ToughBoy 1.2 m

Technical description

Contents

1 Buoy overview

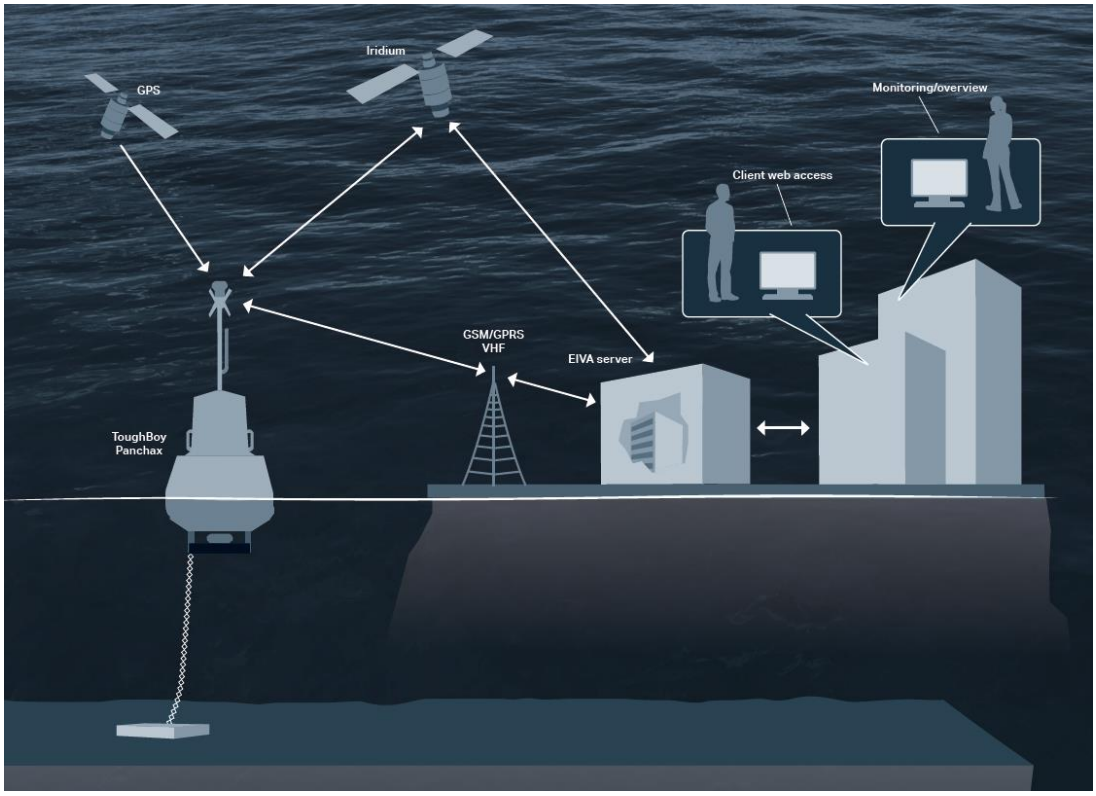

Figure 1 System drawing

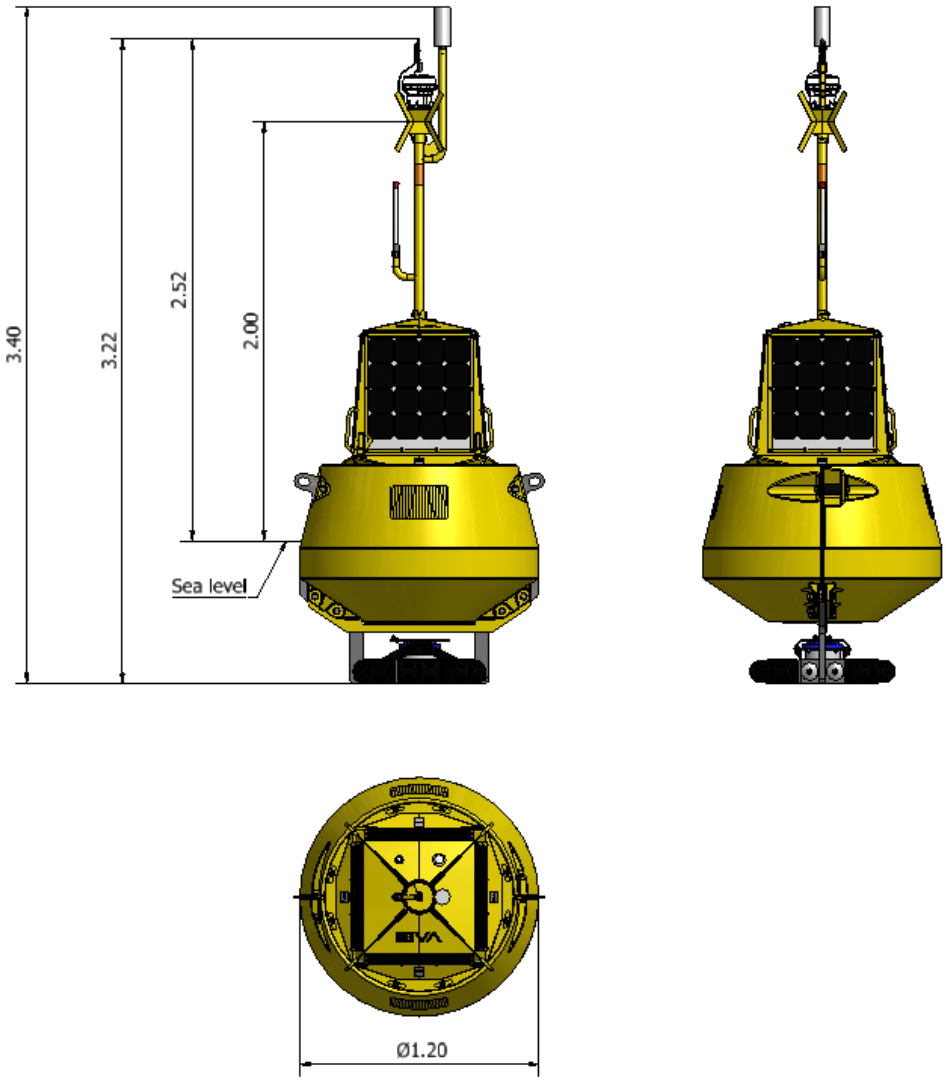

Figure 2 Buoy dimensions

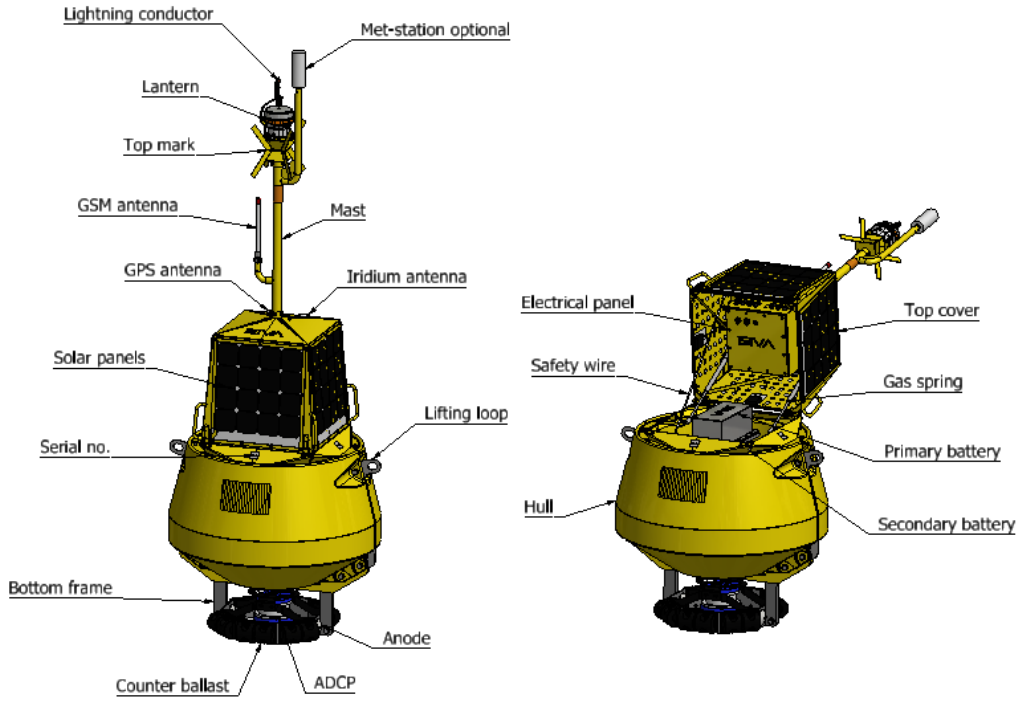

Figure 3 Buoy parts

2 Specification

2.1 Physical dimensions

Height	3.22 m, with optional met-station 3.40 m
Diameter	1.20 m
Net weight (air)	405 kg, with optional met-station 420 kg
Load capacity (maximal)	70 kg extra equipment

Table 1 Physical dimensions

2.2 Mechanical parts

Part	Specification
Top mark	• Easily removable (without tools), eg for transportation • Lightweight design • Seawater-resistant aluminium (EN AW-5754)
Mast	• Easily removable (without tools), eg for transportation • Lightweight design • Seawater-resistant aluminium (EN AW-5754)
Top housing	• Easy access to electrical panel and batteries (without tools) • Reinforced edges designed for rough handling • Lightweight housing • Seawater-resistant aluminium (EN AW-5754)
Box for primary battery	• Pressure-proof design • Safety relief valve, eg to prevent a gas build-up • Acid-proof stainless steel (AISI 316L)
Hull	• Designed for rough handling • Collision secured[2] • Polyethylene high-density (PEHD) float with polyurethane (PU) foam
Bottom frame	• Designed for rough handling • Lifting loops • Galvanised steel (S235JR)

Table 2 Mechanical parts

All parts of the buoy that are visible above sea level are coloured yellow RAL1003. Metal parts are powder coated or galvanised.

[2] In case of cracks in the hull from a collision with, for example, a vessel, the buoy will still float.

2.3 Sensors and Data Communication Unit

The standard ToughBoy Panchax buoy is mounted with the following sensors and Data Communication Unit.

2.3.1 EIVA wave sensor

EIVA wave sensor for accurate wave measurement.

Parameter	Symbol	Interval	Resolution	Max value	Accuracy
Time	t	n/a	0.1 s	n/a	±0.1 s
Wave mean direction	Θ_{mean}	10–180 min	1°	360°	±5°
Significant wave height	H_{m0}	10–180 min	0.1 m	15 m	±0.1 m or 2%
Wave peak period	T_p	10–180 min	0.1 s	25.5 s	±0.1 s or 2%
Wave zero crossing period	T_z	10–180 min	0.1 s	25.5 s	±0.1 s or 2%
Sea surface elevation	η	0.25–0.5 s	0.01 m	15 m	±0.01 m or 2%

Table 3 Wave sensor data

2.3.2 ADCP sensor

Teledyne Workhorse Monitor ADCP.

Parameter	Symbol	Interval	Resolution	Max value	Accuracy
Current velocity	U_z	10–180 min	1 mm/s	5 m/s	0.3/0.5% of water velocity relative to ADCP ±3/±5 mm/s
Current direction	Θ_z	10–180 min	±5°	360°	±5°
Depth range	R	n/a	User-configurable	15–116 m (80 dB)	±1.5 dB
Bins	B	n/a	1	128	1

Table 4 ADCP data

2.3.3 EIVA Data Communication Unit

The EIVA Data Communication Unit (DCU) is the main control unit in the buoy. It handles communication with the land station. It interfaces with the onboard sensors and stores data from the sensors. The raw data is stored on a local USB drive which is wet-mateable. It can store data for two years. It also handles power management of the buoy and controls the intelligent power sources switch.

Parameter	Symbol	Interval	Resolution	Max value	Accuracy
Primary battery	V_1	10–180 min	10 mV	15 V	0.1 V
Secondary battery	V_2	10–180 min	10 mV	15 V	0.1 V

Table 5 DCU data

2.3.4 Other

It is possible to mount other sensors[3] via

- RS-232 (two ports)
- I^2C for internal components
- I^2C line buffered for external components

[3] This will affect the power consumption of the buoy.

2.4 Positioning and communication

The buoy has various ways to communicate with the land station. The buoy has a prioritised communication system, which makes it always possible to communicate with the buoy. This prioritisation gives the buoy the ability to change communication type upon loss of connection – and go back to the prioritised type of communication when re-established.

2.4.1 GNSS – positioning

The onboard GNSS is for locating the buoy. It is possible to make a guard zone for the buoy. If the buoy goes outside the guard zone, it will send a warning to the land station.

GNSS	GPS
Accuracy	≤2 m

Table 6 GNSS data

2.4.2 Iridium

Iridium 9603 Short Burst Data (SBD) modem for worldwide data communication.

Iridium 9603	SBD
Band	1616.0–1626.5 MHz

Table 7 Iridium data

2.4.3 GSM

GSM for nearshore data communication.

2G/3G	GSM/GPRS/EDGE/HSDPA
Band	850/900/1800/1900/2100 MHz
SIM card	Mini SIM, 25mm x 15mm

Table 8 GSM data

2.5 Web-based software

Web-based software administrated by EIVA. The software handles all communication with the buoy. The configuration of the buoy and collected data can be accessed via a simple web interface.

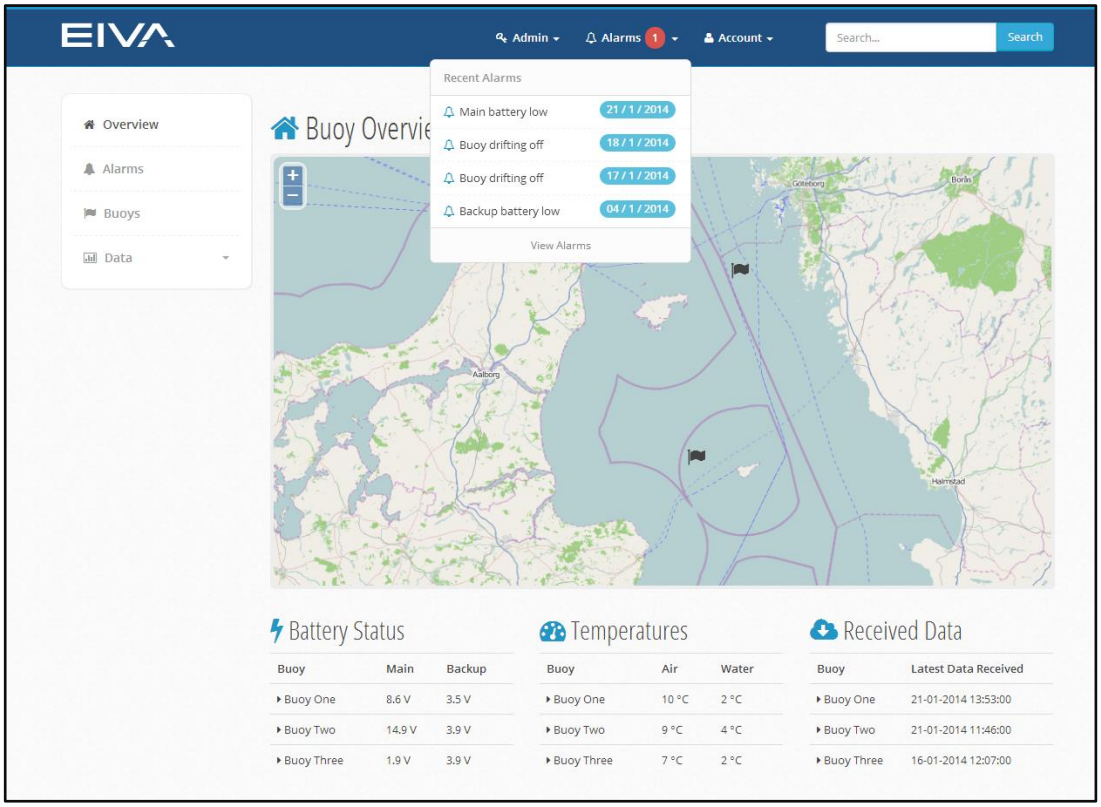

Figure 4 Buoy Overview

In the Buoy Overview, it is possible to get an overview of the data, including:

- Wave sensor
- Temperature
- ADCP
- Power status
- Alarm status
- Etc

All data collected from the buoy are presented/stored in an open format for easy import into various software for post-processing. Data communicated by Iridium are transmitted by email and interpreted by the web-based software.

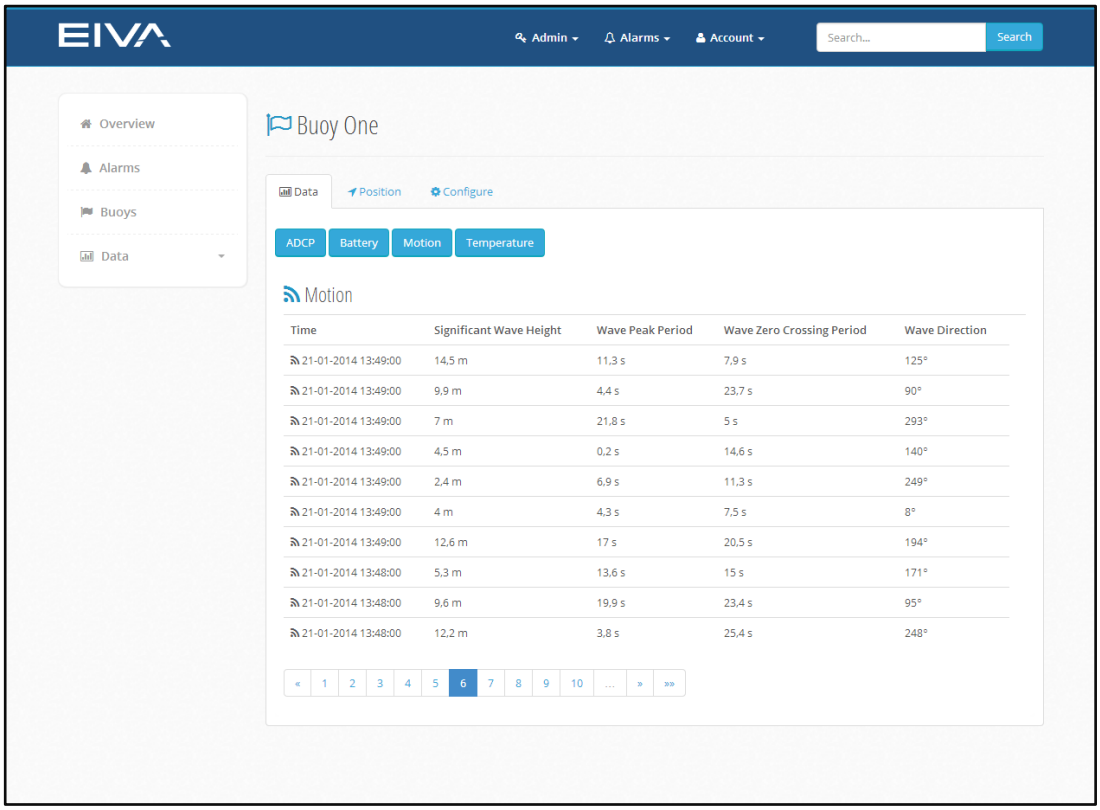

Figure 5 Buoy data

The web-based software will monitor the buoy for alarm activity, including:

- Power failure
- Data loss
- Guard zone
    - It is possible to make a guard zone for the buoy. If it leaves the guard zone, it will send a warning to the land station with attached GPS position.
- Etc

2.6 Power system

The power system is an intelligent system consisting of three power sources: four solar panels, the primary battery (rechargeable) and the secondary battery (non-rechargeable).

The power system is designed to run on the solar panels and the primary (rechargeable) battery for the majority of the time. The secondary (non-rechargeable) battery is the backup battery, for those days with very little sun.

The power system is capable of supplying power to a standard EIVA wave buoy for one year[4]. See Figure 6 below for more details.

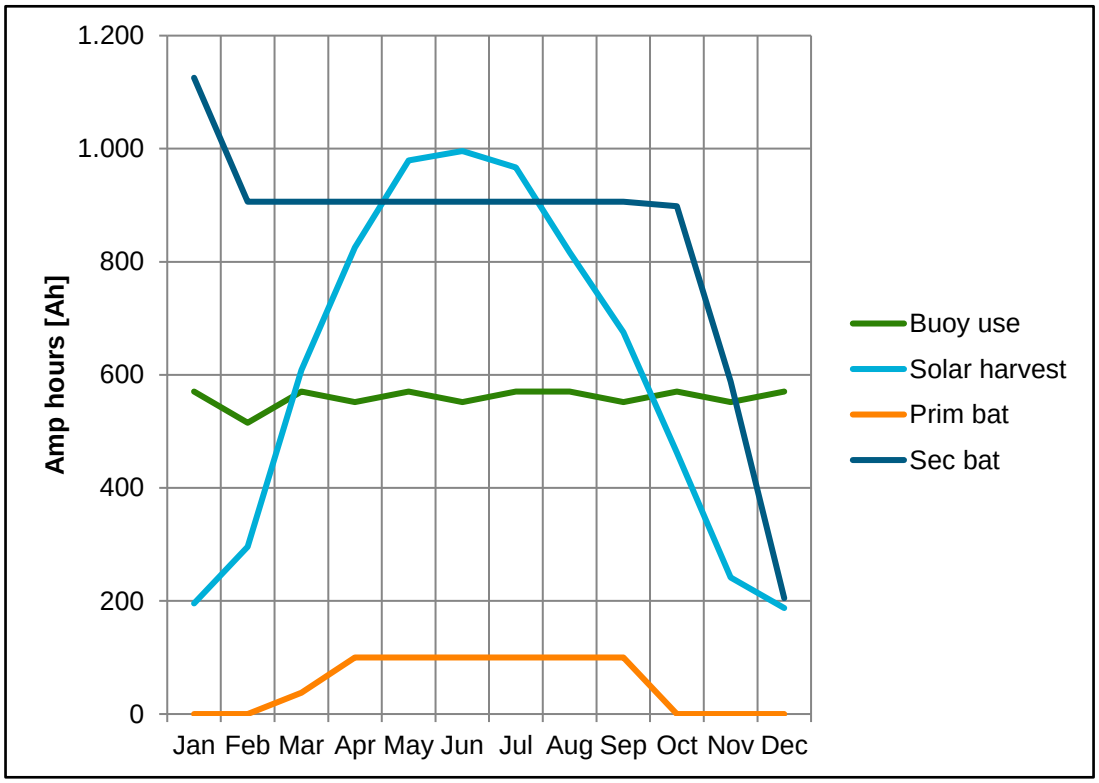

Figure 6 Power consumption in one year

Part	Specification
Solar panels	• 4 x 51 W • Efficiency > 22.5%

[4] Dependent on location.

	• Monocrystalline cells • Designed for rough environments
Primary battery	• AGM – rechargeable • 12 V • 100 Ah • Submersible
Secondary battery	• Alkaline – non-rechargeable • 12 V • 1,700 Ah • Submersible

Table 9 Power system data

2.7 Marking

The buoy is marked for clear visability and to fulfil official standards.

Part	Specification
Lantern	• Yellow light, default flash pattern Fl(5)Y.20s • Custom flash pattern (IALA-compliant) • Range 3 nmi • Placed 2 m above sea level
Top mark	• Yellow St Andrew's Cross • Incorporated radar reflector feature • Placed 2 m above sea level
Reflector	• Yellow luminous reflector near top mark

Table 10 Marking specification

2.8 Mooring system

A wave buoy has to adapt to the wave height in order to obtain accurate measuring data, and therefore, the mooring system has to be flexible. This is accomplished by implementing a rubber cord in the mooring system. The standard rubber cord with safety rope is shown below in Figure 7, with (L) denoting length.

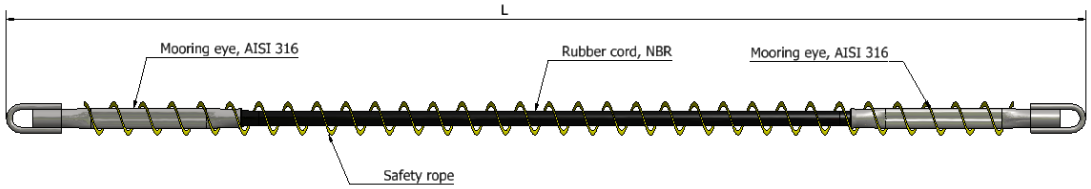

Figure 7 Close-up of mooring system

You can determine the exact setup of the mooring system, which can be one of the systems pictured in Figure 8 below, depending on various parameters of the water, such as the water depth (X), current velocity (V) and wave height (h).

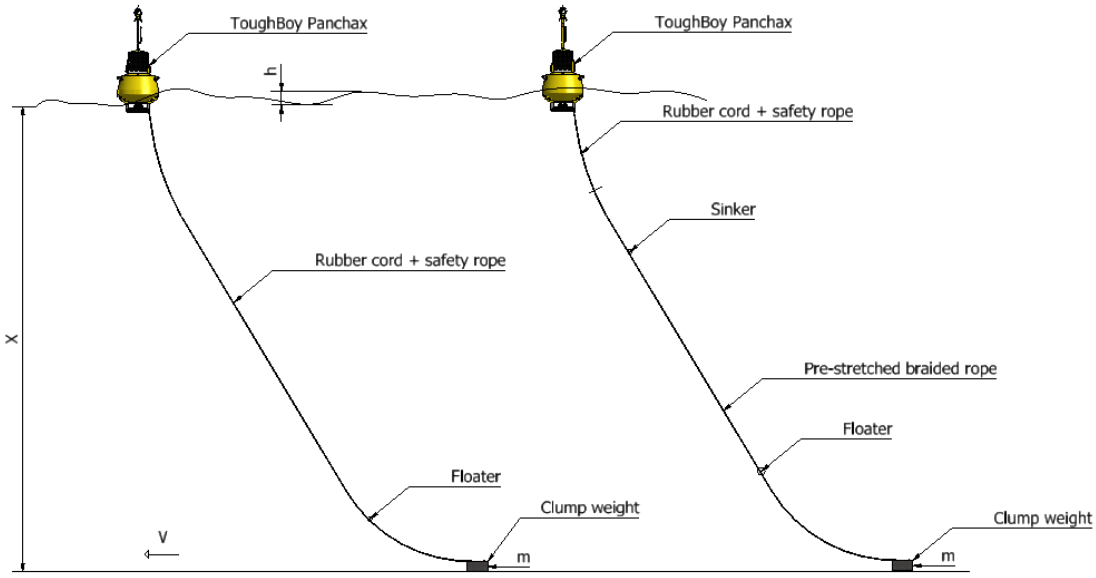

Figure 8 Mooring systems

The maximal water depth for the ToughBoy Panchax buoy to be able to be deployed with the mooring system depends on the local current velocity, as specified in Figure 9 and Table 11 below.

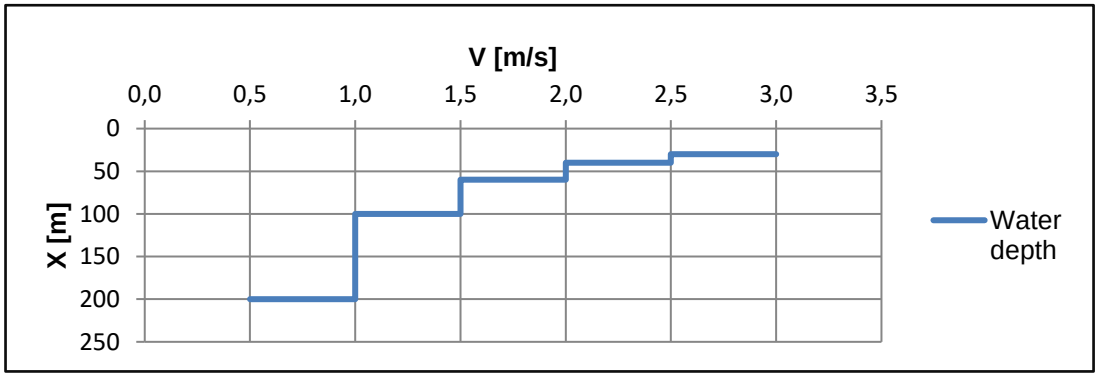

Figure 9 Current velocity vs water depth

Current velocity (groundwater), V [m/s]	Max water depth, X [m]
0.5 < V < 1.0	200
1.0 < V < 1.5	100
1.5 < V < 2.0	60
2.0 < V < 2.5	40
2.5 < V < 3.0	30

Table 11 Current velocity vs water depth

The required type of mooring system and length (L) can be determined according to Table 12 below.

Water depth, X [m][5]	Mooring system
3 < X < 15	Rubber cord + safety rope + floater, L = 1.5X
15 < X < 50	Rubber cord + safety rope + floater, L = 2.0X - 15
50 < X < 200	Rubber cord + safety rope + sinker + pre-stretched braided rope + floater, L = 2.0X - 15

Table 12 Mooring system types

To secure the wave buoy´s position and to withstand the force applied from waves, the mooring system has to be deployed with a clump weight. The necessary weight in kilograms of the clump weight is specified in Figure 10 and Table 13 below.

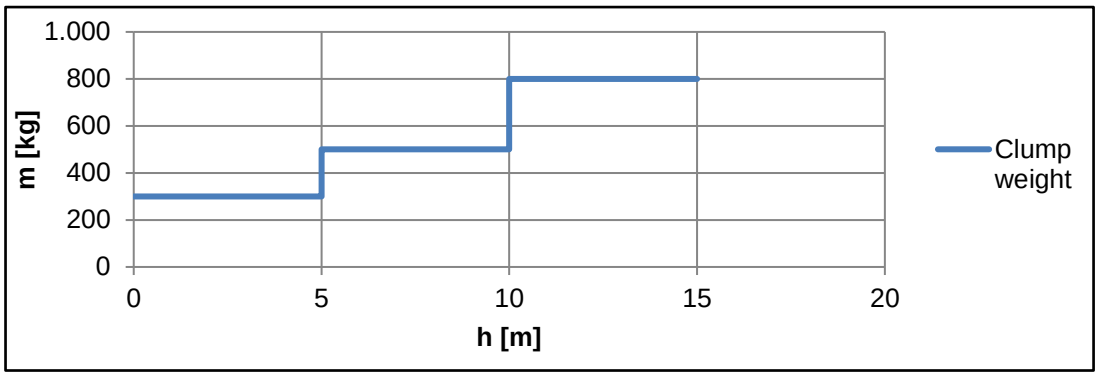

Figure 10 Wave height vs clump weight

Wave height, h [m]	Clump weight, m [kg]
0 < h < 5	300
5 < h < 10	500
10 < h < 15	800

Table 13 Wave height vs clump weight

[5] If the water depth is more than 200 metres, the mooring system has to be customised.

2.9 Service

The ToughBoy Panchax buoy is easy to service. Open the two quick latches (without tools) indicated in the drawing below and service the primary battery or the electrical panel.

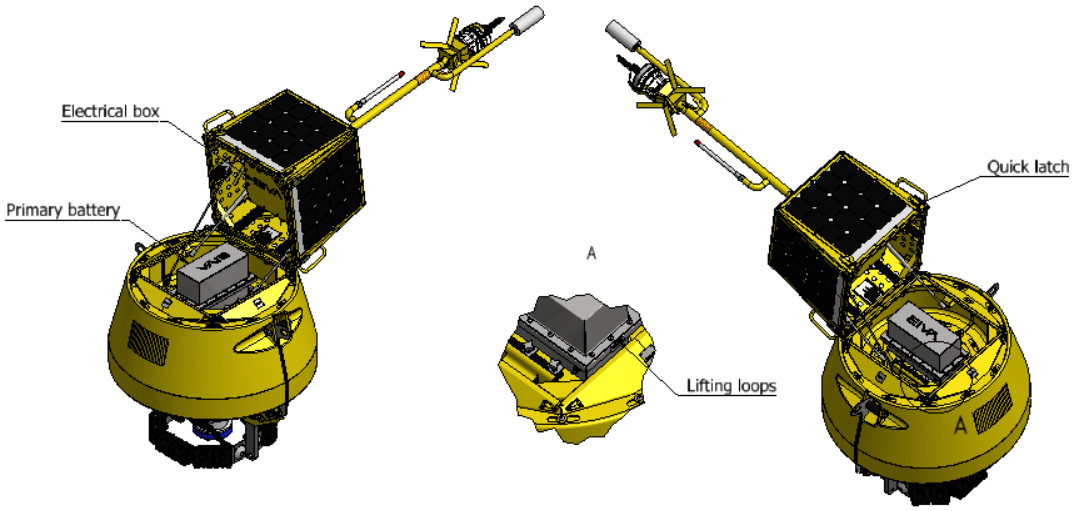

Figure 11 Buoy service view

2.10 Shipment dimensions

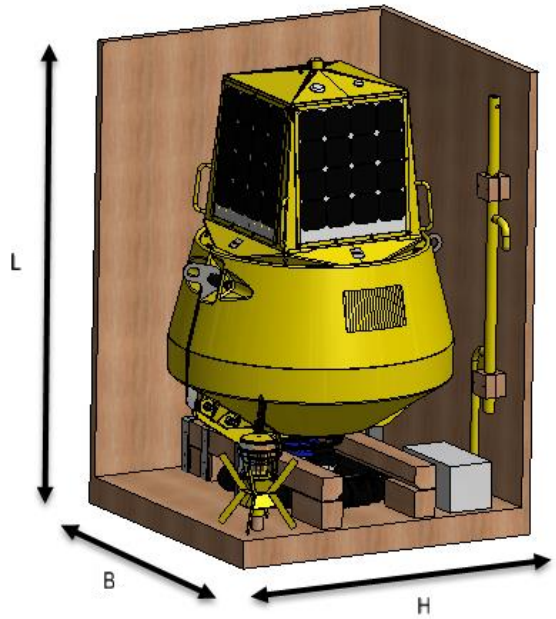

Figure 12 Buoy shipment dimensions for road cargo

Net weight 650 kilograms, including the shipping box. Customised shipment packaging is available upon request.

The dimensions in figure 13 are listed below in table 15.

L	2.05 m
B	1.34 m
H	1.43 m

Table 14 Dimensions

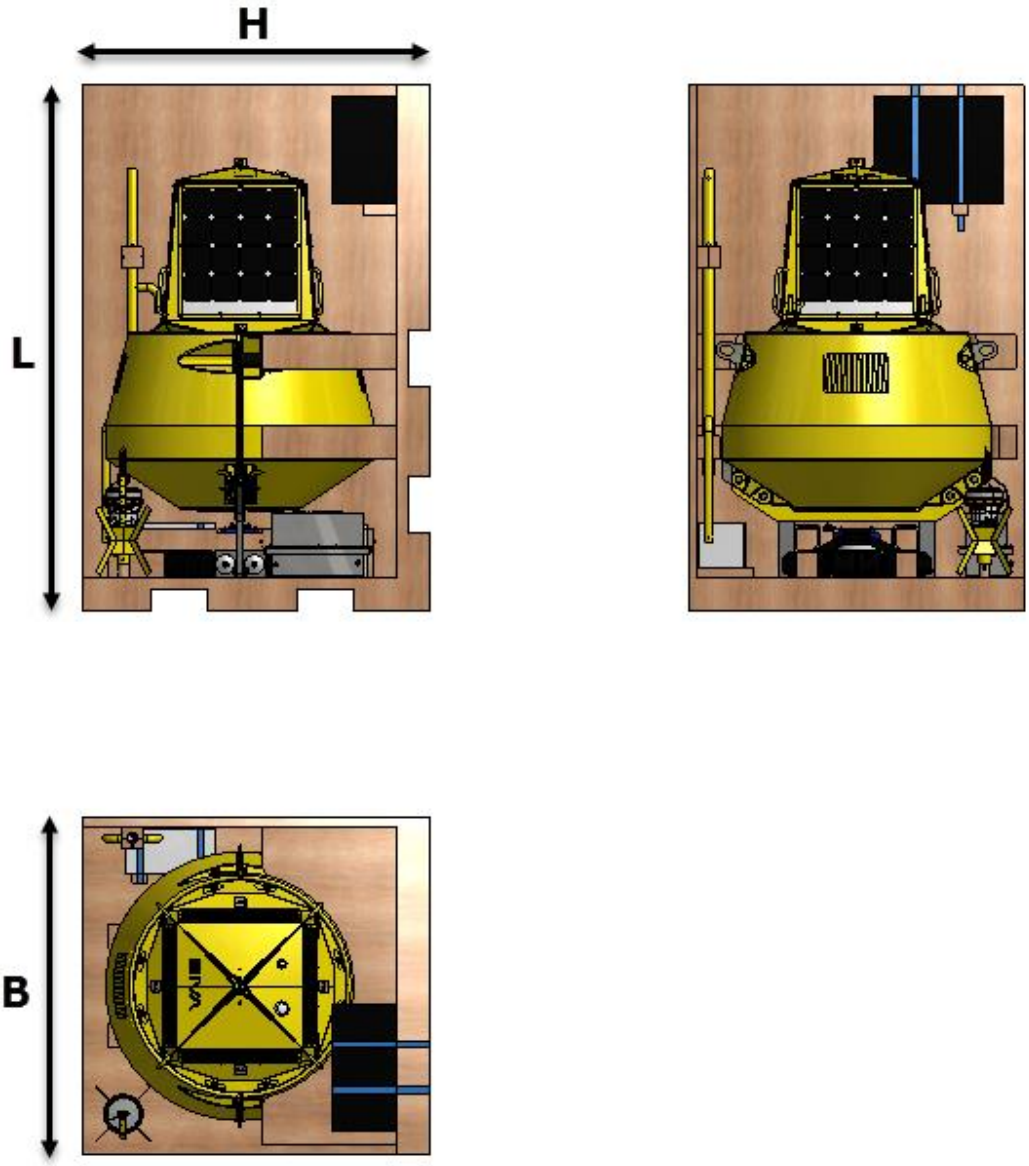

Figure 13 Buoy shipment dimensions for air cargo

Net weight 760 kilograms, including the shipping box. Customised shipment packaging is available upon request.

The dimensions in figure 14 are listed below in table 16.

L	2.35 m
B	1.50 m
H	1.55 m

Table 15 Dimensions