

Difference between Mark I and Mark II

Computer and temperature pcb's have been redesigned. As a set interchangeable with the old set. The firmware has been adapted for the new hardware. The transfer scheme is changed to fit real time - and previous spectral data within exact half hour boundaries.

Resolution has been improved and power consumption reduced.

The wave direction receiver has to be equipped with Mark II firmware in order to process new as well as the old transfer scheme.

installed sensors

The buoy contains

- heave-pitch-roll sensor Hippy-40
- three axis fluxgate compass
- two fixed "x" and "y" accelerometers
- temperature sensor
- micro-processor.

directional measurement

From the accelerations measured in the x and y directions of the moving "buoy reference frame" the accelerations along the fixed, horizontal, north and west axis are calculated. All three accelerations (vertical, north and west) are digitally integrated to get filtered displacements with a high frequency cut-off at 0.6 Hz. Finally, every half hour, FFT transforms of 8 series of 256 datapoints (200 sec) are summed to give 16 degrees of freedom on 1600 seconds of data.

data compression

To save transmitting power the real time data are compressed to motion vertical, motion north and motion west.

data reduction

On-board data reduction computes energy density, main direction, directional spread

and the normalised second harmonic of the directional distribution.

Frequency resolution:

0.005 Hz from 0.025 to 0.1 Hz and
0.01 Hz from 0.1 to 0.59 Hz.

Argos message

To facilitate satellite communication a 32 byte Argos message is computed.

For this reason the spectrum is divided into energy bands in such a way, that by optimum use of the available bits a well detailed graph of energy, wave direction and directional spread versus frequency can be reconstructed.

standard transmission

The Directional Waverider transmits HF in the 27 - 40 MHz band continuously.

In this version the Directional Waverider transmits:

- Real time data:
 - motion vertical
 - motion north
 - motion west
- Quasi static data:
 - computed spectral density
 - directional parameters
 - H_{m0}
 - T_z
 - Monitoring data such as seawater temperature and battery voltage, system status, GPS position (option) and parity bits for error checking purposes.

Transmission occurs with a rate of 81.92 Bps.

The data is framed in 64 bit vectors.

Bits 0-15:

Cyclic message containing a part of the quasi static data.

Some redundancy is built in; for instance the spectral density function and directional data are sent 8 times.

Bits 16-51:

Real time data.

Bits 52-63:

Error check bits.

transmission to Argos satellite

The Directional Waverider can be delivered in satellite version as follows:

- Transmission of the Argos message to the Argos satellite.
- Transmission of the Argos message to the Argos satellite combined with the standard 27-40 MHz radio link.
- Buoy position only combined with the standard 27-40 MHz radio link.

As Argos can keep track of buoy position, use as a drifting buoy is possible. With a moored buoy Argos facilitates a drift alarm.

GPS (Global Positioning System)

The Directional Waverider can be equipped with a GPS receiver module. Latitude and Longitude with some status data will be updated once per half hour and are transferred in the system file. Power consumption is negligible.

internal recording

The Directional Waverider can be equipped with an internal logger. Logging capacity depends on memory installed and schedule chosen ranging from several weeks (continuous recording of all data incl. the real time ("raw") data) to years when recording spectra only. Power consumption 200 mW.

mooring

The Directional Waverider is fitted with 5 kg chain ballast attached to the mooring eye. This provides stability when only a small vertical mooring force is present (free floating or shallow water).

A single point vertical mooring with 30 m rubbercord ensures sufficient symmetrical horizontal buoy response also for small motions at low frequencies.

The low stiffness of 30 m rubbercord allows the Directional Waverider to follow

waves up to 40 m.

Current velocities up to 3 m/sec (6 knots) can be accepted.

Buoyancy is 1630 N.

water temperature measurement

Sea-surface water temperature measurement is standard included.

collision risk

High shock accelerations are absorbed by the fluid surrounding the accelerometer and the shockproof mounting of the accelerometer housing, electronics and batteries.

The hull of the Directional Waverider (AISI316, thickness 3 mm) stays watertight even if largely deformed.

To reduce the risk of collision the Directional Waverider is fitted with a light (group of 5 yellow flashes every 20 seconds, as specified for ODAS in the IALA buoyage system "A").

The flashlight operates below a daylight level of 60 lux and has a visibility range of about 4 nautical miles.

corrosion risk

A few unpainted AISI316 stainless steel Waverider hulls show pitting, whereas fouling by marine growth is more common.

Painting may protect against pitting, but the paint system has to be chosen carefully.

Better (warranted, see our warranty terms) performance is obtained with a hull of Cunifer10 (Copper-Nickel alloy) which material does not pit nor foul. Though its strength is less than that of stainless steel, it can take large deformations.

Specifications

Hull diameter (excl. fender)	0.9 m
Hull material	AISI316 (standard), or Cunifer10 (optional)
Height of buoy without antenna	1.25 m
Height of buoy including satellite antenna	1.45 m
Buoy packed in transport frame:	
Height	1.50 m
Width (= buoy + fender)	1.0 m
Packed weight	255 kg (Cunifer10: 264 kg)
Net weight incl. batteries and chain coupling	212 kg (Cunifer10: 221 kg)
Static buoyancy	1630 N (Cunifer10: 1540 N)
Dynamic buoyancy (acc. = 2.5 m/sec ²)	1215 N (Cunifer10: 1135 N)
Drag (horizontal):	
Small Froude numbers	80 V ² N
Moderate current speed up to 1.8 m/sec	120 V ² N
At around 2.3 m/sec	200 V ² N
(V = current speed m/sec)	
Line force is (drag * $\sqrt{2}$) for a mooring line top angle of 45°	
Rubber line section to be included in mooring line:	
Length	30 m or 2 x 15 m
Diameter	3.5 cm
Hardness	45 - 50° shore
Max. current speed	3 m/sec
Sampling frequency	3.84 Hz
Digital filtering (phase-linear, combined bandpass and double integration FIR filter):	
Delay	45.6 sec
Bandpass characteristics	0.033 - 0.6 Hz: 3dB 0.04 - 0.59 Hz: 0.3dB: 0.056 - 0.58 Hz: 0.03dB
Low frequency side	24 dB/octave
High frequency side	> 60 dB
Heave:	
Range	- 20 - + 20 m
Resolution	1 cm
Scale accuracy	3% of measured value
Zero offset	< 0.1 m
Period time	1.6 sec - 30 sec
Cross sensitivity	< 3%
Direction:	
Range	0 - 360°
Resolution	1.5°
Buoy heading error	0.4 - 2° depending on latitude typical 0.5°
Period time in free floating condition	1.6 sec - 30 sec
Period time in moored condition	1.6 sec - 20 sec (see "Mooring" next page)

Mooring:

A translational buoy is sensitive to asymmetric mooring stiffness. This asymmetry can introduce direction errors for wave frequencies at and below the natural frequency of the buoy-mooring system. For wave frequencies higher than this frequency these errors decrease sharply with frequency.

Mooring resilience:

A mooring line including in total 30 m of rubbercord must be used to ensure sufficient resilience for horizontal buoy motion. This configuration results in a natural frequency of 0.05 Hz.

Sea surface temperature measurement:

Range	-5°C - +46°C
Resolution	0.05°C
Accuracy	0.2 °C
Long term stability	better than 0.1°C/year

Transmitter:

Output	150 - 200 mW
Frequency	27 - 40 MHz
Range	max. 50 km
Modulation	± 80 Hz FSK (0.2 F1)

Battery life:

Leclanché 4511/561 (zinc-carbon, 80 Wh per cell, 85 pcs., self discharge less than 5% per year).
Life depends on buoy configuration ranging from about 12 months for buoy equipped with all options (HF + Argos + GPS + logger) to about 30 months for buoy transmitting through Argos only (flasher on 12 hrs per day).

With HF transmission only	about 19 months
With HF + Argos transmission	about 17 months

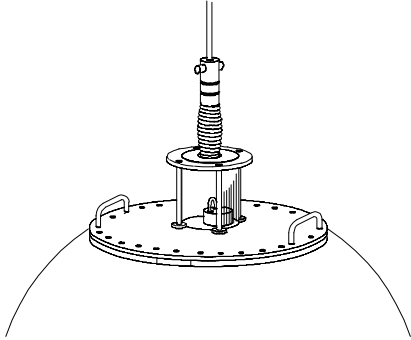
Extreme temperatures:

Operating (water)	-5°C - +35°C
Storage	-5°C - +40°C
Short term storage (weeks)	max. 55°C

External supply:

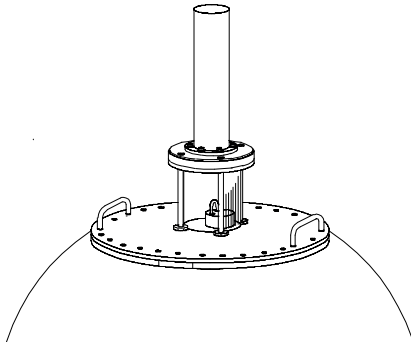
Red jack + black jack - on hatchcover 12 - 30V DC in absence of batteries.
Will also take over internal battery source if it has a higher voltage (typical 28V) than the batteries.

Following versions, also in combination, are available:



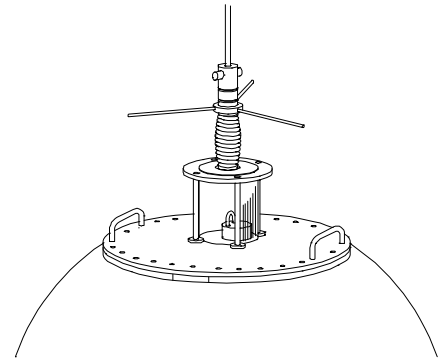
Directional Waverider

with standard transmission
hatchcover for 27-40 MHz transmission



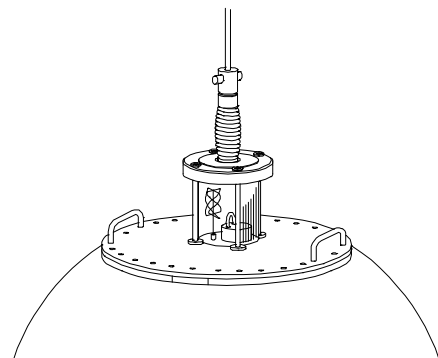
Directional Waverider-Sat

with transmission to Argos satellite
hatchcover for satellite transmission



Directional Waverider Sat-Combi

with standard transmission &
transmission to Argos satellite
hatchcover for 27-40 MHz transmission
combined with satellite transmission



Directional Waverider GPS

with standard transmission & GPS
hatchcover for 27-40 MHz transmission
combined with gps module