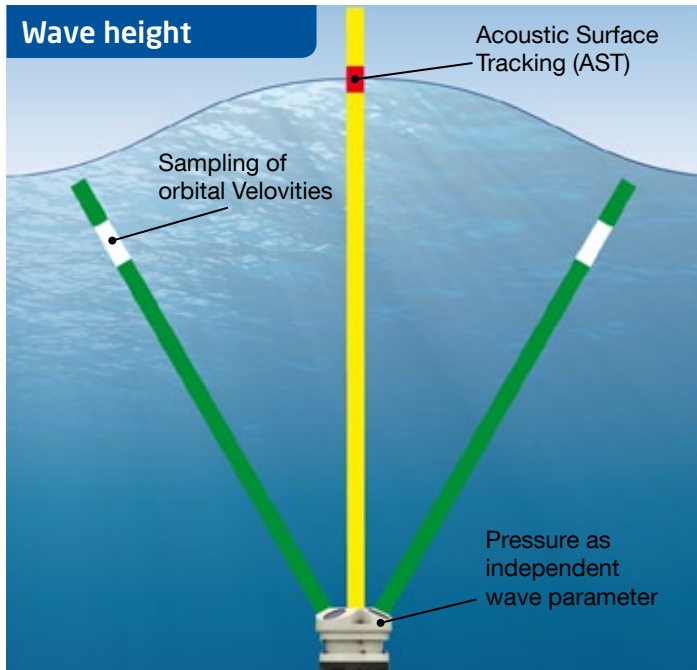


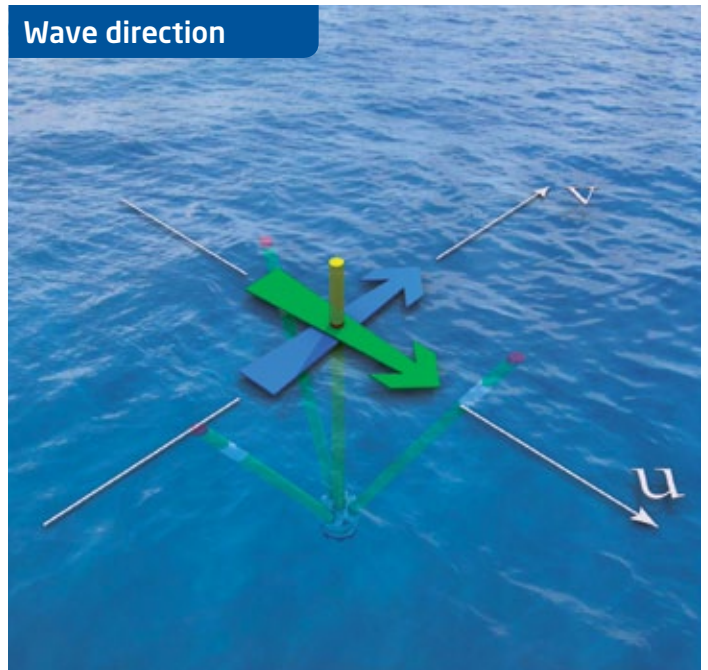
The Nortek Acoustic Wave and Current profiler (AWAC) performs «triple duty»: It measures wave height, wave direction and the full current profile. The system can resolve waves from 1 to 100s, a capability that is unique to the Nortek AWAC.

AWAC

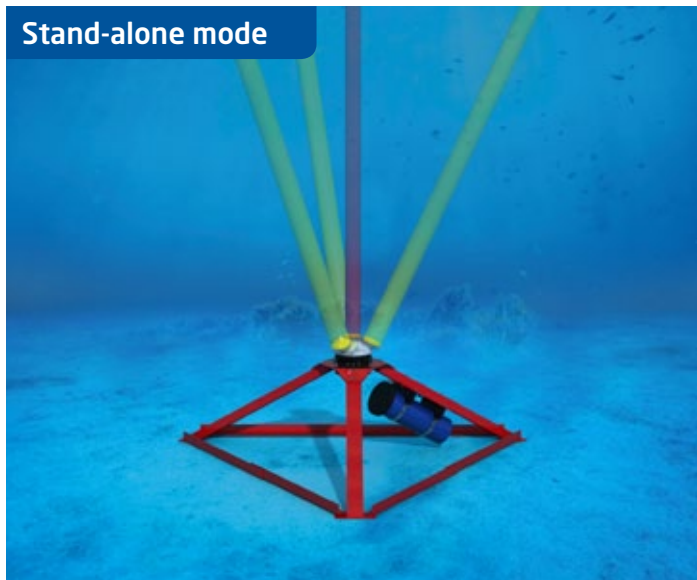
Acoustic Wave And Current Profiler



The AWAC measures wave height and period using the unique acoustic surface tracking (AST) feature. A short acoustic pulse is transmitted vertically toward the water surface, and the time lag between the transmitted ping and its reflection is used to generate a time series of the surface elevation.



Wave direction is calculated by combining AST with orbital velocity measurements in an array near the surface. The four point array data can be processed with the maximum likelihood method to generate accurate directional wave spectra. For AWACs mounted on subsurface buoys, the patented SUV processing can be used to generate similar results from deep ocean moorings.



In stand-alone mode, the AWAC is deployed with an external battery canister that supplies power. Raw data recorded to internal memory can be downloaded to a PC once the instrument is recovered. The maximum duration of the deployment depends on the size of the internal recorder and the number and the type of batteries that are used.



The AWAC can transmit raw or processed data to shore if the instrument is connected via cable or a suitable data modem. Data can be displayed using the SeaState software and made publicly available through custom WEB solutions.

CURRENT AND WAVE MEASUREMENTS IN THE OCEAN, LAKE AND LABORATORY



Nortek AS
Vangkroken 2
1351 Rud, Norway
Tel: +47 6717 4500
Fax: +47 6713 6770
E-mail: inquiry@nortek.no



www.nortek-as.com
True innovation makes a difference

AWAC a small revolution in ocean wave measurements

With the Nortek AWAC, you get a current profiler and a wave directional system in one unit. You can measure the current speed and direction in 1-meter thick layers from the bottom to the surface. Waves of all varieties are measurable; this includes long waves, storm waves, short wind waves, or transient waves generated by local ship traffic.



The AWAC is designed as a coastal monitoring system. It is small, rugged, and suitable for multi-year operation in tough environments. The mechanical design is all plastic and titanium to avoid corrosion. The AWAC is available in three transmit frequencies (1 MHz / 600 kHz / 400 kHz) which allow for different deployment depths.

The sensor is usually mounted in a frame on the bottom, where it is protected from complications at the surface such as harsh weather, vandalism, and ship traffic. While safely located at the bottom, it is operated in online or in stand-alone mode.

In stand-alone mode, the raw data are stored to the internal data logger and power comes from an external battery pack. A variety of options are available with maximum deployment lengths of 12 months with hourly wave data when using lithium batteries.

Online systems have a variety of possible communication configurations. The most common are long, offshore cables (max. 5 km) or acoustic modems. Online systems can be delivered with backup batteries, protected cables, shore side interface units, and online software.

AST breakthrough

The AWACs extraordinary wave performance has largely to do with the Acoustic Surface Tracking (AST). The AST is based on echo-ranging to the surface with the vertically oriented transducer. The beauty of this method of measuring waves is that it circumvents the depth limitations imposed by bottom mounted pressure and velocity measurements. Long waves (swell) and storm waves are rarely difficult to measure, however waves generated by local winds are challenging without AST. Moreover, the AST also gives you the ability to derive wave parameters based on times series analyses. This means that the AWAC can directly measure wave parameters such as Hmax, H1/10, Tmean, etc. which other bottom mounted systems simply cannot.

Tidal elevation with improved pressure sensor

From the spring of 2011, an improved pressure sensor with an absolute accuracy of 0.1% of full scale is available for the AWAC. For a deployment depth of 20 m (and a 50m full scale sensor), this means the absolute accuracy of the sensor is 5 cm, which is within the requirements for many operational harbor systems

Software

The AWAC software is used to configure the instrument for deployment, retrieve the data, and convert all raw data files to ASCII. In order to calculate the wave parameters, you have the choice between the non-graphical QuickWave software and the graphical Storm software. For online systems which require data management and generating content for internet use (e.g. processed results and graphical plots), the SeaState software serves as the link for all your AWAC wave and current data.

New AWAC features

- 400 kHz version of the AWAC
- ProLog Internal Processor
- Special ice detection algorithm
- Improved pressure sensor
- SeaState 2.0 for online data collection



1 MHz



600 kHz



400 kHz



Platform mount

Most Nortek products can be used either in stand-alone or online mode. In stand-alone mode, data is collected to the internal recorder, and the power comes from external batteries. For online system, data is transmitted to shore and the measurements are continuously available.

ProLog

The ProLog consists of a powerful processor and a 4 GB SD-card recorder laid out on a separate circuit board that fits inside the AWAC. The processor takes the raw data from the AWAC, runs the directional wave processing algorithms and outputs the processed data in ASCII (NMEA) or binary format. This makes the ProLog ideally suited for online applications where data transfer rates are limited, as when using acoustic modems or satellites. The NMEA format also facilitates the integration of the AWAC with 3rd party external controllers.

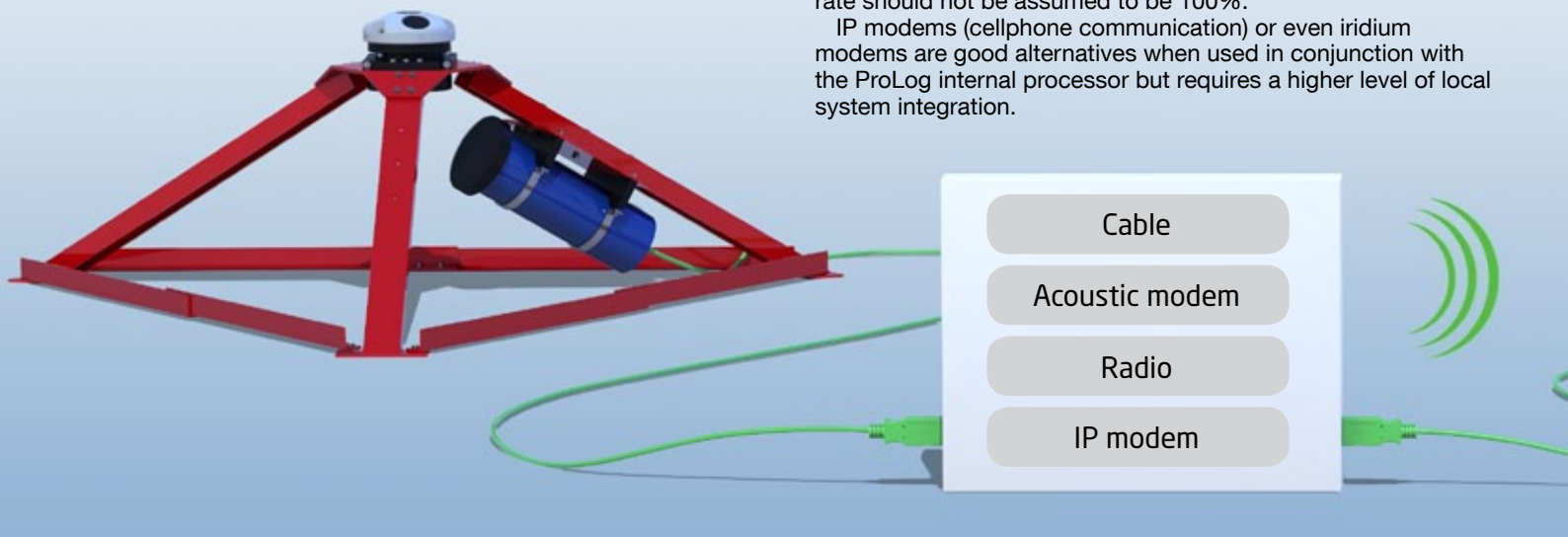
Data transfer

There are several ways that data can be transferred to shore in an online system. A cabled connection is simplest and it also has the advantage that it is possible to supply power from shore. Nortek has spent a significant effort to ensure that cabled systems are both functional and reliable.

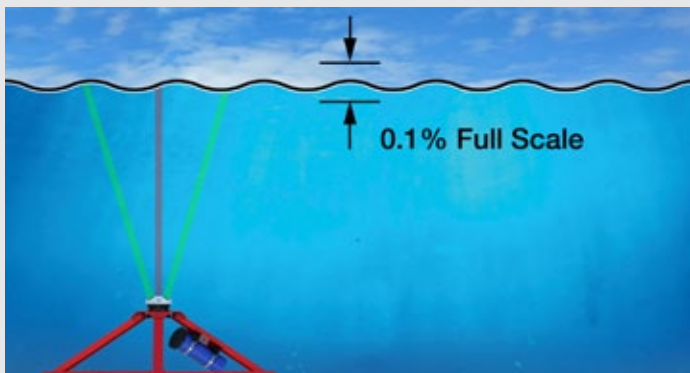
Radio modem can be added to cables and can work over long distance, provided that there is line of sight.

Acoustic modems work over short distances when the two are placed so that there is a line of sight between them. Acoustic data transfer is not always reliable and the success rate should not be assumed to be 100%.

IP modems (cellphone communication) or even iridium modems are good alternatives when used in conjunction with the ProLog internal processor but requires a higher level of local system integration.



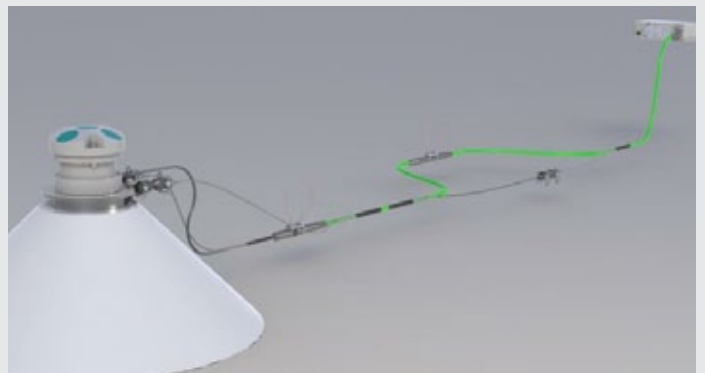
Improved pressure sensor



The piezoresistive sensor used in the AWAC has an intrinsic accuracy of $\pm 0.5\%$ of full scale. The repeatability is much better and the noise level is as low as 0.005% . To allow the sensor to be used for tide or ice thickness measurements, the pressure sensor is now available with an optional absolute accuracy of 0.1% . An AWAC with this option (available for new systems or as a factory upgrade for systems shipped after 1/1/2009) employs a series of non-linear correction terms to adjust the raw pressure readings.

Because the tidal variation is only a small fraction of the total pressure range, the accuracy of the tidal elevation is better than the absolute accuracy, typical values are better than 0.05% of full scale which corresponds to 2.5 cm for a 1 MHz AWAC and 5 cm for a 600 or 400 kHz AWAC.

Cabled online systems



Nortek can supply an «offshore cable» that has been tested with the AWAC at lengths up to 5000m. The cable has a very strong polyurethane jacket that is resistant to abrasion. The six conductors have been specified to comply with the AWAC power and communication requirements.

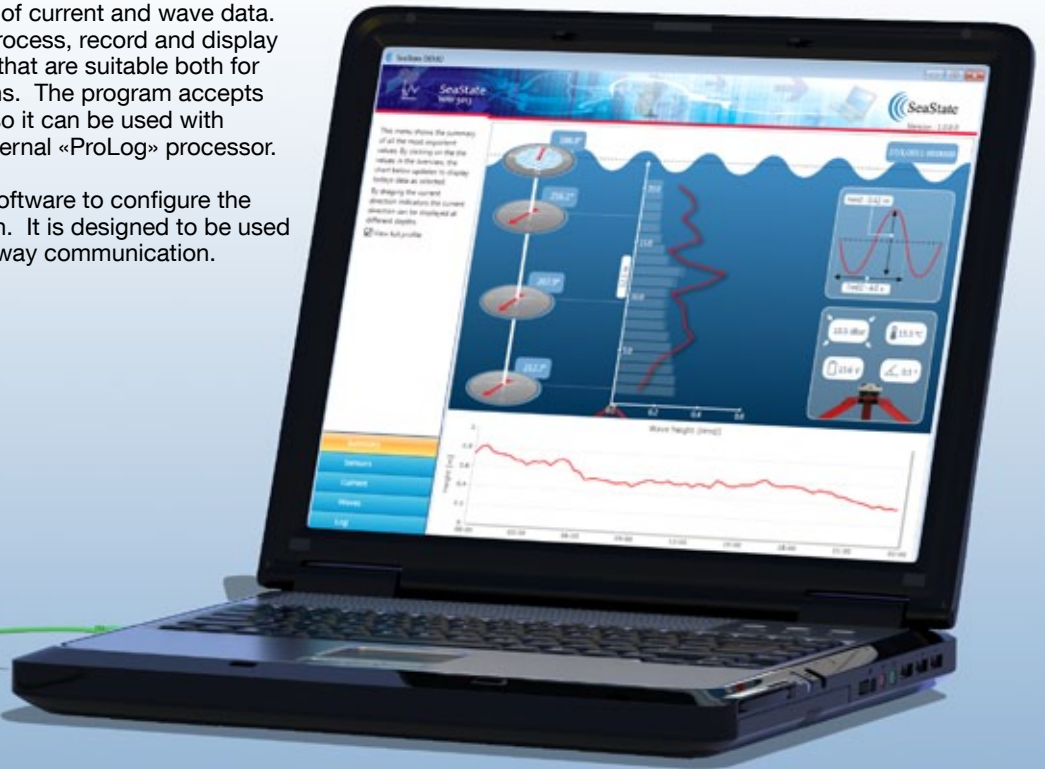
To supply power and RS422 over long cables, Nortek provides an interface box that can be powered from an AC adaptor and/or from a backup battery power supply on shore. The interface box protects the AWAC from surges in the power supply and converts the supply voltage to 48V. At the instrument end, a DCDC converter with suitable capacitance reduces the voltage back down to 15V and works in parallel with an optional external backup battery that can be installed to ensure continued data collection in the event of cable problems.

Online Systems

SeaState online software

SeaState 2.0 provides online display of current and wave data. The Windows software will collect, process, record and display data as a series of graphical images that are suitable both for engineering and scientific applications. The program accepts both raw and processed wave data so it can be used with AWACs both with and without the internal «ProLog» processor.

SeaState uses the standard AWAC software to configure the instrument and initiate data collection. It is designed to be used in configurations where there is two-way communication.



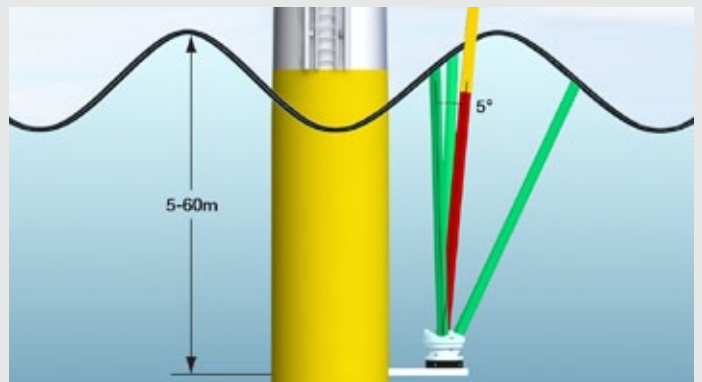
Ice thickness



Ice is a strong acoustic reflector and its submerged depth will show up in the echo from acoustic surface tracking ping. The nature of the echo is a little different from the echo from the free ocean surface and a special «ice tracking» algorithm has been implemented to track the vertical position of floating ice. With «ice tracking» activated in software, every second AST ping will be dedicated to ice detection.

Once the ice position is detected, the value can be subtracted from the pressure sensor reading and a first order estimate of the ice thickness can be derived. The ice thickness estimates can be improved by adjusting for the local atmospheric pressure.

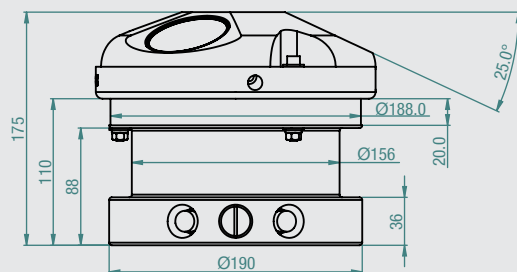
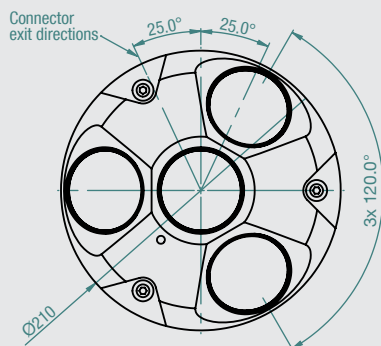
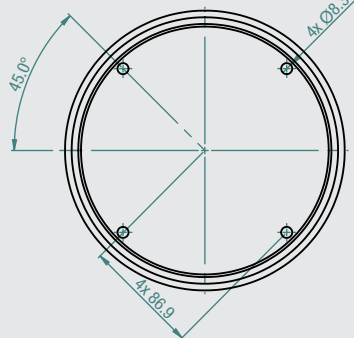
Platform head



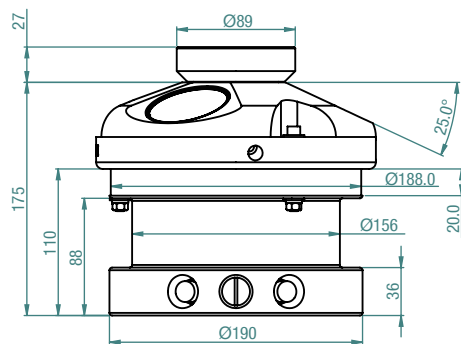
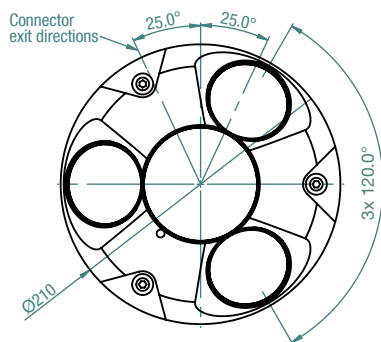
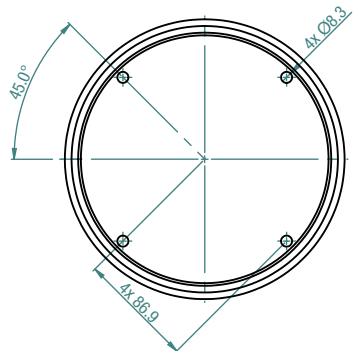
The AWAC Platform mount version permits the instrument to be mounted directly to an offshore structure, close enough to the surface for high quality wave measurements, yet be removed from the dangers of exposure at the surface.

The «Platform Mount AWAC version», employs four acoustic transducers asymmetrically arranged on one hemisphere to ensure that the beams point away from the mounting structure.

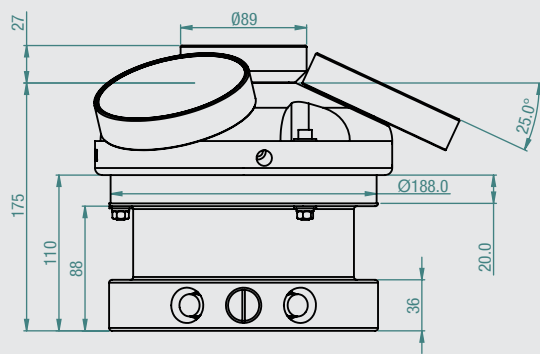
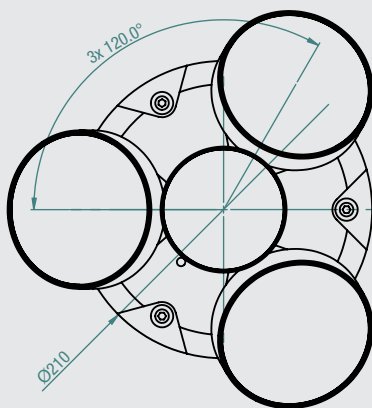
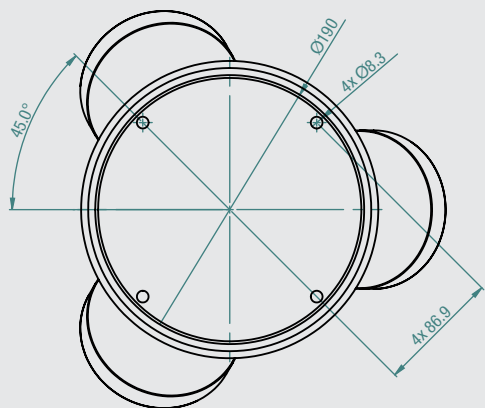
1MHz



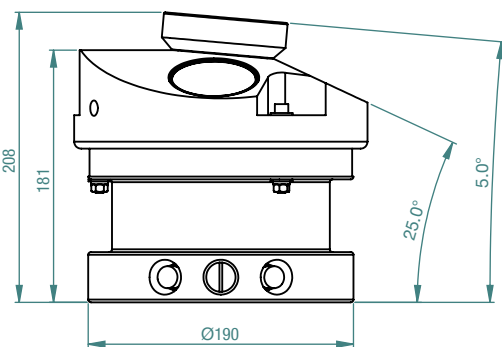
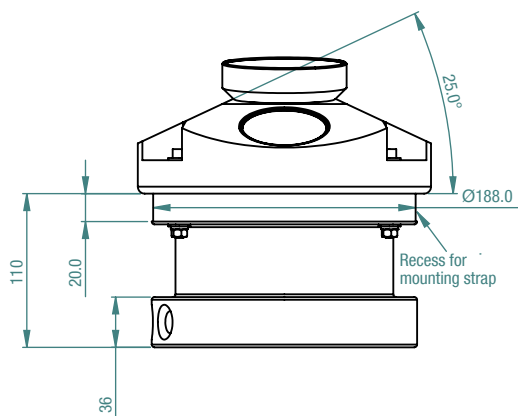
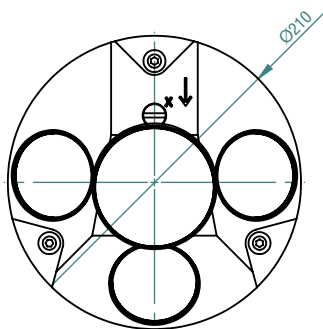
600kHz



400kHz



Platform Mount (1MHz and 600kHz)



System	
Acoustic frequency:	1MHz, 600kHz or 400kHz
Acoustic beams:	4 beams, one vertical, three slanted at 25°
Vertical beam opening angle:	1.7°
Operational modes:	Stand-alone or online monitoring

Current Profile	
Maximum range:	30m (1MHz), 50m (600 kHz), 100m (400kHz) (depends on local conditions)
Depth cell size:	0.25 – 4.0m (1MHz) 0.5 – 8.0m (600kHz) 1.0 – 8.0m (400kHz)
Number of cells:	Typical 20–40, max. 128
Maximum output rate:	1Hz

Velocity measurements	
Velocity range:	±10 m/s horizontal, ±5 m/s along beam
Accuracy:	1% of measured value ±0.5 cm/s

Doppler uncertainty	
Current profile:	1cm/s (typical)

Wave measurements	
Maximum depth:	35m (1MHz), 60m (600 kHz), 100m (400kHz)
Data types:	Pressure, one velocity along each beam, AST*
Sampling rate (output):	2 Hz velocity, 4 Hz AST* (1MHz), 1 Hz velocity, 2Hz AST* (600kHz), 0.75 Hz velocity, 1.5Hz AST* (400kHz)
No. of samples per burst:	512, 1024, or 2048. Inquire for options

Wave estimates	
Range:	-15 to +15m
Accuracy/resolution (Hs):	<1% of measured value/1cm
Accuracy/resolution (Dir):	2° / 0.1°
Period range:	0.5-100s (1MHz), 1 - 100s (0.6MHz), 1.5 - 100s (0.4MHz)

Depth(m)	cut-off period (Hs)	cut-off period (dir)
5	0.5 sec	1.5 sec
20	0.9 sec	3.1 sec
60	1.5 sec	4.2 sec
100	2 sec	5.0 sec

Sensors	
Temperature:	Thermistor embedded in housing
Range:	-4°C to 40°C
Accuracy/ Resolution:	0.1°C/0.01°C
Time constant:	<5 min
Compass	Magneto-resistive
Accuracy/Resolution:	2°/0.1° for tilt <15°
Tilt:	Liquid level
Maximum tilt:	30°, AST* requires <10° instrument tilt
Up or down:	Automatic detect
Pressure:	Piezoresistive
Standard range:	0–50 m (1MHz) / 0-100m (0.6MHz) / 0-100m (0.4MHz)
Accuracy:	0.5% of full scale. Optional 0.1% of full scale.
Resolution:	0.005% of full scale

Transducer configurations	
Standard:	3 beams 120° apart, one vertical
Platform mount:	3 beams 90° apart, one at 5°

Materials	
Standard:	Delrin and polyurethane plastics with titanium screws

Connectors:	
Bulkhead (Impulse):	MCBH-2-FS
Cable:	PMCIL-8-MP

Environmental	
Operating temperature:	-4°C to 40°C
Storage temperature:	-20°C to 60°C
Shock and vibration:	IEC 721-3-2
Depth rating:	300m

Dimensions:	
	See drawing on front page
Weight in air:	7.3 kg (0.4MHz), 6.2 kg (0.6MHz), 6.1 kg (1MHz)
Weight in water:	3.6 kg (0.4MHz), 2.9 kg (0.6MHz & 1MHz)

Analog Inputs	
Number of channels:	2
Supply voltage to analog output devices:	Three options selectable through firmware commands: • Battery voltage/500mA • +5V/250mA • +12V/100mA

Voltage Input:	0-5V
Resolution:	16 bit A/D

Data Recording	
Capacity(standard):	2 MB, can add: 32/176/352MB or 4GB
Profile record:	Ncells×9 + 120
Wave record:	Nsamples×24 + 1KB

Data Communication	
I/O:	RS 232 or RS 422
Communication baud rate:	300–115200
Recorder download baud rate:	600/1200 kBaud for both RS232 and RS422
User control:	Handled via «AWAC» software, or ActiveX® controls. «SeaState» for online systems.
ProLog:	Provides NMEA ASCII or Binary output formats for processed wave and current data.

Power	
DC input:	9-18 VDC
Peak current:	3A
Power consumption:	Transmit power: 1–30W, 3 adjustable levels
Sleep consumption:	0.3 mW (RS232) 5 mW (RS422)

Real time clock	
Accuracy:	± 1min/year
Backup in absence of power:	1 year

Offshore Cable	
The Nortek offshore cable can, when properly deployed, withstand tough conditions in the coastal zone. In RS 422 configuration, cable communication can achieved distances up to 5 km.	

Online Projects	
Nortek can provide long cables, radio/telephone communication equipment, acoustic modems, etc., that can meet the requirements of your specific project.	

*) AST = Acoustic Surface Tracking



TRUE INNOVATION MAKES A DIFFERENCE

NortekMed S.A.S.
Z.I. Toulon Est
BP 520
83 078 TOULON cedex 09
FRANCE
Tel: +33 (0) 4 94 31 70 30
Fax: +33 (0) 4 94 31 25 49
E-mail: info@nortekmed.com

NortekUK
Tresanton House
Bramshott Court
Bramshott
Hants
GU30 7RG
Tel: +44- 1428 751 953
E-mail: inquiry@nortekuk.co.uk

NortekUSA
222 Severn Avenue
Building 14, Suite 102
Annapolis, MD 21403
Tel: +1 (410) 295-3733
Fax: +1 (410) 295-2918
E-mail: inquiry@nortekusa.com

青岛诺泰克测量设备有限公司
地址: 中国青岛香港西路65号
汇融广场1302
邮编: 266071
Tel: 0532-85017570, 85017270
Fax: 0532-85017570
E-mail: inquiry@nortek.com.cn

Nortek B.V.
Schipholweg 333a
1171PL Badhoevedorp
Nederland
Tel: +31 20 6543600
Fax: +31 20 6599830
email: info@nortek-bv.nl