

Finapp S.P.A.

Technical Sheet Probe

1. Description of the Probe

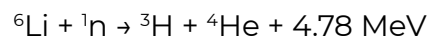
The Finapp probe consists of a particles detector coupled to a photomultiplier, an acquisition board, a data logger and a battery pack, all housed inside an IP67 enclosure for normal outdoor usage or IP68 enclosure for harsh environments. A solar panel above the box harvests solar energy to power the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

1.1 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 ^6Li to a minimum of 95 atom percent.

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



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	
$^6\text{LiF}:\text{ZnS}$ 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.

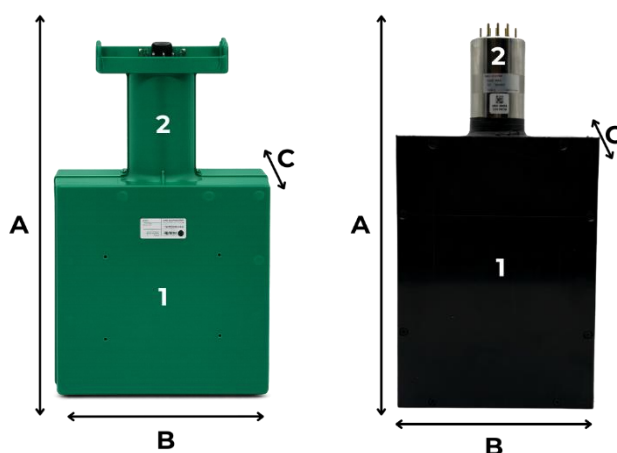


Figure 1 F3 on the left and F5 detector on the right with photomultiplier (1 – Detector, 2- Photomultiplier tube)

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	Neutrons ¹	Muons ¹	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.

1.2 Boxes and Accessories



1.2.1 Boxes

Figure 2 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 3 Enclosure available options with associated IP rated.

1.2.2 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 4 Battery available options for SM probes



Figure 3 9 Ah battery

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