

# ***GeoChirp 3-D***

## ***True 3-D Chirp Profiling System***

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### ***Introduction***

The 3-D Chirp System is the result of collaborative research between National Oceanographic Centre Southampton (NOC) and GeoAcoustics Ltd. The system is based around the GeoChirp II Profiling System transmitter and transducers, using a 2-D grid of receive elements fitted to a lightweight rigid hydrodynamically stable low noise surface towed array. The 3-D Chirp is the first commercially available system capable of generating high resolution (decimetric) true 3-D sub bottom data volumes in “real time” for shallow water applications. The generation of true 3-D volumes requires absolute centimetric positional accuracy, and this problem has been solved using a Real Time Kinematic (RTK) 3-D GPS system. The sonar receive array consists of a large number of separate sub-arrays, each with built in pre-amplifier, and a high bandwidth high resolution multi-channel digital acquisition & processing system.

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### ***Deck Unit***

The Deck Unit supplies power for each of the hydrophone pre-amplifiers as well as controlling multi-channel digital acquisition. Digitised raw data is stored and then processed in near real time. The deck unit is connected to the towed array using specially designed modular cabling. The Deck Unit also interfaces to the RTK GPS system, and stores this data with an absolute time stamp synchronised using the 1PPS GPS information. The Chirp processing, transmitter control, and data visualisation graphical interface runs on XP.

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### ***Towed Array***

The Towed Array is a “just below surface” two dimensional array of hydrophone elements housed in a streamlined platform. The transmit electronics and transducers are also fitted to this platform. The transmitter emits an acoustic swept frequency signal of precisely controlled frequency, amplitude and phase. The signal bandwidth can extend from 1.5 kHz to 13 kHz, allowing high penetration and high resolution to be simultaneously achieved. The source levels can be user controlled to meet even the most environmentally sensitive requirements. Each receiver element consists of several hydrophones integrated with a low noise pre-amplifier. A standard

array of 2.5m by 2.2m allows 60 receiver elements to be fitted. The array is modular allowing expansion to over 100 elements if required. Processing data from the array allows true 3-D data to be generated.



Unlike pseudo 3-D systems which use multiple 2-D slices of data and interpolation, the true 3-D system offers decimetre resolution in all three dimensions down to depths below sea bed of several tens of metres. Unlike sub-sea towed arrays, absolute positional accuracies to centimetre scale are achievable.

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### ***Standard System***

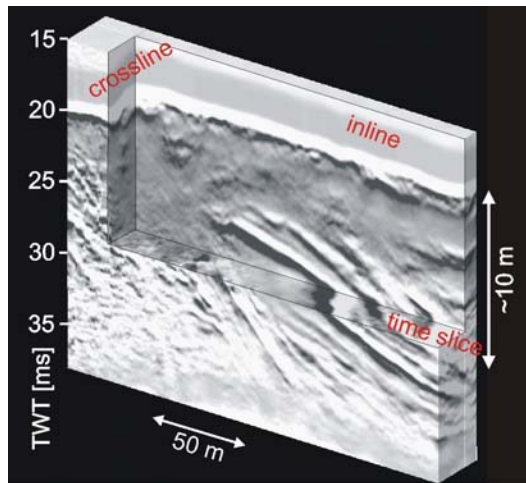
The standard system employs a rigid and robust but relatively lightweight towed array and cable lengths of up to 50 m. The system includes the following:

- Deck Unit, Digital data acquisition, storage and processing.
- RTK 3-D positioning system
- Towed array including GeoChirp II transmitter, and 60 receive elements.

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### ***Features***

- True 3-D data volumes
- Near real time display of data
- High resolution (decimetre) in 2-D and 3-D
- Accurate 3-D RTK positioning
- High penetration of consolidated sediments
- Relatively easy deployment and recovery
- Allows operation in very shallow waters
- High system bandwidth and resolution



Processed True 3-D Data Volume  
Berth 204 – Port of Southampton (2005)

## Specifications

### Deck Unit

#### General

Power requirements: 95-265VAC universal input, 40-60Hz, 500W, optional 24VDC  
Size: 42.8cm W x 48.8cm D x 27.5cm H  
Weight: 23.5kg  
Temperature: Storage: -20 to 75°C  
Operating: -5 to 50°C  
Humidity: 10% to 95% RH, non-condensing  
Mounting: The unit is suitable for either bench or rack mounting.

#### Tow Cable Link

Analogue differential or Gigabit Ethernet  
Cable length: 30m

#### Rear Panel Connectors

BNC: 1PPS key  
RS232/422: Six each for GPS/time/magnetometer etc  
Tow cable: Two each MS3102A-22-34S for deck cable

### Tow Platform

Tow speed: 1 to 6 knots  
Weight in air: 176kg  
Weight in water: Neutrally buoyant  
Dimension: 0.5m H by 2.5m W by 2.2m L, 4 GPS aerials protrude 1.5 m at corners  
Construction: Custom GRP sections, PVC and polyurethane foams & stainless steel

Specification sheet subject to change without notice  
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## Chirp Transmitter Electronics Pressure Vessel

### Transmitter Section

Standard High Power GeoChirp II

Frequency Range: 1.5kHz to >13kHz programmable  
Power Output: 10W to >4kW user programmable  
Source Level: 205dB  $\pm$ 3dB re 1uPa@1m  
Pulse Length: Typically 32ms, programmable  
Pulse Shading: Full amplitude control  
Pulse Repetition Rate: 8 pulses per second maximum  
Protection: Open and short circuit protected  
Efficiency: Greater than 90%  
Beamwidth: 30 to 90 degrees over sweep

### Receive Hydrophone Sections

Frequency Range: 200Hz to 25kHz  
Filter Type: High/Low pass 4<sup>th</sup> order linear phase  
Sensitivity: -205dB  $\pm$ 3dB re 1V/uPa  
Output: Differential signal  
Gain: x 8  
Noise: <3nV/ $\sqrt{\text{Hz}}$

### Timing

GPS 1PPS resolution: 20us

### Positioning

Position Accuracy: 5cm RMS x,y 10cm RMS z  
Heading Accuracy:  $\pm$ 0.2 degree RMS  
Heading Resolution: 0.01 degree  
Roll/Pitch Accuracy:  $\pm$ 0.4 degree RMS  
Roll/Pitch Resolution: 0.01 degree

### Magnetometer Interface

Power: 24VDC @ up to 10A  
Interface: RS232  
Baud rate: Up to 38.4 kbits/sec

### Digital Acquisition

Number of Channels: 60 (expandable)  
Sample Rate: 250kHz maximum per channel  
Sampling: Simultaneous all channels  
Resolution: 16 bit raw signal  
Processing Gain: >25dB  
Processing: Correlation (de-chirping) filtering and 3-D migration  
Single Channel "Slices" Real time  
3D Volumes: Near real time

## Options

- Magnetometer Interface
- Gigabit Ethernet Tow Cable Link
- Higher frequency transmit transducers for shallow sediment work

## Applications

- Buried object detection, location and visualisation
- Determination of sub-sea sediment properties
- Visualisation and tracing of sub sea layers
- Sub sea archaeological investigations
- Pipeline surveys