can be off: if the arcs agree with each other, trust the measured height and use it. If they scatter, look for a second reflector (wall, shore) in the footprint and narrow the sectors or lower the top of the elevation window.
Records <i>interrupted write(s) skipped</i>	Harmless: those records were not acknowledged and download again.
Overwritten records	The running buffer dropped the oldest results: download more often or enable Iridium.
Session start refused: <i>busy</i>	A transmission, a modem job, a pending reboot or the battery guard blocks it; try again in a few minutes.
Compatibility warning in the status bar	The firmware lacks features this app uses: update it.
No Iridium message received	Run Check modem (no traffic) in Maintenance; check the sky view of the modem antenna, the battery (1 short red flash = Iridium held off) and the Cloudloop destination (Iridium setup).

Without a computer, the [status LEDs](#) tell you what the unit is doing.

Status LEDs

The three LEDs next to the processor show the unit state without the app. Watch for about 30 seconds. **Red always means a problem: count the red blinks.**

You see	Meaning	What to do
Red, green, blue (0.3 s each) at power-on	Self-test: the unit started (red may stay on a few seconds first)	Nothing
Short green flash every 5 s (every 2 s on USB)	Running normally	Nothing
Blue flash every 2 s	Receiver searching for a fix	If it lasts a whole session, check the sky view
Blue double flash every 5 s	Session running with a position fix	Nothing
Blue then green, once a second	Iridium transmission	Keep the antenna clear
1 red blink every 5 s	Not configured	Apply a configuration
2 red blinks every 5 s	Storage fault	Save diagnostics, contact support
3 red blinks every 30 s	Battery critical: radios off	Charge or replace the battery
1 very short red flash every 30 s	Battery low: Iridium held off	Check panel and battery soon

You see	Meaning	What to do
Fast red flashing, first minute after power-on	The previous run hung and was reset by a watchdog (switching off and on does not cause it)	Save diagnostics if it repeats
Dark after the self-test	LEDs set to <i>Minimal</i> (healthy) or <i>Off</i>	Nothing
Dark, no self-test	No power or no firmware	Check battery and connections

LED modes are set in [Power & battery](#): *Normal* (about 0.25 mAh per day), *Minimal* (faults and battery warnings only), *Off* (power-on self-test only).

Glossary

Term	Meaning
Arc	One satellite signal followed while the satellite rises or sets through the elevation window over the water. One arc gives at most one water-distance result.
Azimuth sector	A range of compass directions (e.g. 120°–200°) pointing at the water; only satellites in the sectors are used.
BOOTSEL	The RP2350’s built-in bootloader mode: the unit appears as a USB drive named <code>RP2350</code> and accepts a firmware file.
C/NO (SNR)	Carrier-to-noise density ratio, in dB-Hz: the signal strength the receiver reports per satellite. Its oscillations carry the reflection.
Campaign	Experimental autonomous run started by a power-on, with automatic settings and a final satellite report.
Cloudloop	Ground Control’s platform that receives Iridium messages and forwards them to destinations.
Configuration	All settings stored on the unit; written only after the unit validates them; versioned.
Elevation window	The range of satellite elevations used: 5°–45° with the reflexa micro antenna (Campaign: fixed 5°–25°).
Field console	The BREVA reflexa micro desktop app (macOS, Windows, Linux).
Footprint	The water area that reflects the signals for the chosen sectors and elevations; drawn on the map.
Fresnel zone (first)	The ellipse on the surface where most of the reflected energy comes from, for one satellite position.
GNSS	Global Navigation Satellite Systems: GPS (USA), Galileo (EU), BeiDou (China), GLONASS (Russia), QZSS (Japan).

Term	Meaning
GNSS-IR	GNSS Interferometric Reflectometry: measuring a reflecting surface from the interference between direct and reflected signals in one antenna.
GPST	GPS Time, the unit's clock; UTC + 18 s since 2017. The app shows UTC by default.
IMEI	The modem's identifier; ties the unit to the Cloudloop account.
IMT	Iridium Messaging Transport, the message service of the RockBLOCK 9704.
Lomb–Scargle periodogram	Spectral analysis for unevenly sampled data; its peak gives the oscillation frequency and hence RH.
Map data pack	Optional global offline lake shorelines (HydroLAKES), installed from a USB stick or downloaded.
Normal / Advanced mode	The app's two levels: installation and routine pages vs every setting and diagnostic.
Peak-to-noise (PNR)	Height of the periodogram peak relative to the noise; a quality indicator of an arc.
Record	One stored block of results (up to 10 arcs) in the unit's queue.
Reflector height (RH) / water distance	Vertical distance from the antenna to the water. Water elevation = antenna elevation – RH.
RH search range	The range of heights the analysis looks for; <i>Auto</i> by default; the unit can move it and reports that it did.
Running buffer	Storage policy that overwrites the oldest results when full.
Session	A scheduled (or manual) period with the receiver on and arcs recorded.
Session estimate	The robust combination of the accepted arcs of a session, with its spread.

Term	Meaning
Status LEDs	Red, green and blue LEDs on the board that show the state without a computer.
Watchdog	A timer that resets the processor if the firmware stops making progress (internal 2 s; external ~60 s).