Finapp User Manual

User Manual

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Scope

This user manual is intended for customers and provides a detailed description of the probe, installation procedures, and instructions for accessing data through Finapp Cloud.

Disclaimer

FINAPP will repair or replace any product within the guarantee period if the Guarantor declares that the product is defective due to workmanship or materials and has not been caused by mishandling, negligence on behalf of the User, accident or any abnormal conditions or operations.

FINAPP declines all responsibility for damages or injuries caused by an improper use of the probe due to negligence on behalf of the User. It is strongly recommended to read thoroughly the FINAPP User Manual before any kind of operation.

FINAPP reserves the right to change partially or entirely the contents of this Manual at any time and without giving any notice.

Disposal of the Product The product must never be dumped in the Municipal Waste. Please check your local regulations for disposal of electronics products.

Table of contents

1. Introduction

Finapp manufactures CRNS – cosmic ray neutron sensing – probes that count environmental neutrons generated by the interaction between cosmic rays and earth's atmosphere. Thanks to conversion formulae and specific corrections, neutron counting is transformed into Soil Moisture (SM) and Snow Water Equivalent (SWE) measurements. These values refer to an area around the probe with an approximate radius of 125 m (5 ha) at sea level, measuring up to 50 cm in soil depth and several meters in snow, in real time.

Neutrons are naturally moderated by water molecules, CRNS probes correlate cosmic-ray neutron counts with the water content of both soil and snow: a decrease in neutron counts corresponds to an increase in water content and vice versa.
Thanks to Finapp's innovative materials and probe design it is also possible to monitor variations in the incoming cosmic-ray flux by monitoring muons, a subatomic particle also generated by the cosmic radiation. Temperature and barometric pressure are measured as well, enabling the most accurate determination of the total incoming neutron signal. This approach allows real-time in situ validation of water content measurements.
This capability is unique on the market and is protected by Finapp's patented technology.

A data acquisition board developed by Finapp is also included. Data telemetry is accomplished via a GSM/LTE modem and locally stored on an SD card. Furthermore, the probe can communicate through SDI12 and Ethernet protocol. The neutron detector, data logger unit and atmospheric sensors are housed in an IP-67/68 enclosure for outdoor use. The sensor is lightweight making it portable and easy to install.

Finapp probe has a self-checking system that allows to detect probe malfunctions and a specific algorithm for converting neutron counting into soil moisture and SWE according with customer needs.

WARNING: Do not modify this product without first contacting Finapp S.p.A. Unauthorized modifications can damage the product and invalidate warranty.

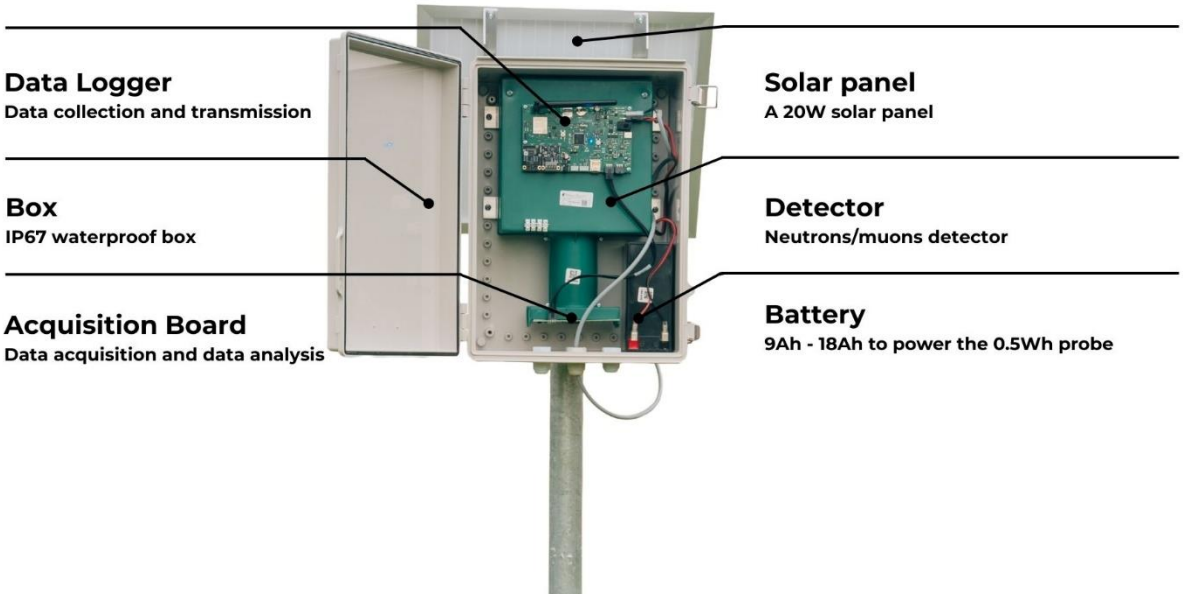


Figure 1 Overview of the standard Finapp Soil Moisture probe configuration

2. Static and Mobile Applications

Depending on the model, Finapp probes provide:

- Soil Moisture – SM (static)
- Soil Moisture maps (mobile)
- Snow Water Equivalent – SWE (static)

The operating principle remains the same for both SM and SWE measurement: a decrease in neutrons counting is related to an increase of water content in the soil or in the snow. The same type of probe is used for both applications; what varies is the number of instruments deployed and their spatial arrangement, depending on the specific monitoring requirements.

The probe can also be operated in motion (mobile configuration) to generate spatial variability maps of soil moisture.

2.1 Soil Moisture (static configuration)

The probe is installed on a pole, typically 1.8m high, and it covers a radius of about 125m (5ha) in standard conditions[1], for a 0-50cm depth and in real time.

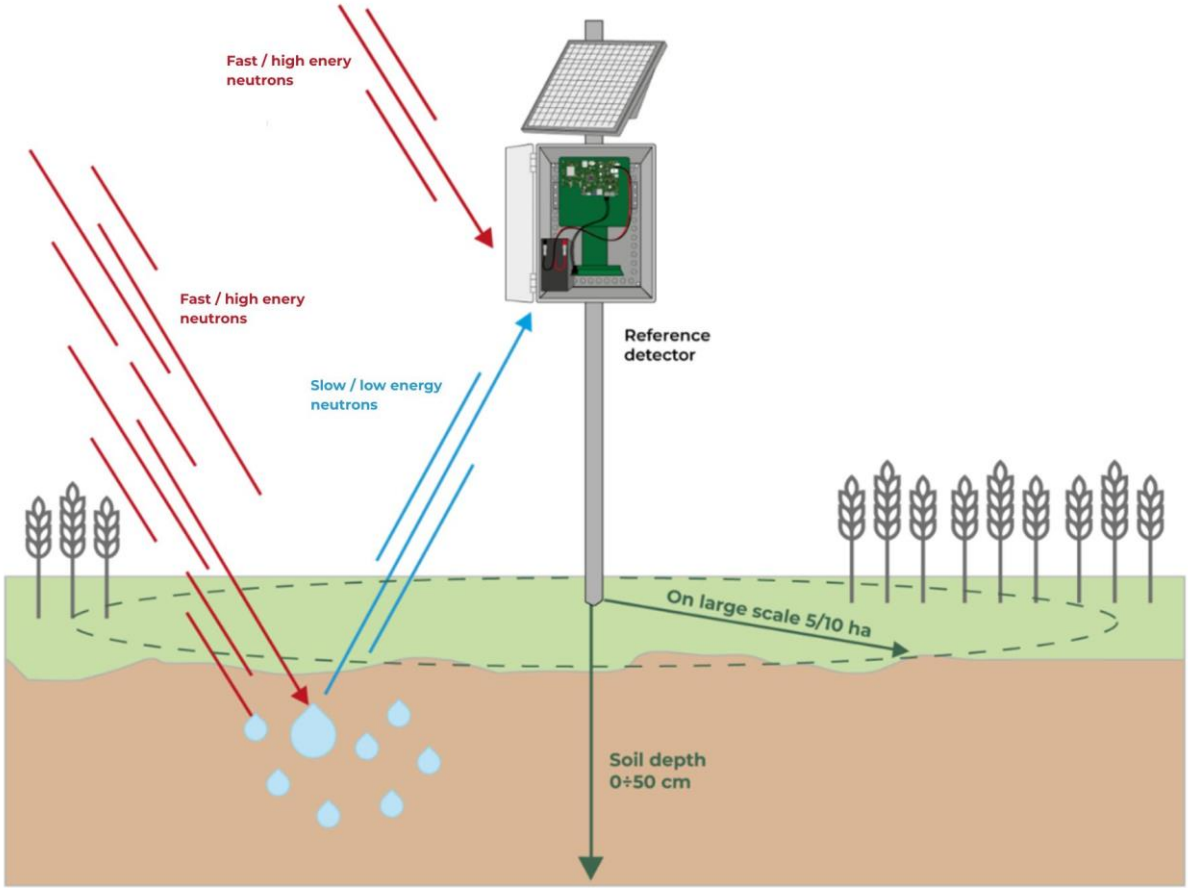


Figure 2 Finapp Soil Moisture installation

In this configuration a single probe can count both muons that are strongly correlated with fast / high energy neutrons arriving from space and the slow / low energy neutrons that escape from the ground after being partly absorbed by water molecules. The measurement of soil moisture represents the average value over a surface area of approximately 5 hectares, but the surface area increases with altitude (approximately 10 hectares at 1,000m above sea level) while the

1

* Each rate is generally achievable at sea level, under standard pressure (NTP), with an air humidity of 10 g/m³, a volumetric soil moisture content of 10% at a latitude of 51° north and 166 counts JUNG.

depth depends on the water content: the drier the soil, the deeper the neutrons will be able to penetrate.

The probe is housed in an IP67-rated enclosure (40 × 30 × 18 cm) with a total weight of approximately 10 kg.

2.2 Soil Moisture Mapping (mobile configuration)

The probe measures soil moisture similarly to the previous case; however, since it is in motion (mobile configuration), it produces a map of the spatial variability of soil moisture. In this configuration, the sensor is equipped with a GPS unit and records time, position, and particle counts at 1 Hz, storing data directly on board via an SD card.

Figure 3: Mobile configuration set up

2.3 Snow Water Equivalent (static configuration)

SWE measurement requires 2 probes. The values are supplied in real time, and are representative of a surface with a radius of ~20 m, with a saturation limit of ~10,000 mm eq.

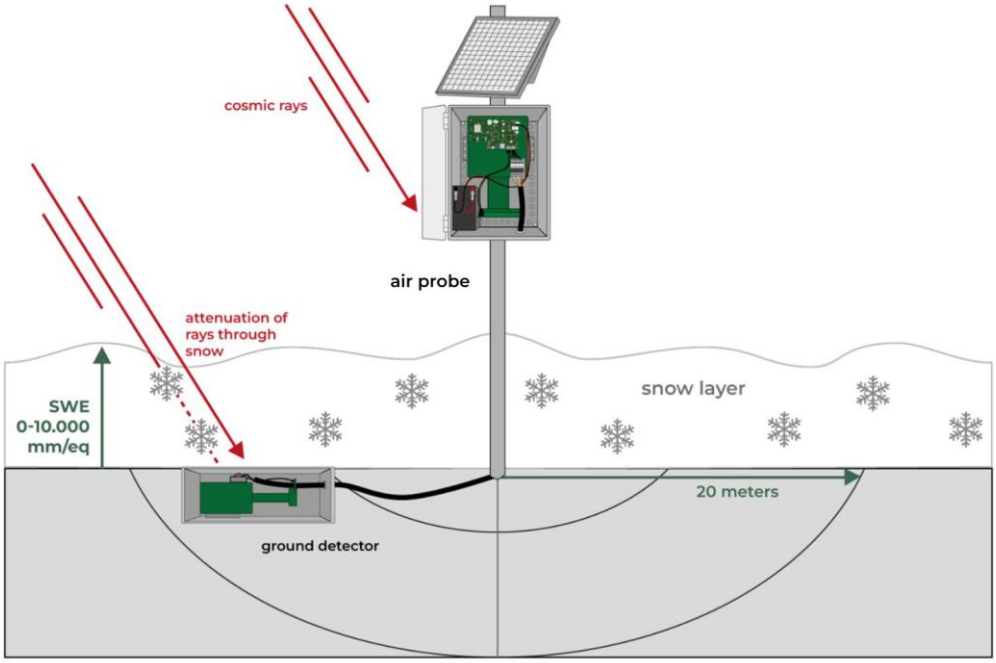


Figure 4 Finapp Snow Water Equivalent installation

In this configuration two probes are used. Referring to Figure 4, the ground detector is buried such that the enclosure of the probe is aligned with the ground level. This probe counts the number of epithermal neutrons (low energy neutrons) that reach the ground after interacting with the snowpack above the probe. The air probe is mounted on a pole, and it must be mounted such that it always stays above the snowpack: by detecting muons the air probe provides the reference number of the high energy neutrons before they interact with the snow. The ground detector and air probe are wired to each other by a communication cable that provides both power and signal transmission.

3. Description of the Probe

The Finapp probe consists of a particles detector coupled to a photomultiplier, an acquisition board, a data logger and a battery pack, all housed inside an IP67 enclosure for normal outdoor usage or IP68 enclosure for harsh environments. A solar panel above the box harvests solar energy to power the system.

3.1 Detector

The detector is a compact system that interacts with epithermal neutrons in an efficient way with low sensitivity to gamma radiation. The detector is wrapped into a 15 mm high-density polyethylene enclosure enhancing the sensitivity to epithermal neutrons which are correlated with water content.

The detector is composed of a layered structure of sheets sensible to neutrons and wavelength shifters (WLS) that collect light through the photomultiplier. The thin sheet able to detect thermal neutron consists of a homogeneous matrix of fine particles of stable (no dangerous or explosive) lithium- 6-fluoride (6LiF) and zinc sulfide phosphor (ZnS:Ag) compactly dispersed in a colorless silicon binder. Lithium is enriched in ^{6}Li to a minimum of 95 atom percent.

The neutron detection process employs the nuclear reaction ^{6}Li (n, α) ^{3}H:

$$^{6}Li + {}^{1}n \rightarrow {}^{3}H + {}^{4}He + 4.78\ MeV$$

with a cross section of 941 barns for 0.025 eV neutrons. The resulting triton and alpha particle are detected by ZnS:Ag phosphor.

Thermal neutron detector sheet	
^{6}LiF:ZnS Mass Ratio	1:3
Thickness	400 µm
Theoretical efficiency	0.25
Light Output (% Anthracene)	300
Wavelength of Maximum Emission	450 nm

Table 1 Particles detector specifications

The (ZnS:Ag) layer is a scintillator able to detect also muons and electrons. Discrimination between neutrons and muons is made by a Pulse Shape Discrimination algorithm covered by a Finapp Patent. The readout of the detector is made with a Head-on Photomultiplier.

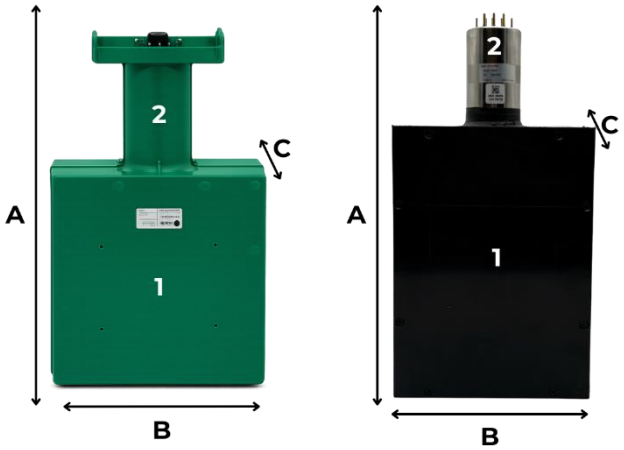


Figure 5 F3 on the left and F5 detector on the right with photomultiplier (1 – Detector, 2- Photomultiplier tube)

Finapp produces four different detectors. F3, F5, and F6 are designed for neutron and muon measurements (F6 consists of two F5 probes combined), they differ in size and therefore in counting rates. FM is designed to measure muon and gamma-ray.

Detector	Neutrons1	Muons1	Gamma rays	Size A (cm)	Size B (cm)	Size C (cm)	Weight (Kg)
F3	1'000	4'000	-	33.8	20.9	9	3.3
F5	2'000	7'200	-	40.4	20.4	9	4.2
F6	4'000	11'000	-	40.4	20.4	18	8.4
FM	-	5'000	20'000	33.8	20.9	9	3.3

Table 2 List of available Detectors and their performance.

[1] *Each rate is generally achievable at sea level, under standard pressure (NTP), with an air humidity of 10 g/m³ and a volumetric soil moisture content of 10% at a latitude of 51° north.*

Finapp manufactures various probe models for different applications - SM, SM maps, SWE measurements - using a single detector from those listed above or a combination of them. Please refer to the commercial information for further details.

3.2 Electronic Boards

There are two different types of board on a Finapp probe communicating using a wired connection.

The Data Logger shown in Figure 6 is a compact electronic board that provides power management, LTE connection, GPS localization and common interfaces (UART, SDI-12) to connect the probe to external dataloggers. This board contributes to less than 2% to the total power consumption. The SIM card installed by default is from 1NCE provider. Alternative options are available accordingly to customer's region and requirements. In case a different provider is needed, please contact Finapp.

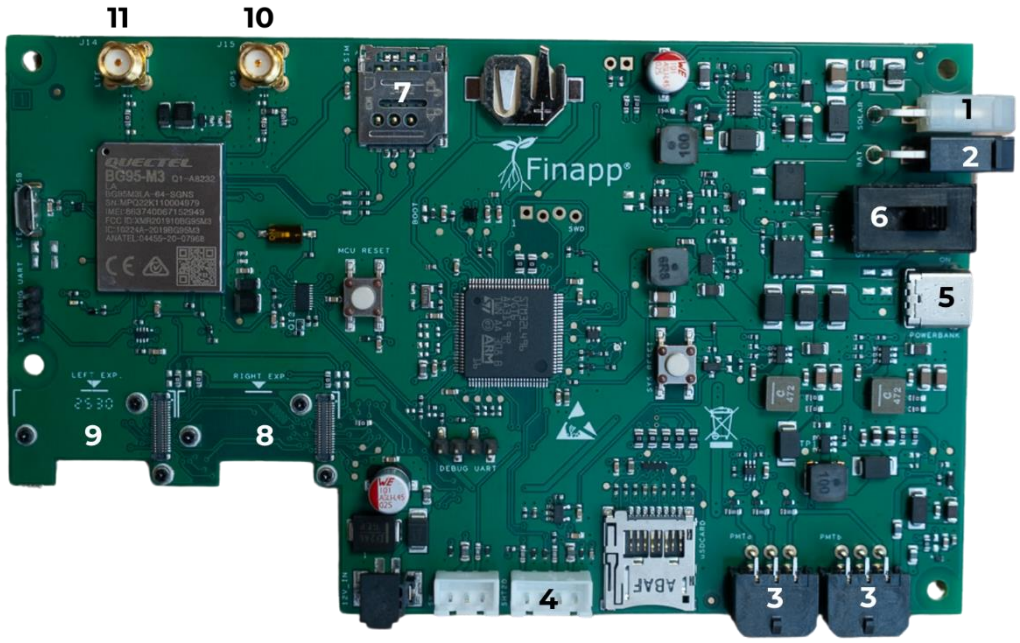


Figure 6 Details of the Data Logger. 1 - MOLEX of solar panel, 2 - MOLEX of the battery, 3 - PMT connectors, 4 - SHT20, red square – LED for debug, 5 - USB-C for indoor use, 6 – Switch, 7 – SIM card slot, 8 – Expansion slot 1 for RAK external modules, 9 – Expansion slot 2 for RAK external modules, 10 GPS unit connector, 11 Antenna cellular connector

The acquisition board shown in Figure 7 is designed specifically for Finapp sensors. It provides data sampling and processing for multiple photomultiplier tubes, it embeds noise rejection and waveform discrimination algorithms. The acquisition board is low power with a consumption around 0.5W per board.

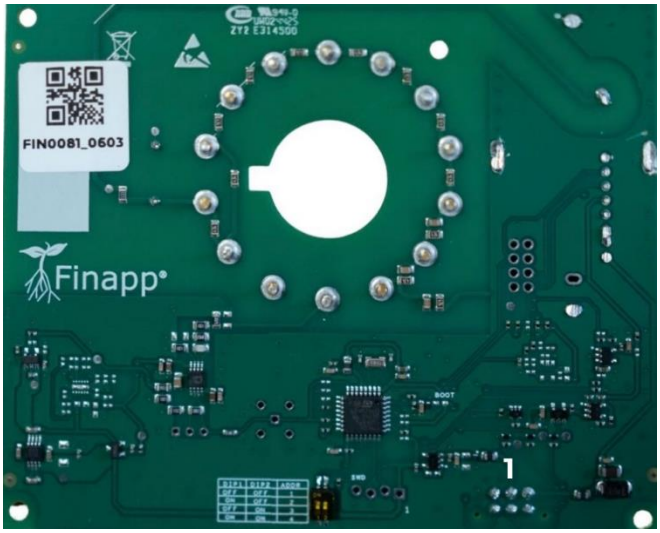


Figure 7 Details of the acquisition board. 1 – Master connector is behind the board

3.2.1 Data Logger

Data Logger Block Diagram

As a reference for a better understanding of the Data Logger, Figure 8 shows the board block diagram. The power management and logic lines wire the functional blocks on the board.

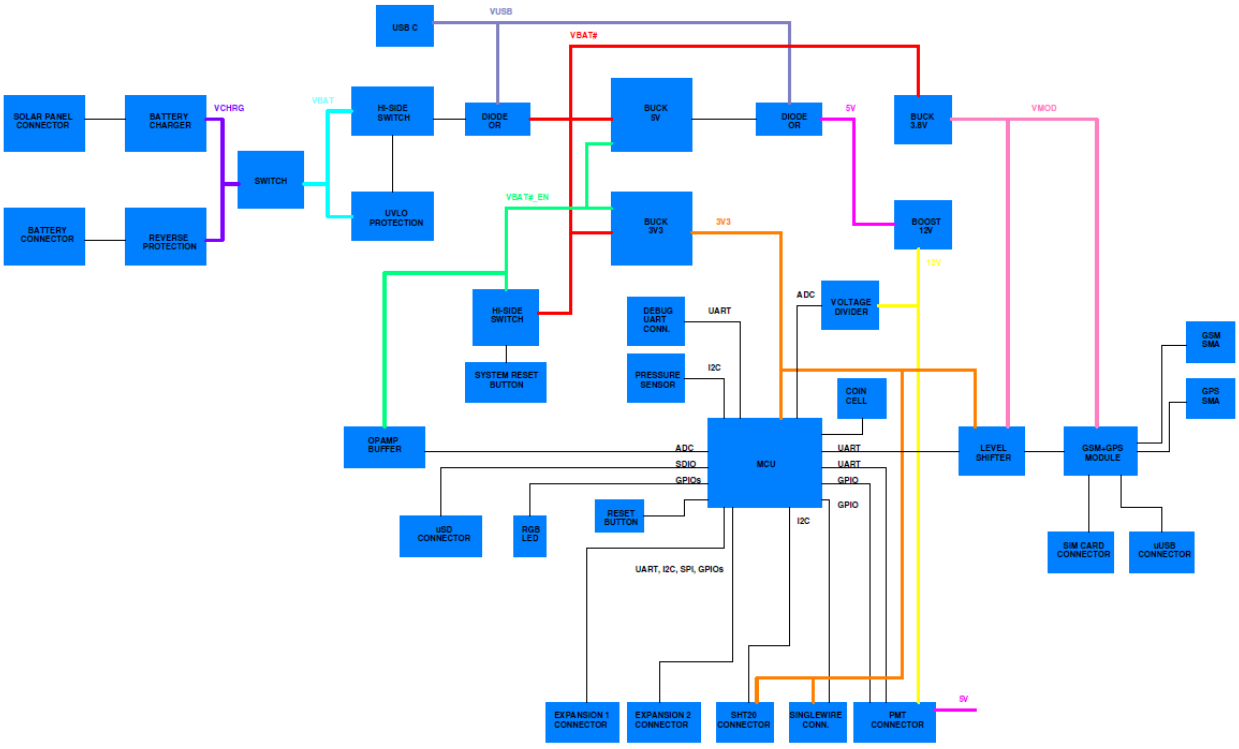


Figure 8 Data Logger block diagram key components

Data Logger Technical specifications

Description	Symbols	Min	Typ	Max	Units
General					
Power Supply Voltage from Solar Panel	V_{IN_SOLAR}	17.1	-	30	V
Supply Voltage from Lead-Acid Battery	V_{IN_BAT}	12	13	15	V
Supply Voltage from SDI-12 interface	V_{IN_SDI12}	13	14	15	V
Average current consumption SM	I_{CC}	-	60	-	mA
Average current consumption SWE	I_{CC}	-	110	-	mA
Peak current consumption during battery operation	$I_{CC\_PK\_BAT}$	-	-	1.22	A
Operating temperature	T_{AMB}	-40	-	85	°C
Power supply output PMT					
Output Voltage #1	V_{12V}		12		V
Output Current #1	I_{12V}	-	-	**0.2**	A
Output Voltage #2	V_{5V}		5		V
Output Current #2	I_{5V}	-	-	**0.5**	A
UART					
Data Rate	D_{R_DBG}	-	115.2	-	kbps
Operating Voltage Range		0	-	V_{3V3}*	V
Additional features					
Dimension	9 x 15			mm	
Battery Power Protections	Inversion, Overdischarge				
Solar Panel Power Protections	Inversion, Transient overvoltages (surge, burst)				
External Memory	Micro SD Card (Up to 32Gb)				
RTC backup battery	Battery CR1220				
Buttons	Reset				
Signaling LEDs	1x RGB LED, 1x Modem Network				

Table 3 Technical specifications or the Data Logger board

Data Logger Pinout

The following section describes the pinout of the boards. Refer to Figure 6 and Figure 7 for connectors position and identification.

Solar Panel Connector

PIN #	Name	Type	Description
1	GND	POWER	Solar panel Negative terminal
2	VIN_SOLAR	POWER	Solar panel Positive terminal

Table 4 Solar panel connector pinout

Battery Connector

PIN #	Name	Type	Description
1	GND	POWER	Negative Battery terminal
2	VIN_BAT	POWER	Positive Battery terminal

Table 5 Battery connector pinout

PMT Connector

PIN #	Name	Type	Description
1	12V	POWER	Power output 12V
2	5V	POWER	Power output 5V
3	GND	POWER	Ground
4	LOGGER_TX	DIGITAL OUT	Transmission line data logger
5	LOGGER_RX	DIGITAL IN	Receiver line data logger
6	PMT_nRST	DIGITAL OUT	Reset Signal for MCU of acquisition board

Table 6 Acquisition board connector pinout

SHT20 Connector

PIN #	Name	Type	Description
1	3V3	POWER	Output power 3.3V
2	SCL	DIGITAL OUT	Clock output I2C
3	GND	POWER	Ground
4	SDA	DIGITAL BI	Data line I2C

Table 7 External Moisture and Temperature sensor connector

Singlewire Connector

PIN #	Name	Type	Description
1	3V3	POWER	Power output 3.3V
2	SW_DATA	DIGITAL BI	Transmission and receiver line Singlewire.
3	GND	POWER	Ground

Table 8 Single Wire connector pinout

UART Connector

PIN #	Nome	Tipo	Descrizione
1	3V3	POWER	3.3V power supply output
2	DBG_TX	DIGITAL OUT	Serial transmission line for Debug
3	DBG_RX	DIGITAL IN	Serial transmission line for Debug
4	GND	POWER	Ground

Table 9 Debug uart connector pinout

3.2.2 Acquisition Board

Acquisition Board Block Diagram

As a reference for a better understanding of the Acquisition board, Figure 9 shows the board block diagram. The power management and logic lines wire the functional blocks on the board.

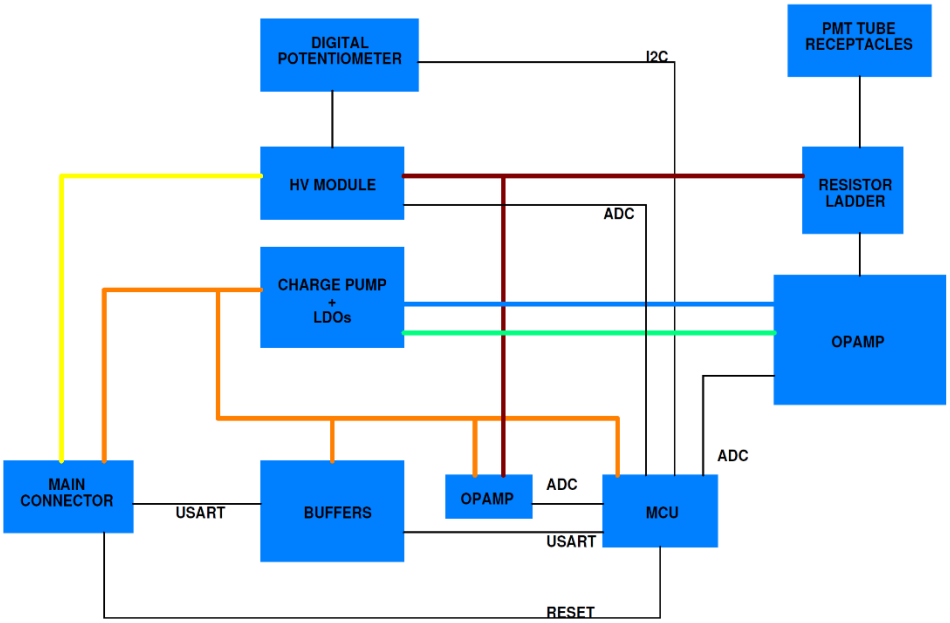


Figure 9 Acquisition Board block diagram

Acquisition Board Technical specifications

Description	Symbols	Min.	Typ	Max	Unit
General					
HV module supply voltage	V_{12V_IN}	10.8	12	13.2	V
Logic Supply Voltage	V_{5V_IN}	4.5	5	5.5	V
Current consumption HV module	I_{CC_12V}	-	-	125	mA
Current consumption Logic	I_{CC_5V}	-	-	25	mA
Operating temperature	T_{AMB}	-40	-	85	°C
MCU					
Core		ARM Cortex-M4 32bit			
Clock Frequency	F_{CORE}	-	-	80	MHz
SRAM		40			kB
Internal Flash		128			kB
Additional features					
Dimension	**90x110 mm**				
Power protections	Transient overvoltages (surge, burst)				

Table 10 Acquisition board technical specifications

Acquisition Board Pinout

The following section describes the pinout of the boards. Refer to Figure 6 and Figure 7 for connectors position and identification.

Data Logger Connector

PIN #	Name	Type	Description
1	12V	POWER	Power input 12V
2	5V	POWER	Power input 5V
3	GND	POWER	Ground
4	MASTER_TX	DIGITAL IN	Master trasmission line
5	MASTER_RX	DIGITAL OUT	Master receiver line
6	PMT_nRST	DIGITAL OUT	Reset MCU

Table 11 Connector to the Data logger pinout

3.2.3 Data Logger Accessories

All Data Logger boards are equipped with:

- 3 V battery
- SD card
- 4G antenna
- 1NCE SIM card (or equivalent accordingly to regional coverage)

The SIM card can be changed according to customer's requirements. In case you would like to use another SIM card or customize your probe accessories, please contact Finapp.

3.3 Boxes and Accessories

3.3.1 Boxes

Figure 10 On the left Plastic IP-67 and on the right Metal IP-68 box

Models	Length x Width x Height (cm)	Weight (kg)	Material
IP-67	40 × 30 × 18	1.75	Plastic
IP-68	40 × 31 × 18	6	Aluminium

Table 12 Enclosure available options with associated IP rated.

3.3.2 Accessories

These are the types of batteries that are used:

For Soil Moisture - SM:

Ah	Voltage (V)	Dimensions (cm)	Weight (kg)	Durability (without solar panel)
9	12	15.1 × 6.5 × 9.4	2.75	7 days
18	12	30.2× 13×18.8	5.5	14 days

Table 13 Battery available options for SM probes

For Snow Water Equivalent - SWE:

Ah	Voltage (V)	Dimensions (cm)*	Weight (kg)+	Durability (without solar panel)
26	12	16.6 × 17.5 × 12.6	9.4	7 days
50	12	23.0 × 13.8 × 21.2	16.5	29 days
100	12	30.7 × 16.9 × 21.5	36.8	58 days

Table 16 Battery available options for SWE probes

**The size may vary depending on product availability and the supplier.*

Figure 11 9 Ah battery

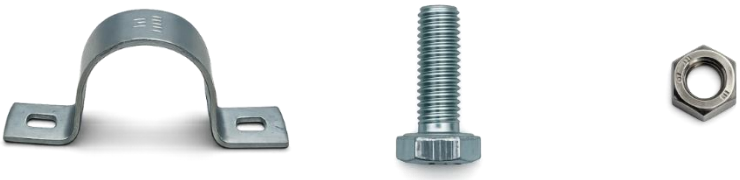
When a longer battery life is required, Finapp can provide a custom solution upon request.

The standard probe is equipped with:

- 20W solar panel with cables and the bracket for pole mounting
- Solar panel dimensions: 35.5 × 43.5 cm; weight: 2.2 kg (including mounting bracket)

Figure 12 Solar panel (left) and the bracket for pole mounting (right)

- 2 x brackets, 4 x M6x16 screws, 4 x M6x16 flange nuts



x 2 x 4 x 4

Figure 13 From left to right, brackets, M6x16 screw, M6 flange nut

For Finapp-SWE installation the package will also contain:

- Aluminum IP-68 enclosure containing a second sensor

Figure 14 Aluminum box containing an F3

- 10 meters cable to connect the two probes.

For mobile configuration, the package also includes:

- GPS unit and antenna
- Configuration file on SD card
  with enable_gps and enable_gps_tracking options activated
- Battery recharge dock station (optional)
- Ergonomic aluminum backpack (optional)

3.3.3 Final assembly configurations

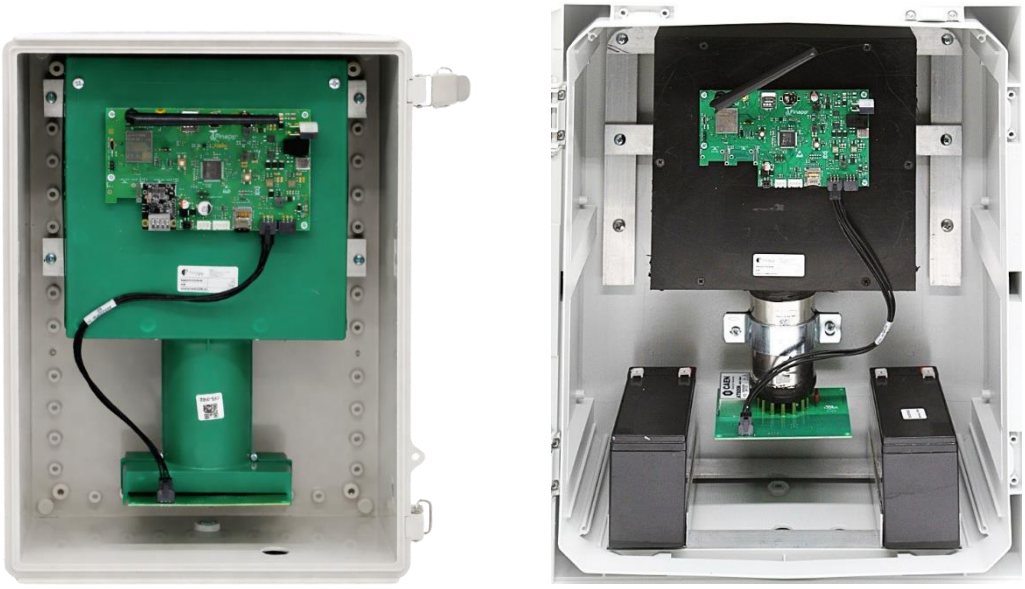


Figure 15 Detector F3 (left) and Detector F5 (right)

Commercial Name	Configuration	Weight (kg~)
Finapp SM	IP-67 box + F3 detector	8
Finapp SM Plus	IP-67 box + F5 detector	9
Finapp SM Premium	2 IP-67 box + 2 F5 detector	18
Finapp SWE	IP-68 box + F3 detector IP-67 box + FM detector	20
Finapp SWE Plus	IP-68 box + F5 detector IP-67 box + FM detector	21
Finapp SWE + SM	IP-68 box + F3 detector IP-67 box + F3 detector	20
Finapp SWE + SM Plus	IP-68 box + F5 detector IP-67 box + F5 detector	22

Table 17 List of available configurations of the Finapp probes.

4. Soil Moisture Configuration Installation Guide

The Finapp probe is a preconfigured plug-and-play system. The customer needs only to mount the system on a pole with the metal ware provided and connect battery and solar panel. Normally the probe is installed 1.8 meters above ground to cover an area of radius of about 125m at sea level. Height above the ground is defined as relative to the center of the box. By default, the system is equipped with collar for a 48mm pole mounting, on request it is possible to equip the system for mounting on a diameter between 30 and 90 mm.

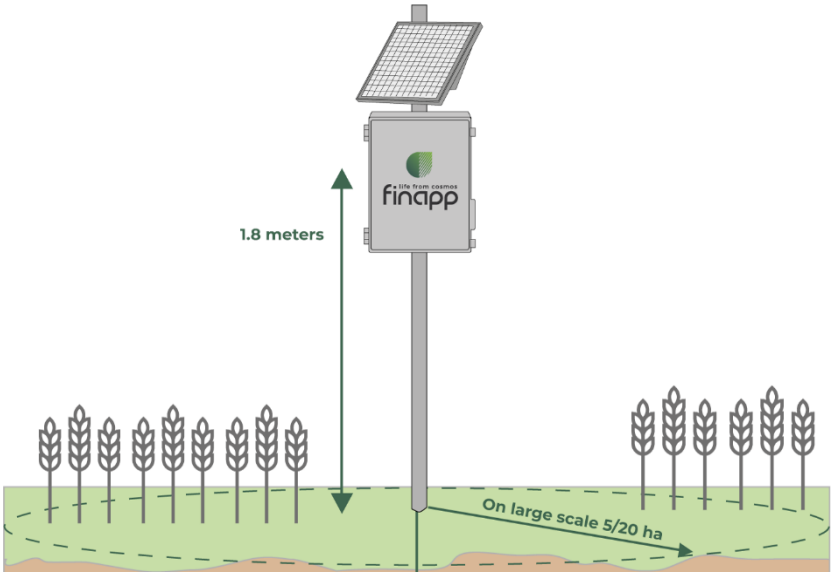


Figure 16 Default height of installation

4.1 Pole's installation

If no structure is available at the installation site, mount the system on a 2.5 m long, 48 mm diameter galvanized iron pole, embedded 0.5 m into the ground for stability. An 80 cm screw foundation may also be used.

To install the screw, construct a T-shaped lever Figure 17 using two tubes smaller in diameter than the foundation screw, joined at 90° with a clamp. This lever allows twisting and applying downward force to drive the foundation into the soil. Leave 10–15 cm of the foundation above ground to insert and secure the 2.5 m pole, ensuring a stable installation.

Figure 17 installation of the screw foundation

4.2 Mount the Finapp probe on the pole

The IP67/68 enclosure containing the detector, master, acquisition board, and battery is equipped with aluminium bars on the rear for pole mounting. Attach the top and bottom collars using two M6 screws per collar (Fig. 15). The collars and screws are included with the hardware. Mount the probe on the pole and tighten the collars securely to prevent any movement.

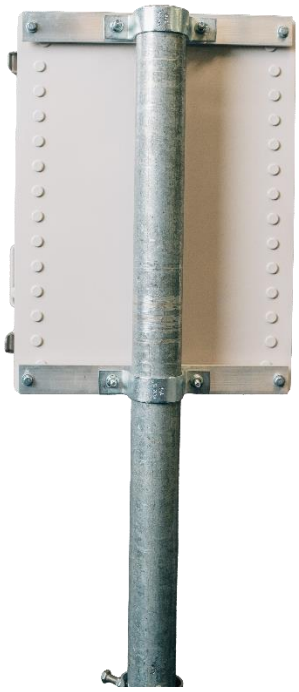


Figure 18 Mounting bars for Finapp box

4.3 Mount the solar panel

The solar panel structure can be assembled by attaching the U-shaped bracket (1) to the horizontal bars of the solar panel as shown Figure 19. Attach the collar to the U-shaped bracket and secure the completed solar panel structure using the provided screws.

The inclination of the solar panel is adjustable. Using the vertical axis as a reference, select one of the following angles based on installation location:

- 30° – recommended for snowy regions or high-latitude installations
- 45° – recommended for mid-latitudes
- 60° – recommended for tropical zones

The solar panel must face south (or north in the Southern Hemisphere) to ensure maximum charging of the backup battery during daylight. Firmly tighten the collar, especially in windy areas, to prevent the solar panel from changing direction.

Figure 19 Mounting brackets for solar panel

4.3.1 Insert pre-wired cables

Pre-drilled holes are located at the bottom of the box to insert the pre-wired cables with the cable gland. Follow the steps shown in Figure 20 to insert each cable into the bottom of the Finapp box. Firmly tighten the cable gland to prevent moisture from entering the enclosure.

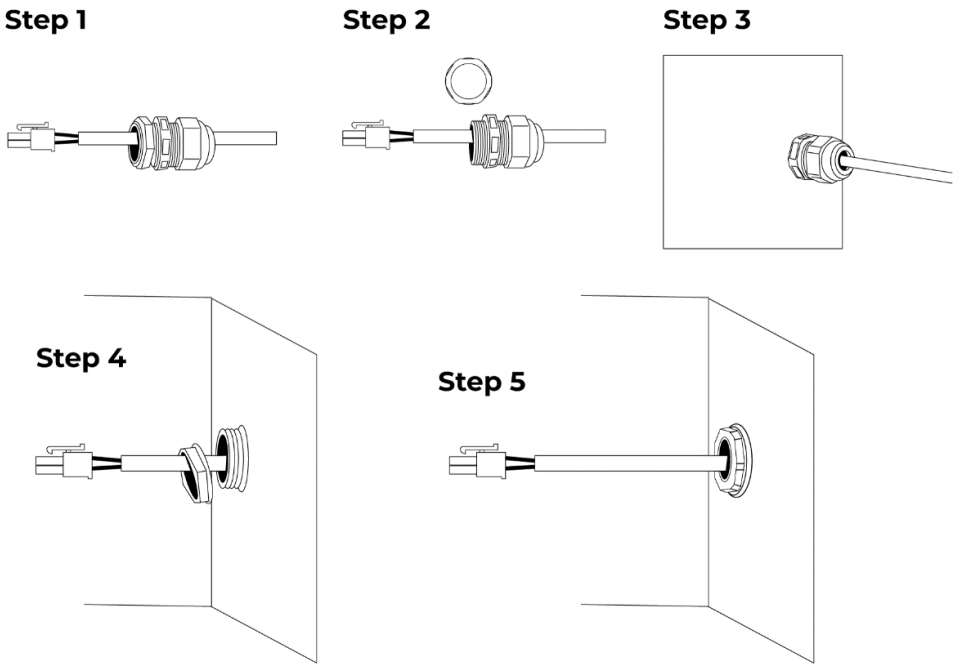


Figure 20 Steps for inserting pre-wired cable into Finapp box

4.4 Connect external temperature-humidity sensor (optional)

An external air temperature–humidity sensor is provided inside a solar shield. Connect the sensor to the main board using the SHT20 connector (Connector 4, Figure 6). Ensure that the air temperature–humidity sensor is connected before powering on the system. To route the cable inside the box, follow the instructions in Chapter 5.4.

Figure 21 Solar shield with temperature sensor inside

4.5 Battery Installation

The battery should be placed at the bottom of the box and connected to the battery cable provided by Finapp, as shown in Figure 22.

If space constraints prevent installation in the standard upright position, the battery may also be mounted horizontally or vertically, as it is hermetically sealed.

NOTE: If the system is powered via an external data logger, **do not use the battery.**

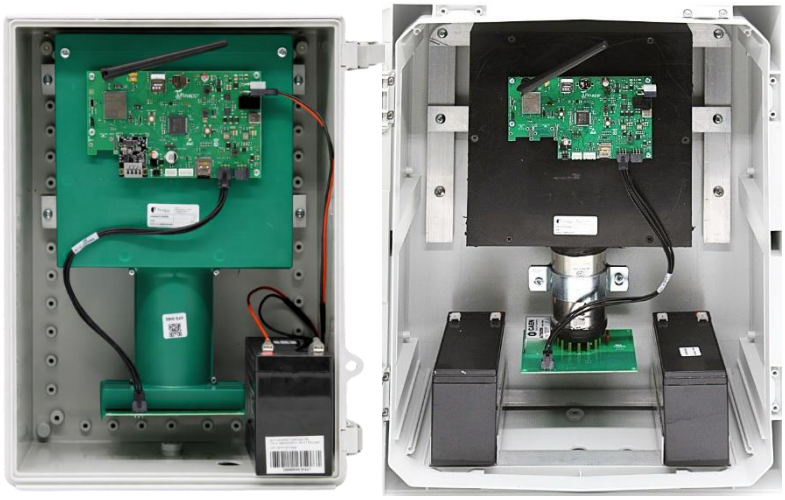


Figure 22 Finapp with 9Ah battery (left) and Finapp Plus with 18Ah battery (right)

4.6 Battery and Solar Panel Connection

The solar panel and battery cables are pre-wired. Connect the black male MOLEX from the battery to the black female MOLEX on the board (Connector 2, Figure 6). Repeat the procedure for the white connector from the solar panel (Connector 1, Figure 6).

4.7 Switch ON the system

The system is now ready to be powered on. Use the switch on the board (Switch 6, Figure 6) to turn on the system. The central LED (red square, Figure 6) will turn green and remain on for a few seconds until the board completes its initialization.

For indoor operation, you can use the USB-C female connector (Connector 6, Figure 6). The power requirement is 5 V, 1.5 A.

When the board is powered on, the LED (red square, Figure 6) lights up. The LED changes color depending on the board's status. If the probe is operating correctly, the LED will display the following colors:

Blink Red --> 10s Green --> LED off -->Long Blue --> LED off

After initialization, the LED turns blue when the board is successfully connected to the Finapp server.

Once you have verified that the LED lighting sequence is functioning correctly, you can check the proper operation of the probe via the Status Control Panel (Chapter 8.3).

If there are any issues with the LED color sequence, or if the Status Control Panel indicates a 'Not OK' status, please contact Finapp for assistance.

5. Mobile Configuration Installation Guide

The following information complements the procedures described in Chapter 4 for setting up the sensor in mobile configuration.

The mobile system is equipped with a GPS unit, pre-installed in Slot 10 (see Figure 6).

5.1Power supply:

The standard 9 Ah, 12 V battery provides up to 20 hours of continuous operation. Connecting the solar panel will extend the operating time. If the solar panel is not used, ensure that the battery voltage does not fall below 12 V to maintain proper sensor functionality.

Battery Maintenance:

- Recharge the battery using the recharger dock station after each use.
- Always ensure the battery is fully charged before deploying the sensor in the field.
- Periodically check the battery voltage and condition to maximize lifespan and reliability.

5.2 External thermo-hygrometer (optional):

The external thermo-hygrometer can be installed to provide additional vapor correction factors for neutron counts, enhancing measurement accuracy.

5.3 Optional backpack carrying system:

All components (sensor, battery, and electronics) can be integrated into an ergonomic aluminium backpack with adjustable hip and chest straps.

The total weight of the complete mobile setup—including sensor, battery, enclosure, and backpack—is approximately 12 kg.

5.4 Configuration

Finapp provides a mobile configuration file (config.fdb), which has been manually placed on the SD card at the following path:

CONFIG/config.fdb

This configuration enables the mobile operating mode, activating the appropriate firmware parameters and logging GPS positions.

In this mode, the data logger records GPS information at 1 Hz, synchronized with the raw neutron data from the F5 sensor. All data are stored on the SD card in a readable string format for subsequent processing.

5.5 Operational Check

To confirm that the sensor is operating correctly in mobile mode:

- After powering on the system (see Chapter 5.8), observe the LED on the motherboard.
- When GPS mode is active, the LED will blink red and green at approximately 1 Hz, indicating that GPS tracking is enabled and data are being recorded.

If the LED behaviour differs from this description, or if data are not being recorded on the SD card, please contact Finapp technical support.

6. SWE configuration Installation Guide

This section describes the configuration required in case of SWE (Snow Water Equivalent) systems.

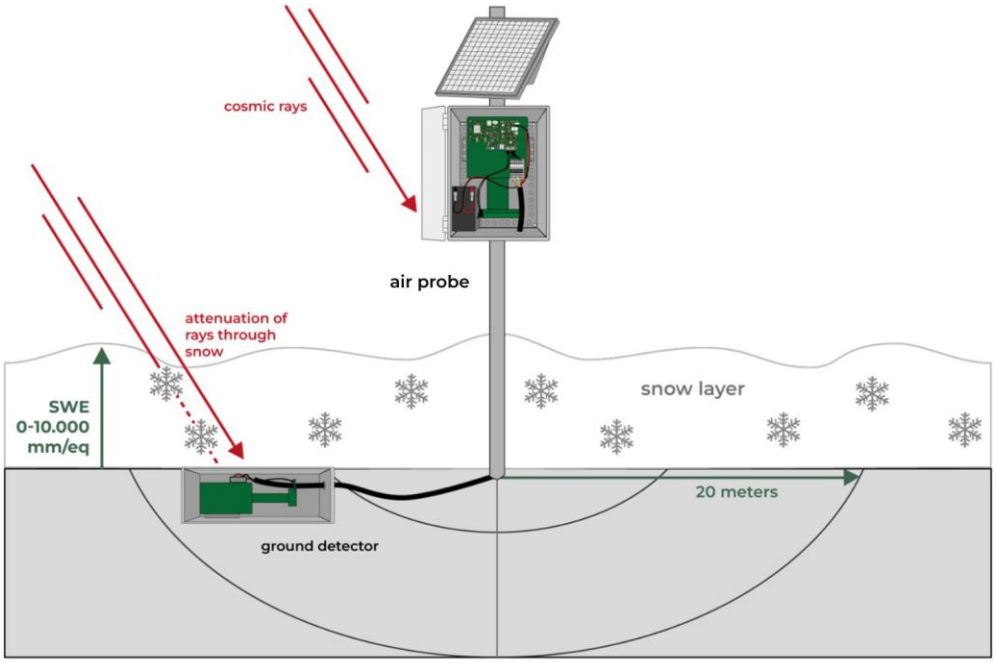


Figure 23 Finapp Snow Water Equivalent installation

6.1 Air Probe

Referring to Figure 23, the Air probe contains the data logger. To install this probe, follow the steps outlined in the Soil Moisture Configuration Installation Guide to Step 6.

NOTE: The probe must always remain above the snowpack. It is recommended to install it at a height at least 1 m above the maximum expected snow depth at the installation site.

6.2 Ground probe

Referring to Figure 23, the next step is to install the ground probe, housed in the aluminium enclosure. The probe should be installed at a distance greater than 3 m from the pole. Place the enclosure partially underground, ensuring that the lid remains accessible and protrudes above ground level.

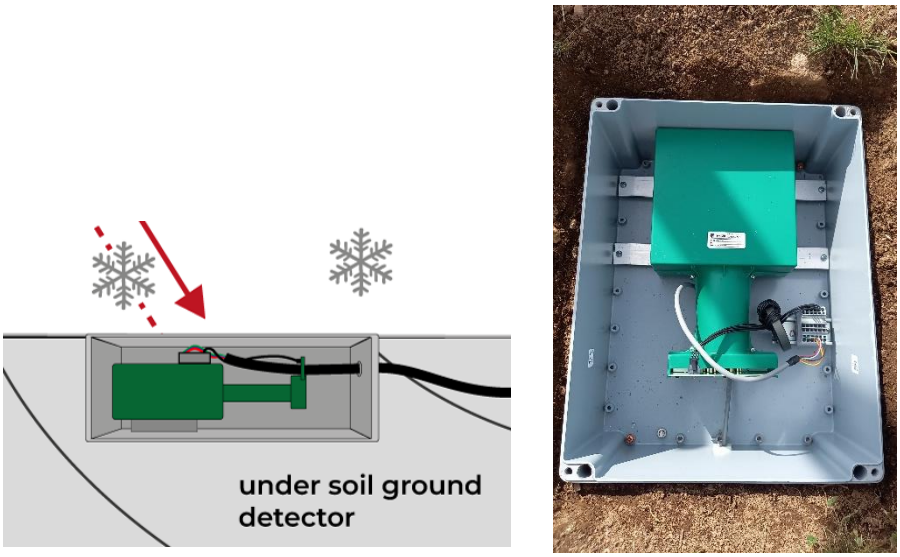


Figure 24 How to position the aluminium box

Alternatively, for example when the ground is rocky, the box can be mounted on the surface and secured using stakes.

6.3 Connecting the two probes

Use the provided 10 m, 6-pin cable to connect the two boxes. The cable features 1.5 mm diameter wires with crimped connectors at each end.

Starting from the air probe, connect the 6-pin cable to the terminal block as shown in Figure 25. Each terminal number corresponds to the colour of the cable wire.

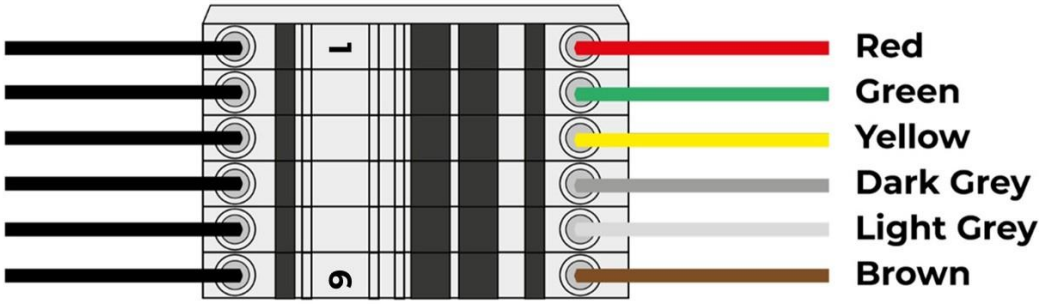


Figure 25 Terminal block for the 6-pin cable on the air probe connector

This cable should exit from the bottom of the box through an IP68 cable gland. Repeat the same procedure for the ground probe, maintaining the same color-numbered wiring. The 6-pin cable supplies both power and signal to this probe.

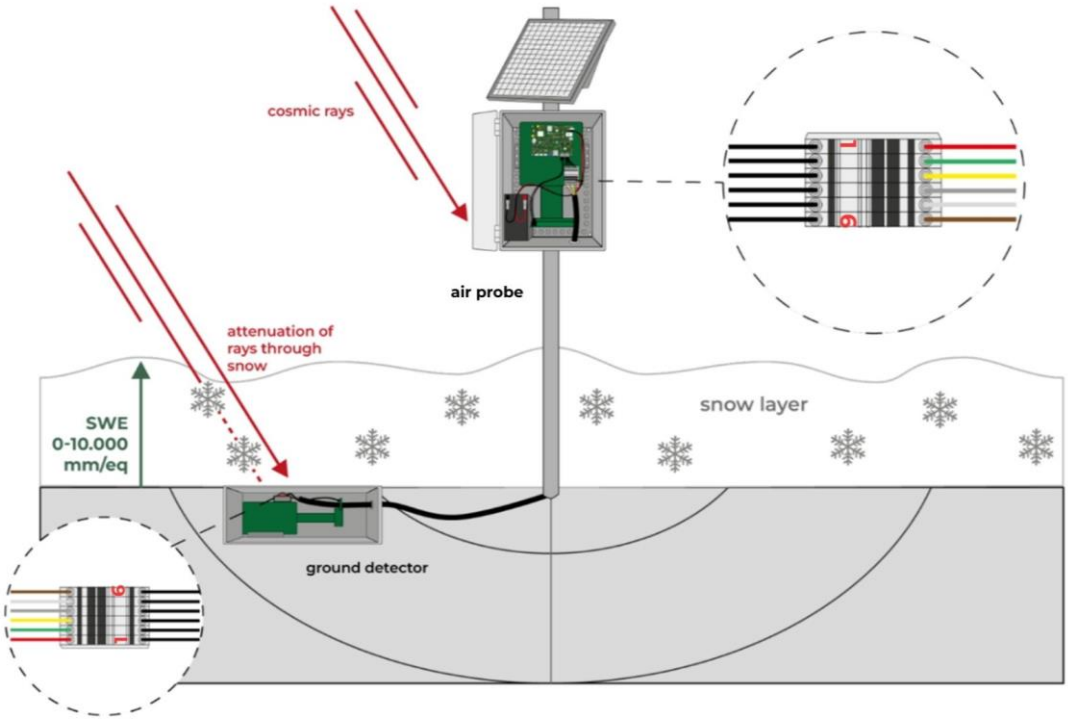


Figure 26 SWE installation with terminal blocks on both the probe

For the ground box, in addition to the IP68 cable gland, it is recommended to apply silicone to further insulate the area where the cable exits. Depending on the installation, using a corrugated protective pipe for the 6-pin cable may also be advisable.

The ground box is made of diecast aluminium. To maintain IP68 protection, tighten the screws in a cross pattern: insert all screws into the cover first, then tighten one screw by a couple of turns, followed by the screw diagonally opposite. Repeat this for the other diagonal and then continue the process until all screws are fully tightened.

Once both probes are correctly installed, the main board switch can be turned on (see Figure 6).

7. Uninstallation

If you need to move or dismount the system, follow the steps in this section to avoid damaging the Finapp system.

7.1 Safe power-off

Open the box containing the data logger and use the switch to power off the probe (Point 6, Figure 6).

7.2 Remove cables

Disconnect the MOLEX connector from the solar panel (Connector 1, Figure 6), followed by the MOLEX connector from the battery (Connector 2, Figure 6). Disconnect the temperature sensor (Connector 4, Figure 6) and remove it from the bottom of the box. The solar panel cable should also be removed.

For Snow Water Equivalent (SWE) installations, remove the 6-pin cable connecting the two boxes.

7.3 Remove battery

Take the battery out of the Finapp probe before removing the probe from the pole to avoid that the moving battery damages the electronics.

7.4 Dismounting hardware from the pole and ground

The system can now be safely dismounted from the probe.

8. Finapp Cloud Platform

The Finapp Dashboard is your personalized interface for accessing data measured by your Finapp probes.

8.1. Create your account

You can reach the Finapp Cloud at the following link:

https://data.finapptech.com/login

The first time you access the Finapp Cloud, you must register an account. Click on the registration link "**New in Finapp?**" available on the login page (see Figure 27):

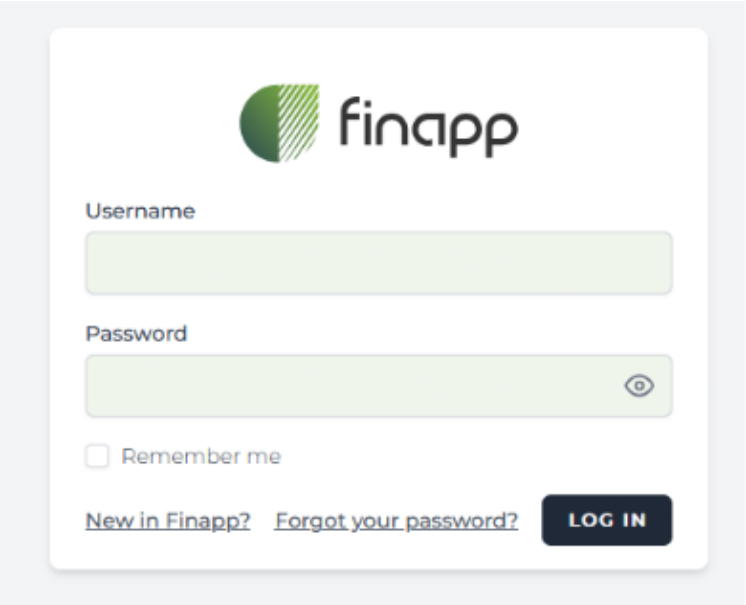


Figure 27 Finapp Cloud login page

Alternatively, you can go directly to:

https://data.finapptech.com/register

On the registration page (shown in Figure 28), insert username, password, and email address.
Please note the following requirements:

- usernames and email addresses must be unique (never used before in our systems);
- passwords must be at least 8 characters long and should ideally include:
    - an upper-case letter.
    - a lowercase letter.
    - a number.
    - a special character (optional but recommended).

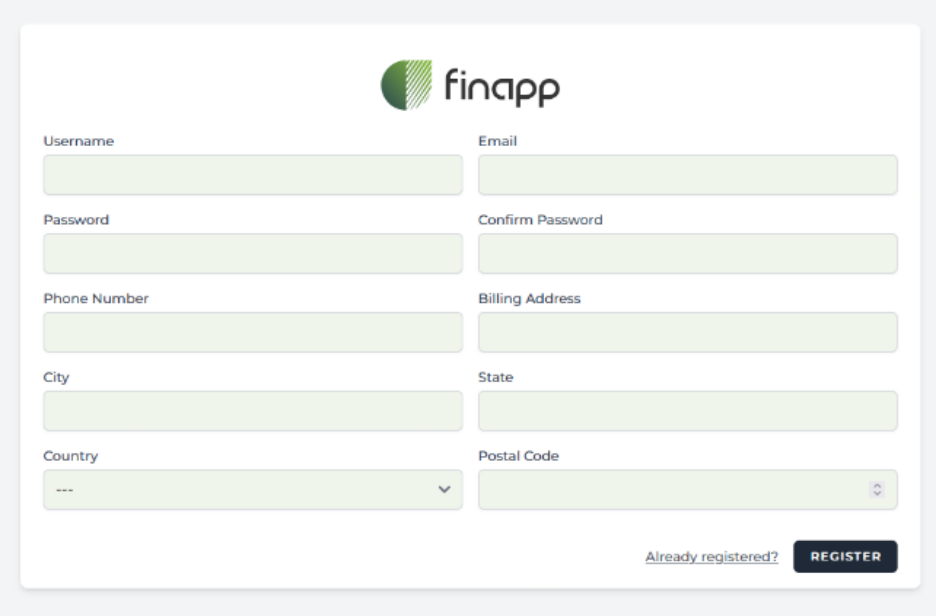


Figure 28 Registration page on Finapp Cloud

Once you registered successfully, you will be redirected to the dashboard page. After registration or login, you must check your e-mail address to verify your user account. If you need any assistance, please contact info@finapptech.com or your referent.

8.2. Add installations to your account

Inside the probe delivery box, you will find the "USER ACCESS & QUICK LINKS" document where you can find the **INSTALLATION ID** and the **ACCESS KEY**. When you access your account, if no installations are linked, a pop-up will

automatically appear (see Figure 29) prompting you to add one. This screen will show up every time you access the dashboard until at least one installation is added.

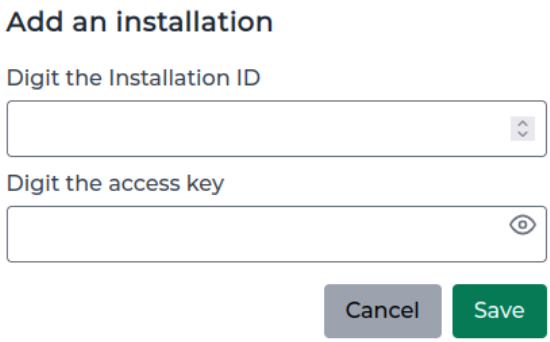


Figure 29 Modal to add installation to your account.

Insert the INSTALLATION ID and the ACCESS KEY, and press "Save". To add further installations, on the top right corner of your Dashboard, press the "Add Installation" button (see Figure 30) and repeat the previous steps.

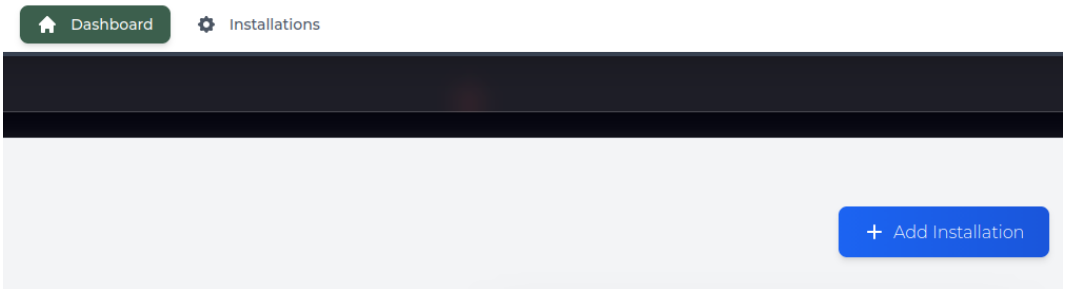


Figure 30 Button to add further installations.

Once all installations are added, they will be accessible by both clicking on the D*ashboard* and on the *Installation* main page (see Figure 31).

Figure 31 Dashboard and Installations tabs to access your installations

In the *Dashboard* section a preview of all added installations is shown, and they can be scrolled by clicking on the black arrow (see Figure 32):

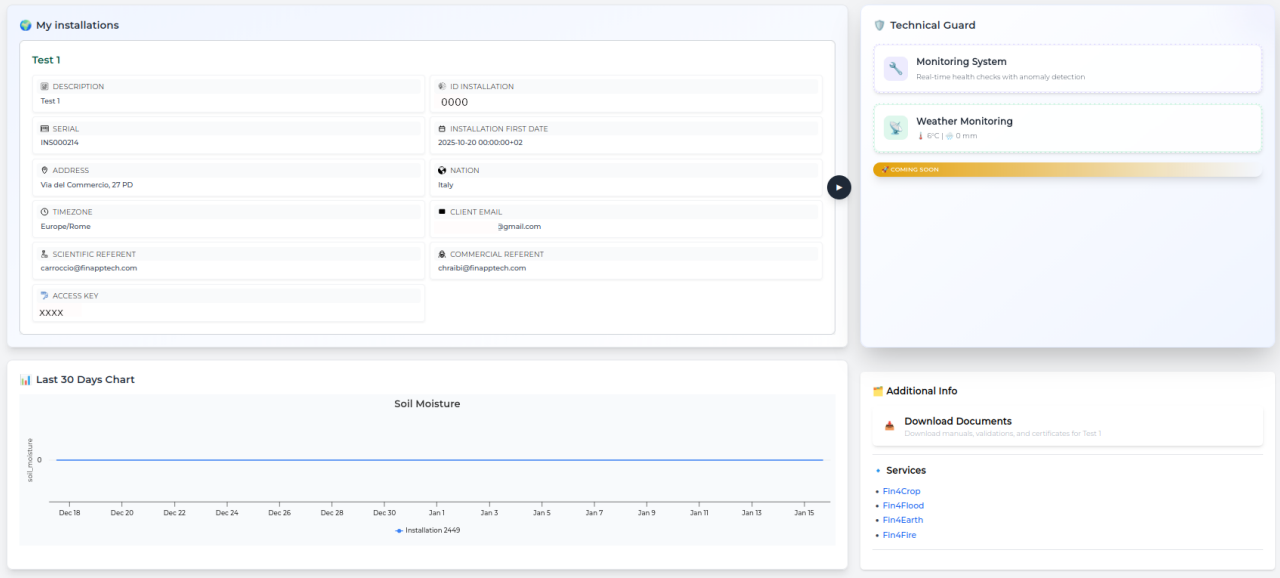


Figure 32 How installations appear in the Dashboard section

Each customer will refer to a commercial and a scientific referent. Their names and e-mail addresses are reported within the installation details.

In the *Installations* section, installations are shown as a list (see Figure 33). Once the probe has been configured (see Section 8.3), for each installation the following quick info is visible:

- installation date.
- nation where the probe is installed.
- time zone.

By clicking on the installation name, the map will zoom in to show the installation site. By clicking on the button “View Details” you will access the probe info and data.

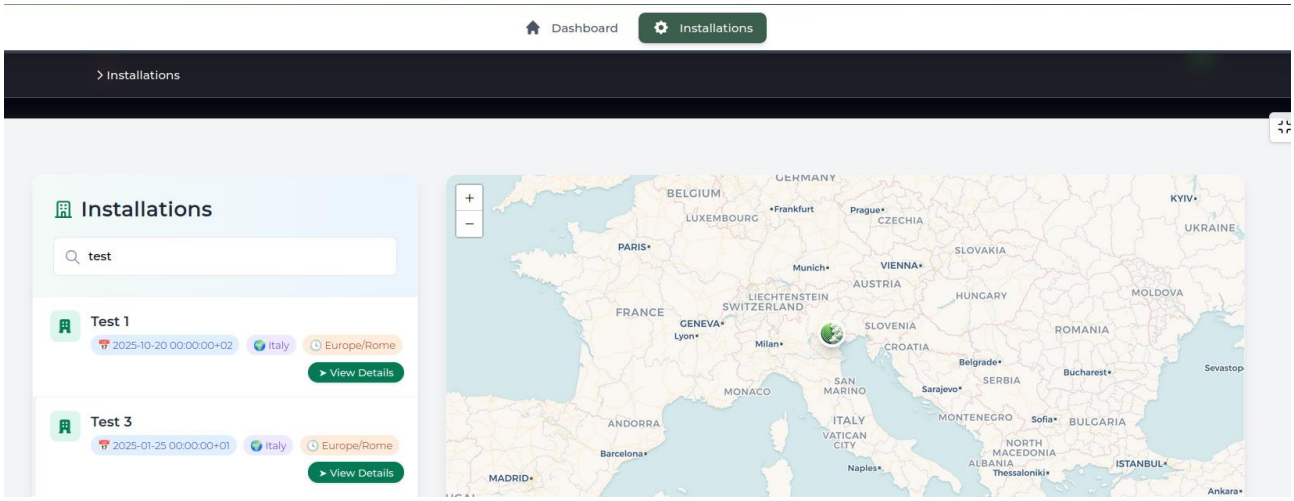


Figure 33 How installations appear in the Installations section

8.3. View your installations

You can access an installation either from the *Dashboard* or from the *Installations* page. In the *Dashboard*, simply click on the installation name. On the *Installations* page, you can either click “View Details” from the list or click on the icon on the map and then select the installation name.

For each installation the following panels are shown:

- “Installation details”: contains the installation information and the e-mail addresses of your scientific and commercial referents.
- “Probe Status": to quickly check if your probe is sending data to Finapp server.
- “Configuration": the panel that will allow you to configure your probe (see Section 8.4 for details);
- “Additional Info”: probe documents and extra services offered by Finapp (this section is still in progress).

Buttons "Weather”" and “View Charts” to access the data (see Section 8.6 for further details).

8.4. Configure your installation

The first time you access an installation, it will require the configuration of a set of parameters for data elaboration.
First enter your installation by clicking:

- on the probe name if you are in the *Dashboard* section.
- on the "View Details" button if you are in the *Installations* section.
- Click on the "Configuration" panel (see Figure 34) on the right side:

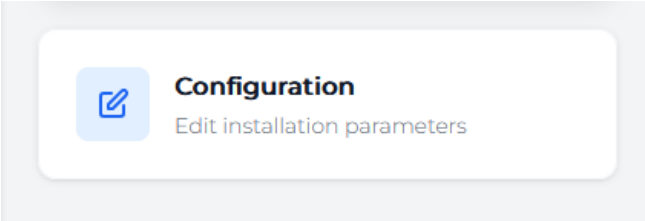


Figure 34 Configuration panel

and the form shown in Figure 35 will appear. Proceed as follows:

- insert the required information.
- click on the button "Chose the position on maps" to insert the probe position whose coordinates can be inserted directly or chosen on the map. Press the button "Confirm position".
- click on the button "Edit Altitude", enter the altitude [m], and press "Save Altitude".
- press "Save Changes" to save all the information.

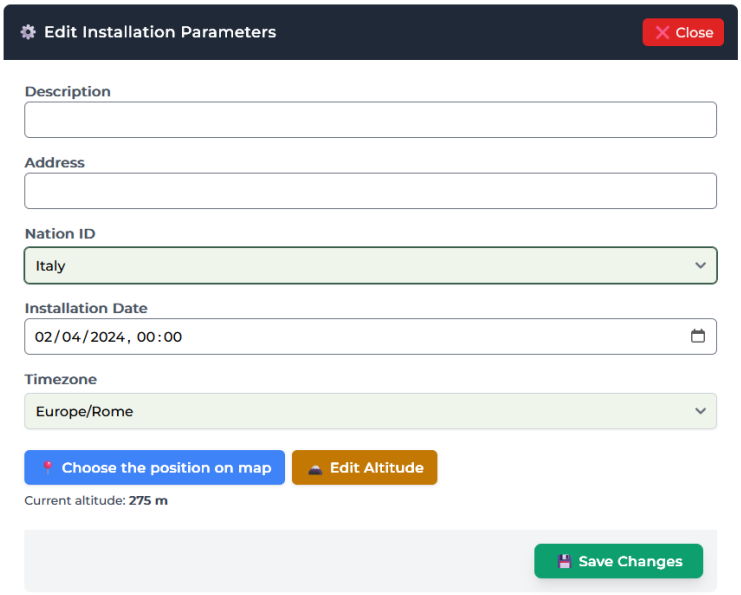


Figure 35 Probe configuration form.

Note 1: Data will not be displayed until the required parameters are set.

Note 2: Soil moisture trend will be available after setting the N0 parameter (calibration value). To get this value:

- Finapp can do calibration in situ thanks to a gravimetric sampling and apply the obtained value on cloud.
- The client can do the calibration in situ thanks to a gravimetric sampling (as reported in the Finapp sampling manuals), and share the raw sampling data, the day of sampling and cylinder's volume used with the scientific referent of Finapp. Based on that, Finapp will elaborate data and provide the customer with the calibration parameters for the calculation of Soil Moisture.
- In case there is no reference data to calibrate with, Finapp will provide an auto-calibration after the first 15 days of measurements of raw particles.

When a probe is switched on for the first time, Finapp will receive an automatic notification and will start the procedure to configure the station. Data collected within the first two weeks will be used to optimize the probe parameters and will be reprocessed accordingly. If you need any assistance, contact info@finapptech.com.

8.5. Status control panel

To quickly check the status of the probe, you can use the status control monitor:

- by scanning the QR code included in the delivery box instructions, which requires the INSTALLATION ID and the ACCES KEY;
- or by visiting the following link: https://data.finapptech.com/status-index And inserting INSTALLATION ID and the ACCES KEY.

The information displayed in the Probe Status Monitor page is shown below:

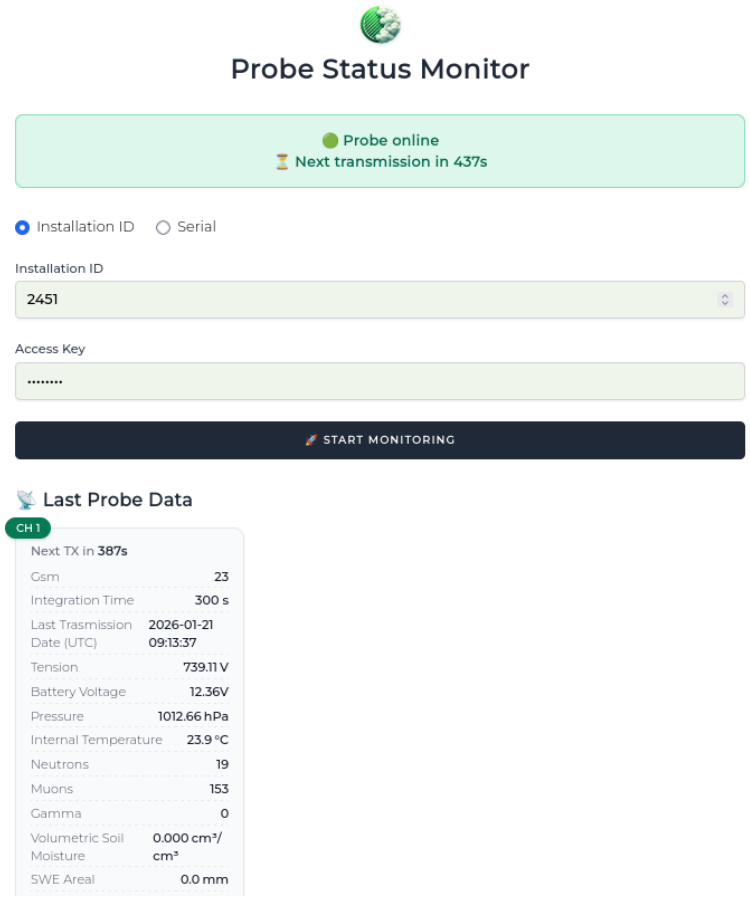


Figure 36 Information displayed on Probe Status Monitor

Alternatively, you can view the probe status directly within each installation page, where it is displayed in the top-right corner (see Figure 37).

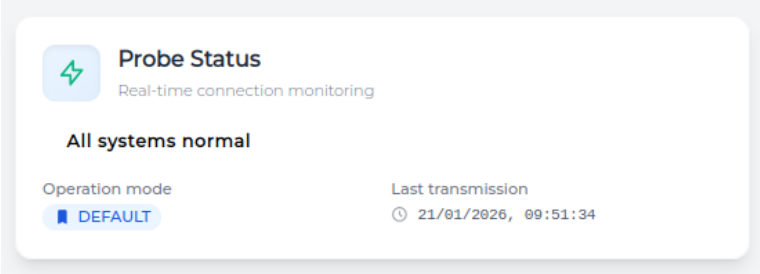


Figure 37 Probe status information panel

The status “All systems normal” or “Connection Loss” depends on some control parameters including the last transmission date and the counts of muons and neutrons.

If the status is “Connection lost” for several hours, first check the battery status and then contact info@finapptech.com for assistance.

8.6. Data visualization

In the top-left corner of your installation section, you will find the “Weather” and the “View Charts” buttons that allow the access to the respective sections. The Weather section is still in progress.

A chart dashboard (see Figure 38) includes the following tabs:

- “SM” or “SWE” (depending on the probe options) that show the soil moisture and/or the snow water equivalent plots.
- “OTHER CHARTS" that shows the raw neutron counts, and the battery voltage of the probe.
- “WEATHER” that shows the pressure and temperature plot measured inside the box of the probe. The external temperature and air humidity plot are shown only if an external extra sensor has been installed.

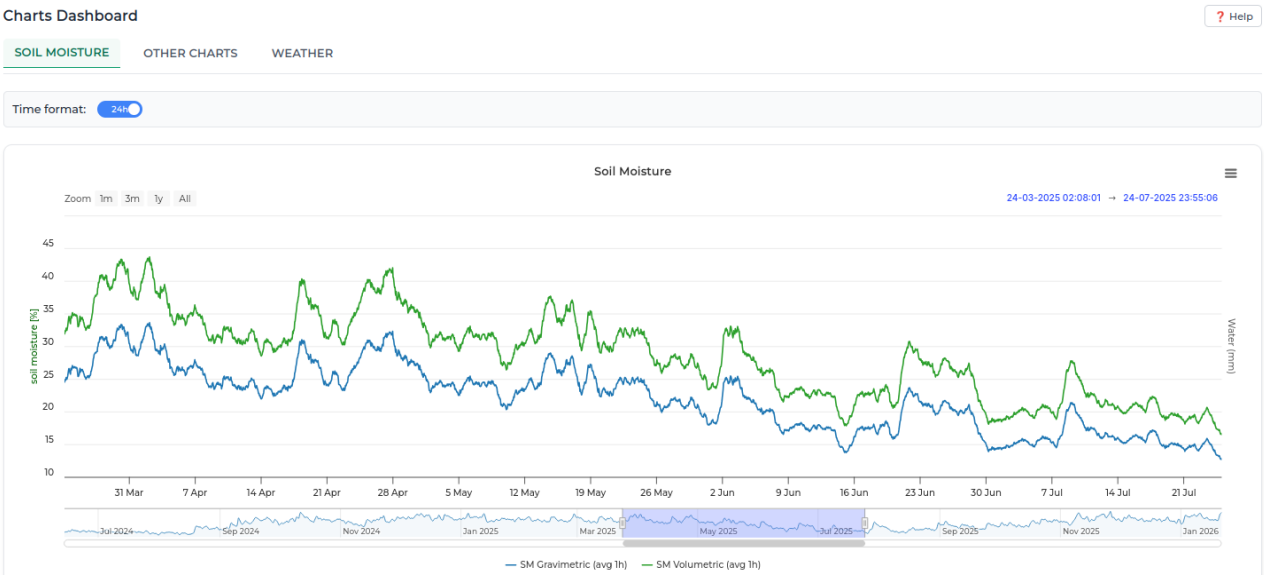


Figure 38 Installation chart section

The list of available tabs and plots may vary depending on your service package and purchased equipment. The buttons inside/below the plot allow you to zoom in, reset the zoom, open the plot in full screen mode, download the plot as an image, or export the displayed data in CSV or XLS format.

You can zoom into specific areas of the chart in several ways:

- by using the mouse wheel.
- by dragging to select an area directly on the chart to select an area on the chart.
- by adjusting the navigator bar below the plot.
- by using option 1 month (1m), 3 months (3m), 1 year (1y) or All on the top left corner of the plot.
- by choosing a date interval, editing the start and end datetime on the top right corner of the plot

Three lines in the top-right corner of the chart (see Figure 38) provide additional export options such as printing the chart or downloading the image/data in various formats.

Please, configure your installation (see Section 8.4). **Some plots may not be displayed until the installation is not configured.**

9. Data Transfer

9.1 Download data from API

Real-time data can be retrieved from the Finapp Cloud through API.

The link to the API is:

https://data.finapptech.com/api/get-finapp-data/{id_installation}/{API_key}

To use the API link, replace the placeholders {id_installation}/{API_key} with your unique identifiers:

- "{**id_installation**}": this is the identification number of the probe. It can be found in the Installation sheet on your dashboard, where it is labeled "Installation ID" (Note: this Installation ID is different from the serial number shown on the box label);
- "{**API_key**}": this is the personal key to access data from any probe associated to a USER. It is an alphanumerical code that you can find in your User profile (whose info can be retrieved by clicking on the button on the top right corner with your account name). NB: This is different from the access keys of each probe that you used to connect the probes to your User.

Data - printed in columns separated by semicolons - are:

- "Datetime (UTC)";
- "Datetime (selected time zone)";
- "Pressure [hPa]";
- "Internal Temperature [°C]";
- "External Temperature [C]" (if an extra sensor has been installed)
- "Air Humidity"[%] (if an extra sensor has been installed);
- "Power Supply [V]";
- "Acquisition Time [s]";
- "Gravimetric Soil Moisture [g/g]" (if supported by your installation);
- "Volumetric Soil Moisture [cm3/cm3]" (if supported by your installation);
- "Snow Water Equivalent (Local)" (if supported by your installation);"
- "Snow Water Equivalent (Areal)" (if supported by your installation).
- "Neutron Counts D1" (row counts);
- "Muon Counts D1" (row counts);
- "Gamma Counts D1" (if supported by your installation).

Note: The label *D1* in *Neutron Counts D1* (and wherever it appears) typically refers to **Detector 1**. If multiple detectors are connected, this suffix will increase accordingly (e.g., *D2*, *D3*, etc.) to indicate readings from each individual detector.

If the probe is equipped with a GPIO module, you will find the corresponding data in the API under the label:

- "GPIO counters" [# per channel].

The API supports optional filters to control the time range and the number of returned records.

If no options are provided, the following defaults apply:
start = installation date
end = now

Available options:

- No options
  Returns all available data from the installation date up to now.
  Example: https://data.finapptech.com/api/get-finapp-data/{id_installation}/{API_key}
- Limit only
  Limits the number of returned records. Data is taken from the most recent entries.
  Example: https://data.finapptech.com/api/get-finapp-data/{id_installation}/{API_key}/limit=100
- Start and end
  Returns data within the specified date range.
  Example: https://data.finapptech.com/api/get-finapp-data/{id_installation}/{API_key}/start=2026-01-01/end=2026-01-15
- Start, end, and limit
  Returns data within the specified date range, limited to a maximum number of records.
  Example: https://data.finapptech.com/api/get-finapp-data/{id_installation}/{API_key}/start=2026-01-01/end=2026-01-15/limit=50
- Start only
  Returns data starting from the specified date up to now.
  If end is not provided, it defaults to now.
  Example: https://data.finapptech.com/api/get-finapp-data/{id_installation}/{API_key}/start=2026-01-01

- End only
  Returns data from the installation date up to the specified end date.
  If start is not provided, it defaults to the installation date.
  Example: https://data.finapptech.com/api/get-finapp-data/{id_installation}/{API_key}/end=2026-01-15

Notes:
Dates must be provided in YYYY-MM-DD format.
All parameters are optional and can be combined as shown above.

9.2 Retrieve data on SD Card

In addition to the API, there are 2 other ways through which data can be obtained:

- Printed on SD at address: SD:/READABLE_LOG inside the file named after the date on which the data was acquired. In this case the data is formatted in this way:

Index	Parameter	Unit
1	Datetime (UTC)	YYYY-MM-DD hh:mm:ss
2	Datetime (Timezone)	YYYY-MM-DD hh:mm:ss
3	Pressure	hPa
4	Temperature on Board	C° Degrees
5	External Temperature	C° Degrees
6	External Relative Humidity	%
7	Battery Voltage	Volt
8	Acquisition Time	s
9	Gravimetric Soil Moisture	g/g
10	Volumetric Soil Moisture	cm^3/cm^3
11	SWE local	mm
12	SWE areal	mm
13	SWE punctual	mm
14	GPIO counters	# per channel
15	RAW Neutron Count D1	--
16	RAW Muon Count D1	--
17	RAW Gamma Count D1	--
18	RAW Neutron Count D2	--
19	RAW Muon Count D2	--
20	RAW Gamma Count D2	--
21	RAW Neutron Count D3	--
22	RAW Muon Count D3	--

23	RAW Gamma Count D3	--
24	RAW Neutron Count D4	--
25	RAW Muon Count D4	--
26	RAW Gamma Count D4	--

Table 18 List of the data contained in the readable log columns

NOTE: this feature is active only when requested by the client, and it is not active by default.

9.3 GPS data

The probe can be equipped with a GPS for rover use. The GPS model is QUECTEL BG95-M3. The integration time for GPS is fixed at 1 second. Aggregation at greater intervals can be done offline by software. The data are stored locally on an additional SD card "GPS\STORED" and "GPS\LOG", that can be easily removed. The output format of the Finapp probe in the .csv files in the "GPS\STORED" is as follows:

FW10.00.00,1609939256,863740067216041,105401.000,45.33782,11.76326,4.0,9.5,3,0.00,0.0,0.0,210126,0,101138,23590,0,0,29,143,0,304,,,,,,,,,,

Index	Parameter	Unit	Range	Length
1	FW Version	MM.mm.pp	[00-99].[00-99].[00-99]	10
2	Epoch	[s]		10
3	IMEI	--	--	15
4	UTC date & Time	hhmmss.sss	hh: [0,23] mm: [0,59] ss.sss:[0.000,60.999]	10
5	Latitude	±dd.dddddd	[-90.000000,90.000000]	10
6	Longitude	±ddd.dddddd	[-180.000000,180.000000]	11
7	Horizontal precision	Meters	[0.5–99.9]	4
8	MSL Altitude	Meters		
9	Position Fix	--	[2 – 3]	1
10	Course Over Ground	ddd.mm [degree, minutes]	ddd [000–359] mm 00–59	6
11	Speed Over Ground	xxxx.x [Km/hour]	[0,9999.9]	6
12	Speed Over Ground	xxxx.x [knots]	[0,9999.9]	6
13	UTC date when fixing position	ddmmyy	dd: [1,31] mm: [1,12] yy[0,99]	6

14	Number of Sat	nn	[00-12]	2
15	Pressure	ppppp [pa]	[0-99999]	5
16	Temperature Onboard	ttttt [milli °C]	[0-99999]	5
17	Temperature External	ttttt [milli °C]	[0-99999]	5
18	Relative Air Humidity	[milli %]	[0- 100000]	6
19	Neutron RAW Count D1	--		
20	Muons RAW Count D1	--		
21	Gamma RAW Count D1	--		
22	Trigger Count D1	--		
23	Neutron RAW Count D2	--		
24	Muons RAW Count D2	--		
25	Gamma RAW Count D2	--		
26	Trigger Count D2	--		
27	Neutron RAW Count D3	--		
28	Muons RAW Count D3	--		
29	Gamma RAW Count D3	--		
30	Trigger Count D3	--		
31	Neutron RAW Count D4	--		
32	Muons RAW Count D4	--		
33	Gamma RAW Count D4	--		
34	Trigger Count D4	--		

Table 19 List of data contained in the columns of the GPS file

For further details regarding the environmental measurements:

Moisture -> Relative Humidity from external sensor in milli%. Default value with no sensor present: 0;

Pressure -> Atmospheric Pressure in Pa

Temperature_int -> Temperature inside the box in milli Celsius

Temperature_ext -> Outside temperature in milli Celsius. Default value with no sensor present: 0;

N.B. The particles counter is not reset every second, but it integrates the value until 1h, when the counts are transmitted to the CLOUD as in normal probe operation.

10. External Modules and Sensors

10.1 SDI-12

In case SDI12 protocol is to be used, an additional module will be provided to be connected to the data logger.

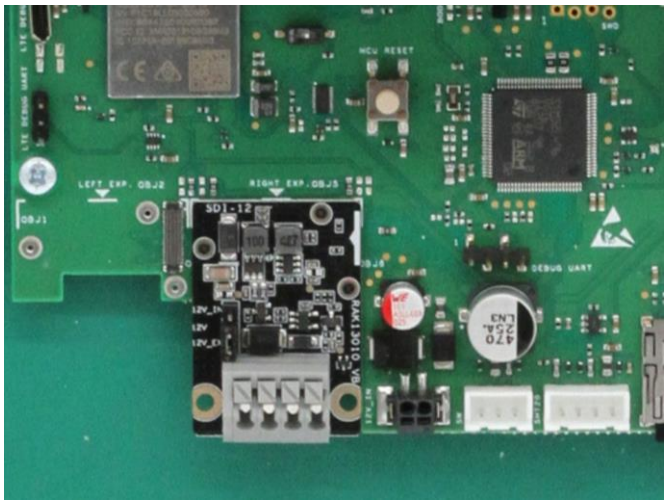


Figure 39 SDI12 Module

10.1.1 SDI12 module connection

You can connect the external data logger to the module following the instructions in Figure 40. In case you need additional information about the SDI12 module, you can find the module data sheet at the following link:

RAK13010 WisBlock SDI-12 Module Datasheet | RAKwireless Documentation Center

WARNING: the data logger will be powered with the SDI12 module power supply. To avoid any malfunction, please do not attach other power supplies from the main board (battery or solar panel).

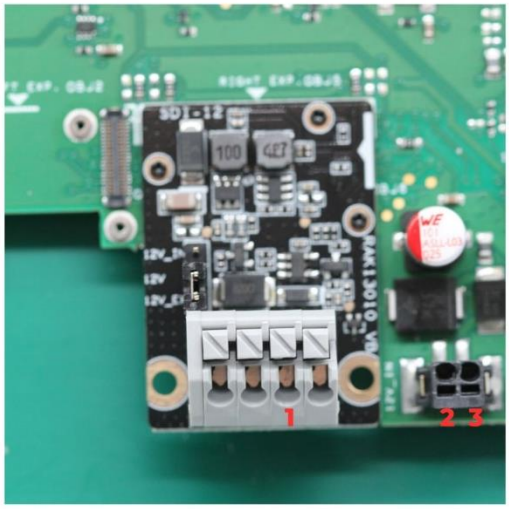


Figure 40 SDI12 module to data logger connections: 1 - DATA, 2 - GND, 3 – 12V

If you would like to use the battery and solar panel to give power supply to the board, you can connect the datalogger like described in Figure 41.

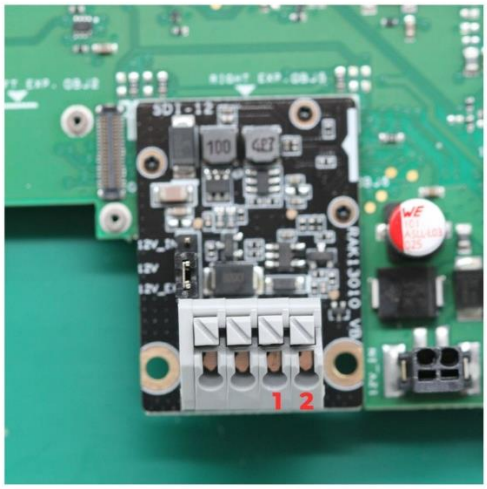


Figure 41 SDI12 module to data logger connections: 1 - DATA, 2 - GND

10.1.2 SDI12 commands description

The default address of the probe is “F” and can only be changed by the manufacturer. If you need to set a different address, you must notify Finapp staff.

ATTENTION: the progressive measurement counter changes when new measurements are retrieved. We strongly recommend taking at least **two or more SDI-12 readings evenly distributed in time every hour**, such that in case

of communication error the data is nonetheless retrieved on the next retry. When acquiring data check the progressive measurement counter to make sure that it differs from the previous one acquired. The same consecutive counter will represent repeated readings.
After a reboot the progressive measurement counter will reset.

Finapp sensor identification

Command description	Command	Response
Send Identification	aI!	AIlccccccccmmmmmmmvvvxxx…xxx<CR><LF>

Table 20 Command and response of the SDI-12 protocol implementation

Where:

A	**Sensor address [default “F”]**
II	SDI version [default “14”]
cccccccc	vendor [default “FinappII”]
mmmmmm	model [default “Fprobe”]
Vvv	main firmware version [default “003”]
xxx…xxx	last 13 characters of IMEI

Table 21 Details of the command and response of the SDI-12 protocol implementation

Data Logger Information

The information measured by the data logger mainly refers to atmospheric data and battery status.

ATTENTION: The aM! command must be followed by the aD0! command. This is usually a default implementation in external data loggers, however when commands are sent via terminal, both the aM! and aD0! commands must be sent.

Command description	Command	Response
Master Information	aM!	atttn<CR><LF>

Table 22 Command and response of the SDI-12 protocol implementation

Where:

a	**sensor address [default "F"]**
ttt	time to prepare the data [default "1"s]
n	Number of measurements [currently "6"]

Table 23 Details of the command and response of the SDI-12 protocol implementation

Followed by the data request:

Command description	Command	Response
Master data	aD0!	a<values><CR><LF>

Table 24 Command and response of the SDI-12 protocol implementation

Where:

a	**sensor address [default "F"]**
<values>	1) measurement progressive counter
	2) battery voltage [mV]
	3) pressure [Pa]
	4) temperature on board [m°C]
	5) external temperature (optional SHT20)
	6) external air humidity (optional SHT20) [mRH]

Table 25 Details of the command and response of the SDI-12 protocol implementation

Raw data from Finapp sensors

This command retrieves raw data from several Finapp sensors used in the same installation. N refers to the Finapp ID (N = 1,2,3,4 = Finapp ID), the number of Finapps installed depends on the application:

Installation type	Finapp ID	Commands (with sensor address "F")
Finapp SM	1	FM1!
Finapp SWE	2 (probe on the pole) 3 (probe on ground)	FM2!, FM3!
Finapp SWE + SM	1 (probe on the pole) 3 (probe on ground)	FM1!, FM3!

Table 26 List of SDI-12 IDs to be used referred to the Finapp probe associated with

ATTENTION: The aMn! command must be followed by the aD0! command. This is usually a default implementation in external data loggers, however when commands are sent via terminal, both the aMn! and aD0! commands must be sent.

Command description	Command	Response
Sensors raw data	aMn!	atttn<CR><LF>

Table 27 Command and response of the SDI-12 protocol implementation

where:

a	**sensor address [default "F"]**
ttt	time to prepare the data [default "1" s]
n	number of measurements [currently "5"]

Table 28 Details of the command and response of the SDI-12 protocol implementation

Followed by the data request:

Command description	Command	Response
Sensors raw data	aD0!	a<values><CR><LF>

Table 29 Command and response of the SDI-12 protocol implementation

Where:

a	**sensors address [default “F”]**
<values>	1) measurement progressive counter
	2) HV voltage Feedback [mV] ! NOT CALIBRATED
	3) acquisition time [ms]
	4) neutron counts
	5) muon counts

Table 30 Details of the command and response of the SDI-12 protocol implementation

Elaborated data

This command returns the data processed by Finapp sensors (soil moisture or snow water equivalent).

ATTENTION: By default, soil moisture is gravimetric (g/g); if bulk density is provided, the output will be volumetric (m3/m3).

The aM5! command must be followed by the aD0! command. This is usually a default implementation in external data loggers, however when commands are sent via terminal, both the aM5! and aD0! commands must be sent.

Command description	Command	Response
Elaborated data	aM5!	atttn<CR><LF>

Table 31 Command and response of the SDI-12 protocol implementation

Where:

a	**sensor address [default "F"]**
ttt	time to prepare the data [default "1" s]
n	number of measurements [currently "5"]

Table 32 Details of the command and response of the SDI-12 protocol implementation

Followed by the data request:

Command description	Command	Response
Elaborated data	aD0!	a<values><CR><LF>

Table 33 Command and response of the SDI-12 protocol implementation

Where:

a	**sensor address [default "F"]**
<values>	1) measurement progressive counter
	2) soil moisture [fraction*1000] (123 = 12.3%)
	3) SWE Areal [mm*10] (123 = 12.3 mm)
	4) SWE Local [mm*10] (123 = 12.3 mm)
	5) SWE Backup [mm*10] (123 = 12.3 mm)

Table 34 Details of the command and response of the SDI-12 protocol implementation

10.2 GPIO (for rain gauge / pluviometer)

The GPIO is an external module for the connection of digital I/O sensors, usually a rain gauge/pluviometer.

The external module has 2 pins for GND, 2 pins for VCC (3.3V) and can connect up to 16 sensors. The signal pins are called PA$ and PB$, where the dollar is a number between 0 and 7. The PA0 pin is the standard pin for the first sensor attached.

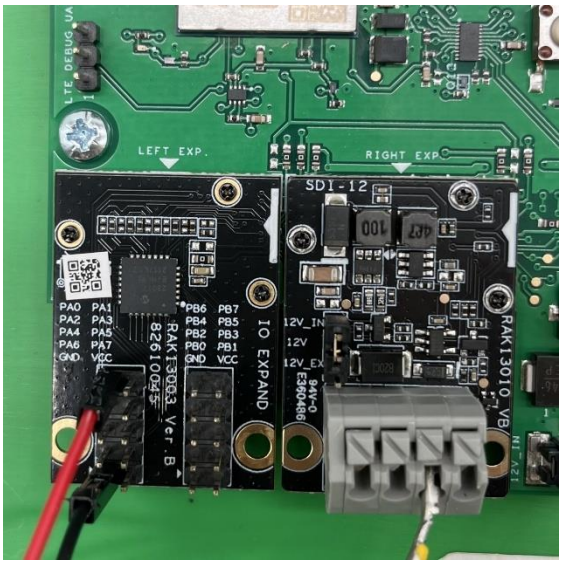


Figure 42 GPIO module to rain gauge: BLACK - GND, RED – PA0

Rain gauge / pluviometer installation

1. Install the bracket at the top of the pole.
2. Use cable ties to secure the cable connected to the rain gauge to the horizontal arm of the bracket.

Figure 43 Rain gauge connected to the bracket on top of the pole

3. Pass the cable through the Finapp probe enclosure.
4. Connect the rain gauge cable to GND and PA0 as indicated on the labels at the ends of the cable and on the terminal block on the probe.
5. Tighten the cable gland securely.

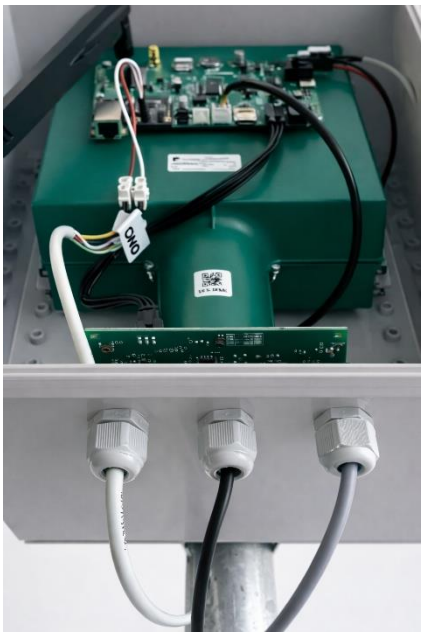


Figure 44 Rain gauge cable connected to the terminal block

10.3 Ethernet connection

The ethernet external module is installed in case there is the need to connect the probe to a router or antenna to ensure internet connection.

ATTENTION: In case you want to connect with the ethernet protocol, the cellular modem on the probe will be turned off, and the standard LTE connection will not be available.

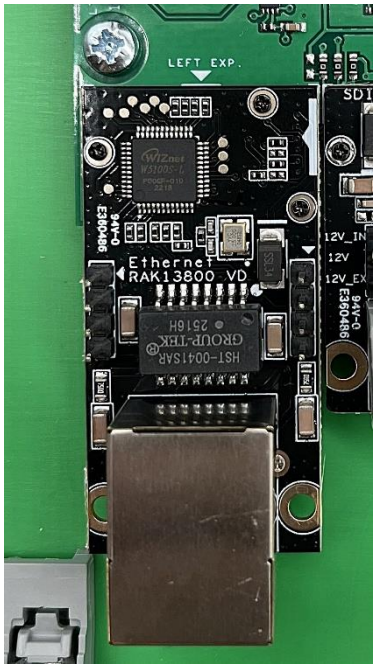


Figure 45 External module for ethernet connection

Ethernet cable installation

1. Connect the network cable to the antenna/router.
2. Pass the cable through the Finapp probe enclosure.
3. Connect the network cable to the external module.
4. Tighten the cable gland securely.

To verify correct operation: when the probe is turned on and the network cable is connected, check that the two LEDs on the external module connector are lit and that one of them is flashing.

11. Firmware Update and configuration change

11.1 Firmware update

Firmware updates on installations that are connected to the internet is run automatically upon client notification and approval.

In offline installation it is still possible to update the firmware when necessary, with a manual procedure. Please contact Finapp for more information on the availability of updates for your installation.

Below are the steps to update manually the firmware in the sensor by using the SD card:

Data Logger & Acquisition board firmware update

1. Turn off the probe and remove the SD card

2. We suggest creating a backup of the contents of the SD card, and then deleting all files and folders from it

3. Paste the “updmst.bin” and “slaves.fpkg” files into the SD card as shown in Figure 46

4. Reinsert the SD card into the data logger and restart the probe

5. Check that a light blue led lights for a few seconds, after which the turn-on LED sequence will start or- check that a light blue LED lights up for a few seconds. The LED turn-on sequence will then begin. This process could take a few minutes.

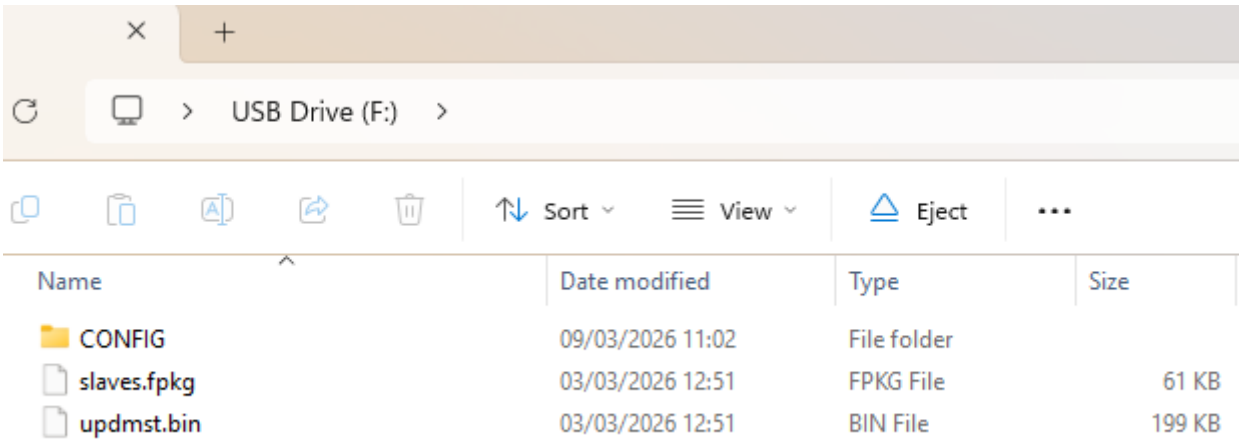


Figure 46 Content of the SD card when manually updating the firmware of both Data Logger and Acquisition board

11.2 Configuration Change

If a custom configuration is provided, paste (or replace if already present) the "config.fdb" file in the CONFIG folder in the SD card.
Follow the same procedure as in 11.1 to remove the SD card from the probe.
The content of the SD folder CONFIG should be as shown in Figure 47.

If needed, please request Finapp to provide the the "updmst.bin", "slaves.fpkg", and the "config.fdb" files for completing a manual firmware update.

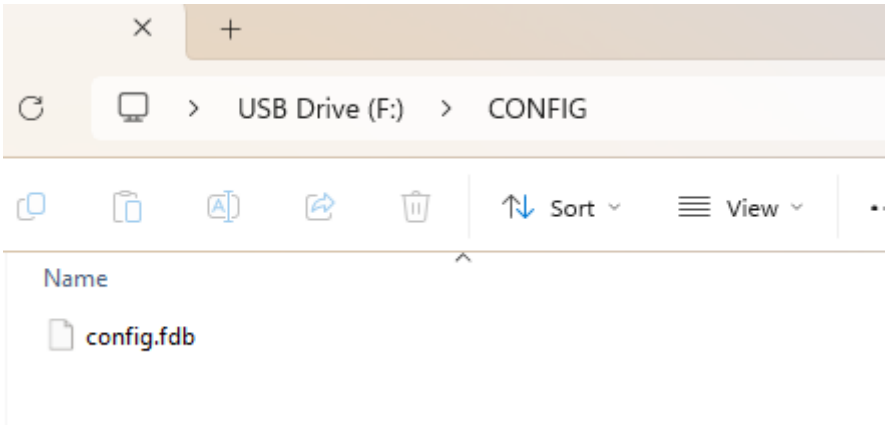


Figure 47 Content of the CONFIG folder to manually add a configuration.