AWAC

Acoustic Wave And Current Profiler

CURRENT AND WAVE MEASUREMENTS IN THE OCEAN, LAKE AND LABORATORY

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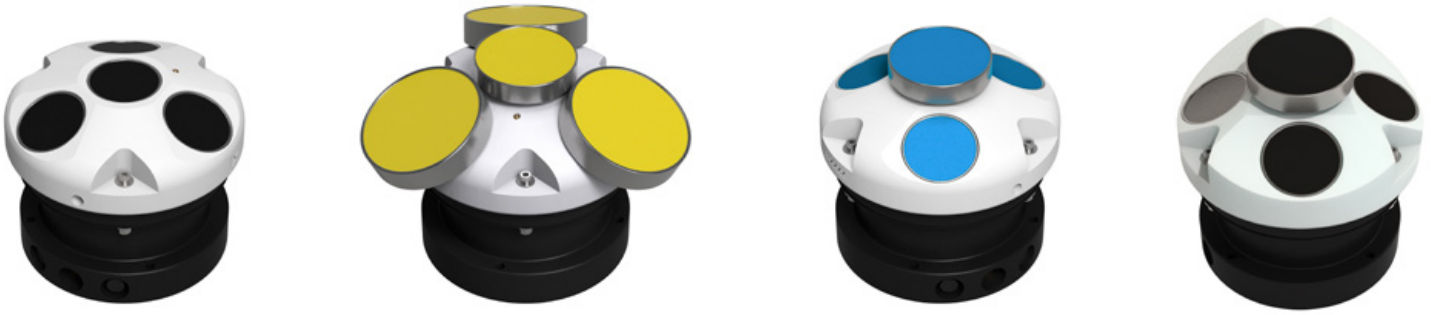
True innovation makes a difference

AWAC

A STANDARD IN OCEAN WAVE MEASUREMENTS

The Nortek Acoustic Waves and Currents (AWAC) sensor is a current profiler and directional wave system in one unit. Nortek has shipped more than 1700 AWACs worldwide since the launch of the first generation unit over a decade ago. The instrument has since revolutionized subsurface wave measurements.

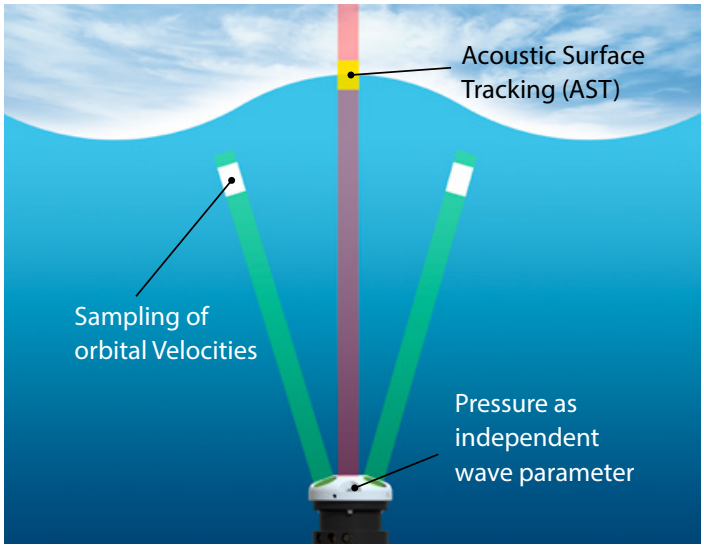


The AWAC is well suited for both autonomous data collection and as part of a real-time data telemetry system. Subsurface deployment means the instrument is always protected from harsh weather, vandalism, and ship traffic. The small, yet rugged instrument is suitable for multi-year operation in tough environments. Plastic and titanium parts avoid corrosion. The AWAC is available in three transmit frequencies for operational ranges spanning 2m to 100m.

Trusted Wave Measurements

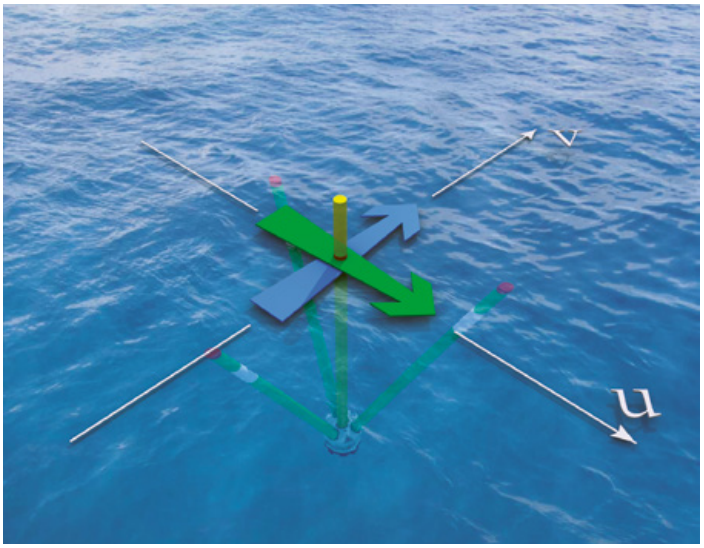
- The AWAC is in use for online and stand-alone applications all over the world. In Europe, researchers have employed dozens of AWACs to evaluate and improve coastal wave models. In Asia, port and harbor authorities trust AWACs to survive and provide excellent data during typhoon conditions. The AWAC has become a reference system for wave measurements after numerous meticulous comparisons with buoys.
- Nortek provides the AWAC as part of a turnkey solution for long-term monitoring. This includes durable connectors and long cables, integrated acoustic modems, a verified internal wave processor, and online processing and data display software.
- The AWAC of today has seen over a decade of development, continually being optimized with enhanced features. These include rapid pinging, narrow acoustic beams to provide the best time and space resolution, adaptive tracking algorithms to accommodate large variations in depth and low power consumption for long endurance deployments.
- The AWAC can be mounted in subsurface buoys to add wave measurements to long moorings or to avoid burial and excessive tilt in soft sediments. Nortek's validated and patented SUV technology (US patent 7,352,651) makes accurate wave measurements and high resolution surface currents attainable in deep water as well as areas with uncertain bottom conditions.

Wave Height



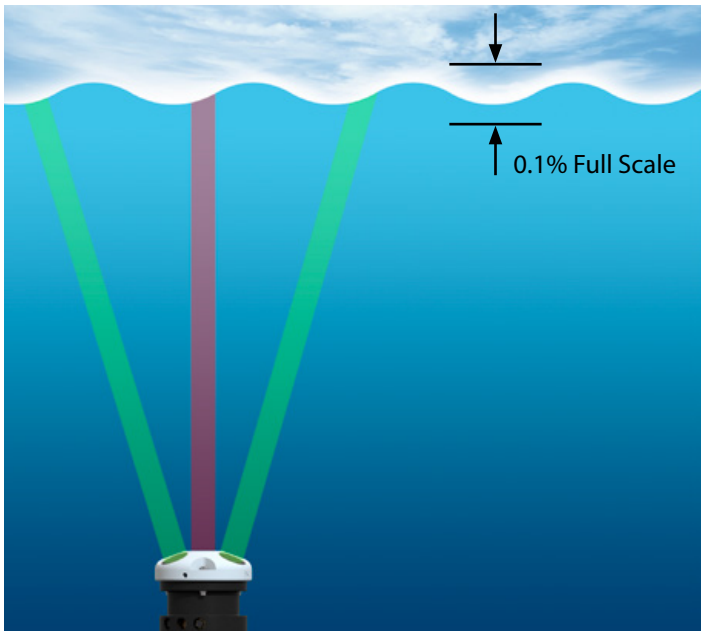
The AWACs extraordinary wave height measurements are a result of the extensively validated and optimized Acoustic Surface Tracking (AST) algorithms. AST estimates the distance to the surface by echo-ranging with the vertically oriented transducer. This method circumvents the depth limitations imposed by bottom mounted pressure and velocity measurements and allows the instrument to capture 1 to 50 second period waves. Moreover, AST gives you the ability to derive wave parameters based on times series analyses such as Hmax, H1/10, and Tmean. Time series analysis is included in the Nortek wave processing software.

Wave Direction



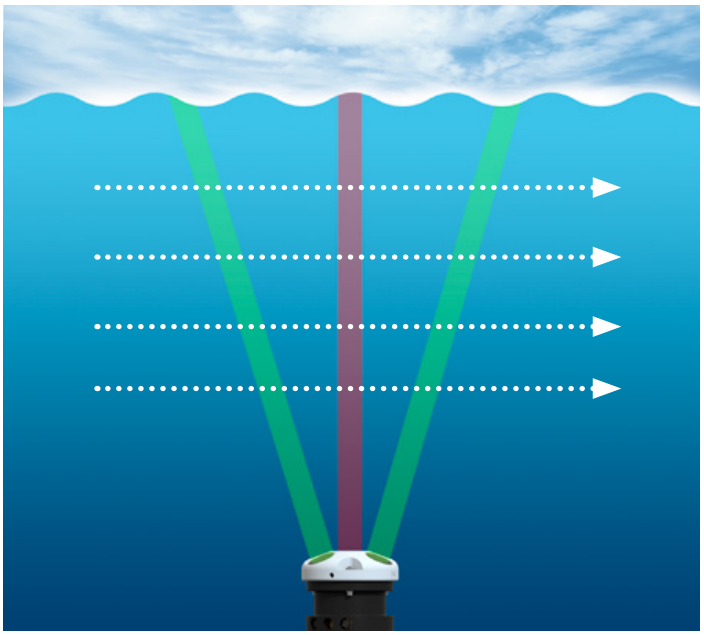
Wave direction is calculated by combining AST with orbital velocity measurements that have adaptively been sampled in a large cell located near the surface. If the AWAC is mounted in a non-moving frame or structure, Nortek uses the maximum likelihood method applied to the three velocities and the surface position to estimate all directional wave parameters and spectra. and spread. Nortek's patented SUV processing can be used to calculate all the same directional estimates from an AWAC on a subsurface buoy.

Tidal Elevation



The AWAC pressure data are suitable for measuring the tidal elevation from a fixed bottom mounted structure. Nortek recently extended the option to upgrade the AWAC pressure sensor to an absolute accuracy of 0.1% of full scale, or 5 cm for a 50 m sensor. This pressure sensor is temperature compensated and the tidal changes only span a small portion of the full-scale range. Therefore, accuracy of the change in tidal elevation is normally twice that of the absolute accuracy, or around 2.5 cm for a 50 sensor.

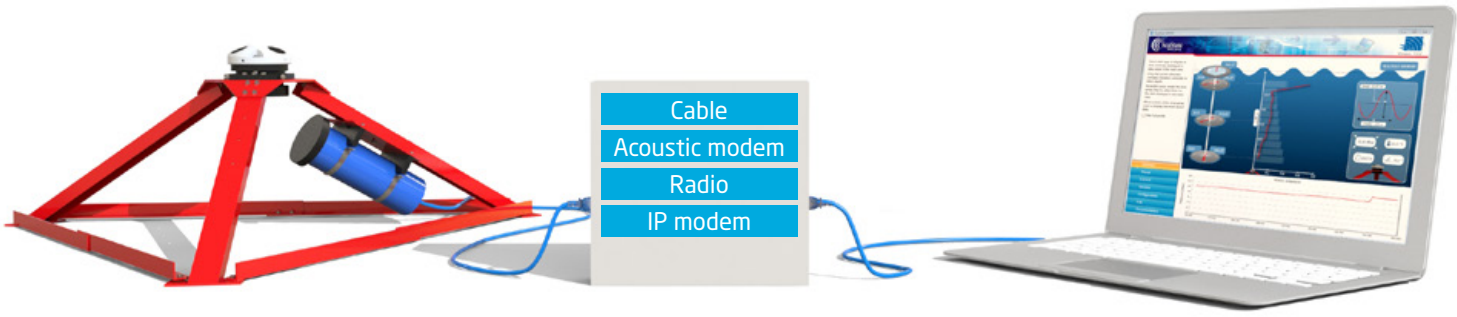
Current Profile



The AWAC uses the three slanted beams to measure the current profile over a range determined by the acoustic frequency. Large transducers transmit narrow acoustic beams and provide accurate data. The AWAC will alternate between wave data collection and current profiling. If the wave data collection is longer than the interval between current profiles, the AWAC will skip a current profile to ensure continuous wave data. Please contact Nortek if concurrent wave and current information is required.

Real-Time Data Collection

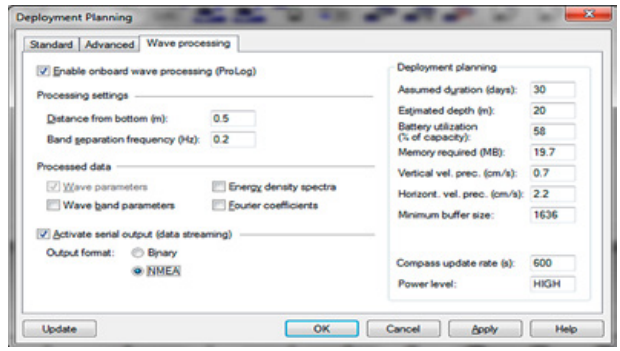
Most Nortek products can be used either in stand-alone or online mode. In stand-alone mode, data is collected to the internal recorder, and the power comes from external batteries. In an online system, data are transferred to a shore station using one or more communication links.



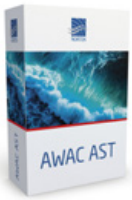
- **Cables:** Nortek provides rugged polyurethane cables with optional titanium connectors. Data may be transferred over cables of up to 5000m. An interface box installed on shore protects the AWAC from surges and converts the supply voltage to 48V. A DCDC converter in the instrument reduces the voltage back to 15V.
- **Acoustic modems:** In combination with the ProLog internal processor, it is possible to transfer wave and current data over short distances underwater using acoustic modems provided by Nortek.
- **Radio and IP modems:** Radio communication relies on line-of-sight and can be used to transfer AWAC data from an offshore buoy to shore or from a point along the coast further inland. In areas with adequate cellular communication, IP modems may be used to transfer data.
- **AOS:** It is possible to integrate the AWAC with the Nortek Autonomous Online System and view the resulting data in a hosted web environment.

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.



Nortek offers a full suite of software with the AWAC



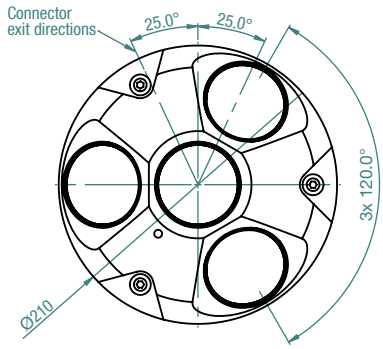
AWAC-AST is included with all AWAC deliveries. It features a simple interface used to configure the instrument for deployment, retrieve the data, and convert the raw data to ASCII.

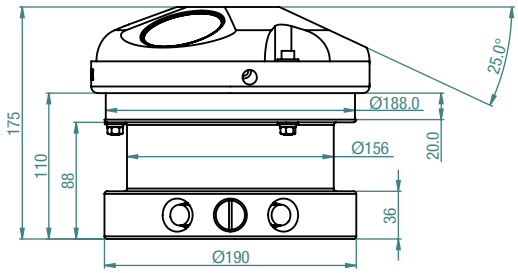
Quickwave provides the functionality of Storm in a non-graphical environment. A wave processing module embedded in a DLL is available for those who wish to write their own real time software.»

Storm provides a full graphical interface to view the raw wave data and current profiles, perform QA/QC, and plot the directional and non-directional wave parameters.

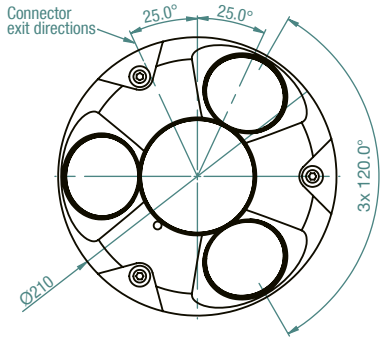
SeaState is designed for configurations where there is direct communication. It collects, processes, records and displays data in real-time as a series of graphical images, which are suitable both for engineering and scientific applications. SeaState accepts both raw data and processed wave data from a ProLog internal processor.

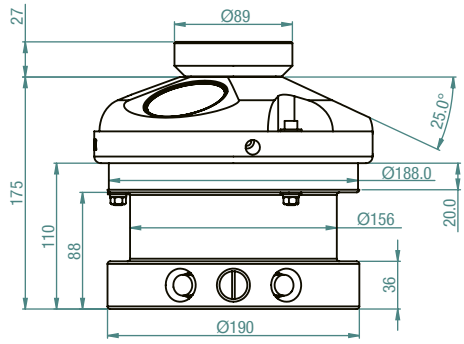
1MHz



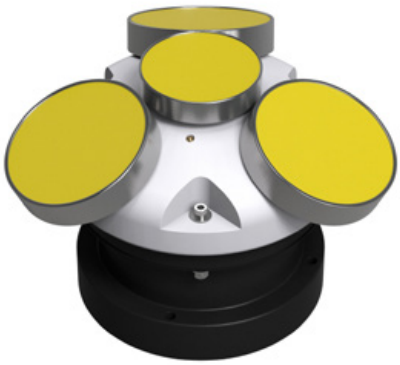


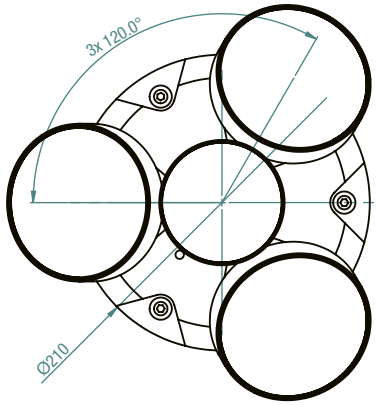
600kHz

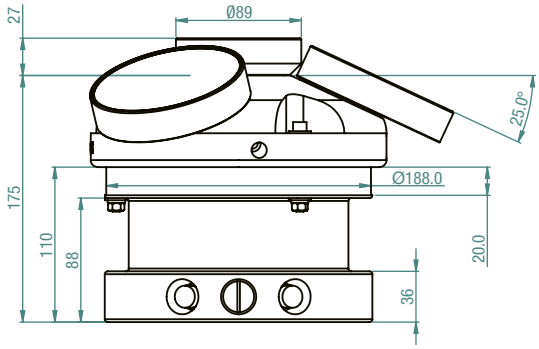




400kHz

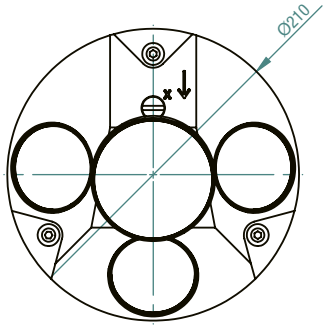


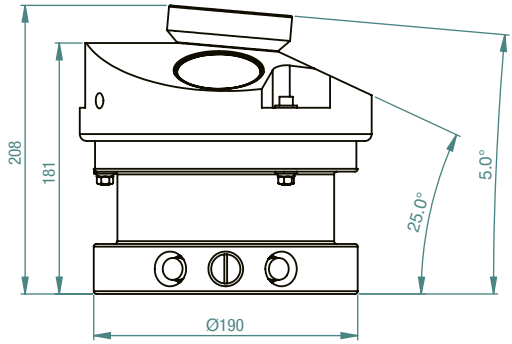




Platform Mount (1MHz and 600kHz)

Contact Nortek for additional transducer configuration options designed to mount on coastal, offshore, or marine renewable energy structures.





All dimensions in mm.

Technical Specifications

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)*
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
*)depends on local conditions	
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 - 50s (1MHz), 1 - 50s (0.6MHz), 1.5 - 50s (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	Magnetoresistive
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, MCBH-8-FS, optional Birns 3K-7-OR-CA
Cable:	PMCIL-8-MP, Optional Birns

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
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)
Canister for 2*36D pack with Alkaline batteries:	In air 17,2kg, in water 7,8kg
Canister for 2*36D pack with Lithium batteries:	In air 14,4kg, in water 5kg
Canister for 1*36D pack with Alkaline batteries:	In air 10,5kg, in water 4,3kg
Canister for 1*36D pack with Lithium batteries:	In air 9,1kg, in water 2,9kg
Analog Inputs	
Number of channels:	2
Supply voltage to analog output devices:	Three options selectable through firmware commands: • Battery voltage/500mA • +5V/250mA (default) • +12V/100mA
Voltage Input:	0-5V
Resolution:	16 bit A/D
Data Recording	
Capacity(standard):	9MB (standard), 4GB upgrade option
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.
Output formats:	Output formats: NMEA, Binary. Prolog provides same types also 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:	1 mW (RS232) 5 mW (RS422)
Real time clock	
Accuracy:	± 1min/year
Backup in absence of power:	1 year
Online Cable	
Polyurethane jacket, Shore D hardness, 13mm in diameter. Maximum RS422 communication distance 5km when used with interface box.	
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

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