# MWD/LWD SYSTEMS

## ANCILLARY EQUIPMENT

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The AOM-35A is a premium, high accuracy 3-axis borehole surveying instrument designed for extreme downhole oilfield environments. Qualified to high temperature and drilling shock and vibration levels, the instrument is designed for reliability under the most demanding of environments.

The sensor utilises TruMag™, a novel 3-axis flux-gate magnetometer design and high grade quartz-hinge accelerometers for excellent precision and stability. Proprietary high reliability electronics packaging and printed circuit board mounting, provide an extremely robust instrumentation assembly with industry leading performance.

**AOM-35A ANALOGUE ORIENTATION MODULE**

**DOM-35A DIGITAL ORIENTATION MODULE**

The DOM-35A is a precision Digital Orientation Module, designed for direct compatibility with existing Tensor MWD systems and after-market replacement modules. The sensor is available in 150 and 175°C options and is designed to meet the most demanding and extreme conditions downhole. You can rely on Azimuth’s consistent high quality sensor performance when you need it most.

The sensor is based around high-grade quartz-hinge Accelerometers and an ultra-stable proprietary Magnetometer design, known as TruMag™ - the performance of which is unmatched in stability over temperature, shock and vibration. Coupled with high-temperature electronics and highly robust packaging, Azimuth delivers a premium Orientation Module, thoroughly tested and with industry leading performance – ready to improve your reliability in hole.

**Features**
- Proprietary high stability/accuracy flux-gate magnetometers
- Low power consumption
- Modular assemblies for ease of maintenance
- Robust and reliable assembly
- Analogue or digital options available
- Mechanical and electrical interfaces engineered to suit application
- Compatible versions for major MWD systems

**Applications**
- MWD/LWD Borehole Surveying
- Direct replacement of existing sensors
- OEM implementation in LWD systems
- Wireline directional surveying

**Benefits**
- Increased accuracy and stability
- Highly integrated and robust assembly
- Custom options
- Experienced and dedicated support team
- Collaborative approach to meet customers’ needs

**A791-714-3 Digital Orientation Module, DOM-35A-150**

**A933-954-3 Digital Orientation Module, DOM-35A-175**

**Features**
- Rugged chassis design
- Reliable 175°C operation
- Ultra-stable proprietary Magnetometers
- High-temperature surface mount electronics
- On-board Analog to Digital Converter
- On-board EEPROM K-Factor storage
- Low power consumption
- Independent Mag and Accel switching

**Applications**
- Drop-in Tensor replacement
- MWD/LWD Borehole Surveying
- OEM implementation in new MWD systems

**Benefits**
- Increased accuracy and stability
- Highly integrated and robust assembly
- Custom options
- Experienced and dedicated support team
- Collaborative approach to meet customers’ needs

**Products**
- A231-393-5 Analogue Orientation Module, AOM-35A-150
- A162-468-6 Analogue Orientation Module, AOM-35A-175
- AOM-35A DIGITAL ORIENTATION MODULE
The IOM-35A is the latest in a series of high-accuracy Orientation Modules from Azimuth. It incorporates a full processing unit to provide fully corrected and computed results in an easy-to-use manner for the customer.

The sensor utilises a proprietary flux-gate magnetometer design and high-grade quartz-hinge accelerometers for excellent precision and stability. High reliability electronics packaging and printed circuit board mounting, provide an extremely robust assembly with industry leading performance.

The unit communicates through a simple serial RS232, RS485 or CanBus interface, and is designed for extreme downhole oilfield environments. Qualified for high temperature and extreme shock and vibration levels, the sensor provides reliability under the most demanding of conditions.

**Features**
- Integrated microprocessor and fully computed angles
- Low power consumption
- Proprietary serial communications protocol
- Robust and reliable assembly
- Programmable communications protocol
- Mechanical and electrical interfaces engineered to suit application
- INC, AZI, TF, MTI, Temp, Gt, Ht, RPM and Rotation detection

**Applications**
- MWD/LWD Borehole Surveying
- Direct replacement of existing sensors
- OEM implementation in LWD systems
- Wireline directional surveying

**Benefits**
- Increased accuracy and stability
- Highly integrated and robust assembly
- Fully computed data
- Experienced and dedicated support team
- Simple interfacing for integration into MWD system
- Reliable hot-hole performance (available in both 150°C and 175°C options)

The µG MEMS sensor is the latest in a range of Azimuth sensors specifically aimed at advancing the technology of downhole directional measurements for the MWD market.

This sensor provides accurate and repeatable directional measurements using the latest in proprietary Azimuth MEMS Accelerometer technology, but partnered with our industry leading flux-gate Magnetometers. This hybrid of technologies means cost savings can be achieved for the end-user, but also improvements are delivered with increased robustness against high shock and vibration.

The µG MEMS sensor is qualified to 150DegC (302F), and tested under the same rigorous conditions expected of all Azimuth sensors. This new technology can be implemented in a wide range of sensor configurations, including DOM (Tensor type), AOM (Analogue) and the full IOM (Integrated Orientation Module) sensor configurations.

**Features**
- Reduced cost
- Reduced power consumption
- Multiple sensor configurations
- High-shock specification
- Robust Accelerometer design
- Accurate, repeatable directional measurements

**Applications**
- Drop-in Tensor replacement
- MWD/LWD Borehole Surveying
- OEM implementation in LWD systems
- Wireline directional surveying

**Benefits**
- Increased reliability in the field
- Lower cost of operations
- Reduced ‘downtime’
- Reduced LIH costs

**Products**
- A226-275-3 Integrated Orientation Module, IOM-35A-150
- A113-181-7 Integrated Orientation Module, IOM-35A-175
- A449-542-8 Integrated Orientation Module, IOM-35B-175
- A326-275-3 Integrated Orientation Module, IOM-35A-150
- A235-814-1 µG MEMS, DOM, 150C
- A945-977-7 µG MEMS, IOM, 150C
- A561-666-6 µG MEMS, AOM, 150C
The Mag-031A/Mag-023A are precision 2-Axis Flux-Gate Magnetometer Systems designed for use in high temperature and high shock and vibration environments for Dynamic Azimuthal scanning applications. When combined with MWD Survey information, the Magnetometer Systems can be used to accurately log sensor data Azimuthally whilst drilling.

The 2-Axis system consists of two single-axis Magnetometers, a Dual Channel Processing Board and a single Dual Channel Excitation Board. Specified for operation at a continuous temperature of 175°C, and a survival temperature of 185°C, the System operates from single +5V power supply with power consumption of less than 250mW.

**Features**
- Easy implementation for Azimuthal scanning
- Simple +5V power supply
- Low power consumption
- Robust sensor and electronics design
- High Temperature qualified
- Full calibration record provided
- Small footprint

RGM RUGGEDISED GAMMA MODULE

The RGM Ruggedised Gamma Sensor is a highly robust detector and electronics design, for use in the most demanding environments. Employing the unique method of oil-damping for the sensitive detector elements, the sensor can offer unrivalled reliability in high-shock environments.

Using oil-damping for the crystal and photomultiplier, the Gamma sensor can be exposed to shock and vibration levels that similar sensors cannot achieve. Specifically aimed at the high-shock market segment, the methods employed act to reduce the shock and vibration observed by the internal components – increasing lifetime and overall downhole reliability.

The sensor can be operated in most MWD systems and is designed to be drop-in compatible with existing 'Tensor type' MWD systems.

**Features**
- ‘Oil-Damped’ detector design
- Tensor type MWD compatible
- Highly ruggedized design
- High-shock specification
- Calibration traceable to API

**Applications**
- Drop-in Tensor replacement
- MWD/LWD and Near Bit
- High-shock wells/environments

**Benefits**
- Increased reliability in the field
- Lower cost of operations
- Reduced ‘down-time’
- Reduced Gamma repair budget
**Negative Pulse MWD Toolstring**

The Azimuth Negative Pulse MWD System is a new generation Directional/Gamma toolstring with the capability to support Resistivity data communications and transmission. Incorporating the latest technologies and features, this rugged and reliable fixed collar mount system ensures that reliability is delivered throughout the lifetime of the system. In addition to real-time shock and vibration, the system is also available with a 175°C operating temperature for hot-hole applications.

When your number one priority is reliability, and you value simple system set-up, then the Negative Pulse MWD System is the clear choice.

**Features**
- Easy set-up and configuration
- Adaptable to variable collar ID
- Real-time shock and vibration
- Diagnostic data recording
- Quick-connect couplers
- Gamma and Resistivity support
- Automatic TF Enable/Disable (Rotation Detection)
- High resolution Gamma data memory

**Products**
- A387-743-0 Toolstring, Negative Pulse, Directional, Single D, LP
- A387-437-1 Toolstring, Negative Pulse, Directional, Double D, LP
- A511-409-9 Toolstring, Negative Pulse, Directional, Single D, H
- A099-453-2 Toolstring, Negative Pulse, Directional, Double D, HP
- A789-239-6 Transmitter, Negative Pulse, Field Ready
- A831-422-8 3.5 Slim-Hole Pulser, STX

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**Negative Pulse Transmitter**

The Negative Transmitter is a reliable and proven MWD mud pulse module developed to work in the toughest conditions — including high mud weights and LCM. The transmitter is designed to operate over a wide range of collar sizes and flow rates, with low operating power and excellent reliability.

Coupled with the new high efficiency controller (APC), the transmitter ensures low power and reliable communications to the surface.

**Features**
- Robust and reliable data transmission
- Wide flow and pressure operating range
- High Temperature qualified (175°C Option)
- Battery efficient data transmission
- Direct flow on/off detection
- Easy adaptation to various sizes
- High force dual-solenoid drive
- Simple maintenance procedures
- 3.5" Slim-hole Transmitter option
- Up to 1.0deg/ft bending radius (Slim-hole)
Actuator Power Controller (APC)

The Actuator Power Controller (APC) is part of a new generation of advanced modules designed to be compatible with the Negative Pulse MWD System. The module contains highly efficient control electronics for the dual solenoid Negative Pulse Transmitter. Implementation of new technologies and proven methods delivers new features and specifications, coupled with the known robustness and reliability of the Negative Pulse system.

**Features**
- Dual Solenoid Transmitter Control
- ‘Active’ battery/power saving mode
- High temperature qualified (175°C Option)
- Proven/robust technology
- Low quiescent power consumption
- Geolink system compatible
- Up to 20Kpsi Pressure rating
- Support for fast data transmission

Survey Electronics Assembly (SEA)

The SEA module is a Geolink compatible Directional and Control unit, consisting of the AOM-35A Analogue Orientation Module, and new generation SEA Electronics Assembly. In addition to fully computed Directional data, the module provides 2-axis shock/vibration detection, mud-pulse signal encoding, rotation detection and Gamma/Resistivity tool communications control for the Negative Pulse MWD System. The module expands the capability of the Negative Pulse System, to include high temperature wells (175Deg Operating option).

**Features**
- High temperature qualified (175°C Option)
- Proven/robust technology
- Low quiescent power consumption
- Geolink system compatible
- Up to 20Kpsi Pressure rating
- Support for fast data transmission
- Shock and Vibration in Real Time
- Precision Orientation Module

Products

- A778-483-7 Actuator Power Controller, Field Ready
- A827-215-3 Survey Electronics Assembly, Field Ready
**Gamma Ray Module (SGR)**

A rugged scintillation based Gamma Ray Module designed for the toughest conditions. The module provides real time and memory storage of natural background Gamma radiation, serial communications, and a unique shock and vibration damping system to enhance the life of the sensor. The module is designed to be fully compatible with the Negative Pulse MWD System, but may be operated independently or in conjunction with other legacy MWD systems.

**Features**
- Real time data and Memory storage
- High temperature qualified (175°C Option)
- Stabilised measurement over temperature
- Serial communications
- Geolink system compatible
- Up to 20Kpsi Pressure rating
- Variable averaging
- Low battery voltage detect
- Fully calibrated

**Products**
- 9994-666-2 Gamma Ray, Standard, D Battery, Field Ready

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**MWD Surface System**

The Azimuth MWD Surface System provides a complete Directional and Gamma Depth logging system - fully compatible with the Geolink Negative Pulse system and Navigator Surface Software. The package contains four main elements - Surface Interface Box (SIB), Depth Tracking Unit (DTU), Communications Interface Module (CIM) and Rig Floor Display (RFD).

The new system provides a range of new features, such as enhanced display and easy to use firmware on the Depth system (DTU*), direct digital display of Standpipe Pressure and Internal Clock rate and full WITS Serial and Ethernet support for data distribution.

The Surface System units are designed to be modular for ease of maintenance, and packaged in field ready robust enclosures.

**Features**
- Full Geolink/Navigator compatibility
- WITS Serial and Ethernet support
- Intrinsically safe
- Robust transportation cases
- Automatic Depth tracking
- Compact/portable system
- Direct Standpipe Pressure measurement o/p
- HookLoad pressure Tx or Line Tensiometer
- Modular design for maintenance ease
- USB Interface

**Products**
- A515-068-5 Surface System, MWD, Directional
- A515-128-8 Surface System, MWD, Directional, Gamma

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*See individual module specification sheets for detailed description and data.*
Surface Interface Box (SIB)

The Surface Interface Box is a complete MWD mud pulse decoding and data distribution system. The unit incorporates sophisticated filtering techniques for reliable data decoding in high noise environments from the Standpipe Pressure Transducer.

The unit also provides support for a Rig Floor Display and WITS connectivity, including an Ethernet connection. The SIB is directly compatible with the Geolink surface and downhole system, and is supplied in a robust, modular case for reliable field use.

Features
- Digitally adjustable internal filter clock
- Direct Standpipe Pressure measurement output
- Internal/external pump synchronisation
- USB Interface to PC
- WITS Serial and Ethernet support
- Adjustable low-pass filters
- RFD and Depth Tracking Unit interfaces
- Robust modular units
- Intrinsically safe sensor inputs

Rig Floor Display (RFD) & Communications Interface Module (CIM)

The RFD and CIM combine to provide an Intrinsically safe and robust display system in a small footprint. A single umbilical to the Rig Floor provides power and communications, simplifying rig-up/down in the field. Both units are supplied in a compact and rugged case, and designed to be easily portable between sites.

Features
- Single umbilical (including power)
- Survey, logging and diagnostic data displayed
- Rugged construction
- Sunlight viewable
- Small footprint
- Modular construction (CIM)
- Highly portable
- Intrinsically safe

Products
A578-772-4 Rig Floor Display Termex
A198-683-1 Communications Interface Module
Depth Tracking Unit (DTU)

Using a combination of Hookload Sensor and a Rotary Encoder, the Depth Tracking Unit automatically tracks bit depth in drilling applications. The unit is designed to be directly compatible with the Geolink system, but may be operated independently as part of other MWD/LWD surface systems.

As a supplementary function, the unit also provides Instrinsically Safe power and serial communications for rig floor tool configuration and download.

Features
- Rotary Drawworks or Geolograph input
- Hookload pressure Tx or Line Tensiometer
- Modular package - maintenance ease
- Robust transportation case
- Bright display and entry pad
- Instrinsically Safe tool communications
- Drawworks layer compensation
- Advanced In/Out Slips algorithm

System Test Box (STB)

The System Test Box provides an simple means to check the Negative Pulse Toolstring modules and components. Modular parts can be substituted into the unit for a rapid assessment of their condition on the rigsite or workshop.

The unit is designed to match the downhole toolstring configuration in a logical layout - simplifying the testing and evaluation of modules.

Features
- Full toolstring testing facility
- Simplified toolstring layout
- Pressure pulse (SPP) output to STB
- Gamma simulator and test module
- Robust transportation case
- Portable unit

Products
- A581-152-2 Depth Tracking Unit
- A583-974-4 MWD STB-3 Assembly
The Azimuth Gamma Calibrator provides an easy and convenient method to maintain the accuracy and calibration of your Gamma sensors within specification. The calibrator is made from a particular Granite with a wide activity spectrum typical of many downhole formation conditions. The unit is traceable to API specification, easily transportable and requires no radiation control for use or shipping.

The Battery Monitor Box (BMB) provides a means to load test and de-passivate your Directional and Gamma batteries. The unit provides a facility to apply known loads to the battery cartridges and monitor the voltage output under those conditions. The Azimuth BMB provides clear digital voltage and current displays for dual or single battery polarities.

The Orientation Module Interface is designed for testing and evaluation of Digital Orientation Modules (Tensor type) operating on an SPI interface platform. Used in combination with a digital sensor, it provides facilities to quickly troubleshoot, conduct roll tests or reprogram the EEPROM containing the calibration coefficients within the sensor. The provision to reprogram the EEPROM memory allows greater flexibility for the user when operating multiple processor unit types.

The USB IOM Module Interface is designed to be used for communication with Azimuth Integrated Orientation Modules. The module provides a USB to RS232/RS485 or CanBus conversion, and a 30V power output derived from the USB. The unit requires no additional power and comes with an associated software application for IOM configuration, testing and settings adjustment.
The Rotary Depth Sensor couples directly to the Azimuth Depth Tracking Unit (DTU) and is a robust rotary encoder designed for use in hazardous areas. The unit connects directly to the drawworks, is fully ATEX approved, IP67 enclosure rating and designed for heavy duty applications such as MWD depth monitoring.

The Azimuth Hookload Line Tensiometer is designed to be fully compatible with the Negative Pulse Depth system. Measuring the Hookload on the dead line anchor, the HLT eliminates the need to connect a hydraulic sensor into system and simplifies the rig-up and rig-down process. The unit is designed to accommodate loads up to 75t, and available with operating ranges to 30t and 45t also. The unit is fully ATEX certified and sealed to IP67.

The Hookload Pressure Transmitter provides an option to measure the hookload by hydraulic means, in order to determine the ‘slips’ status. The transducer is all Stainless Steel construction, fully ATEX approved and IP68 enclosure rating – nominally rated at 1.5kpsi (other ranges available). The Hookload transducer is supplied with a robust flying lead tail with the appropriate connector for coupling to the Azimuth depth system.

The Standpipe Pressure Transducer is a robust 4-20mA output, 6kpsi pressure transducer suitable for direct coupling to the standpipe via a WECO Hammer Union. The hammer union Pressure Transmitter is fully ATEX approved, IP68 enclosure rating and can withstand extreme vibration and impact.

The sensor is also available as an electrically insulated Standpipe Transducer - designed to provide complete electrical isolation between rig and signal detection ground in your decoding system. This reduces the interference observed on the SPT signal in cases where rig electrical noise is significant.

### rotary depth sensor

- The Rotary Depth Sensor couples directly to the Azimuth Depth Tracking Unit (DTU) and is a robust rotary encoder designed for use in hazardous areas. The unit connects directly to the drawworks, is fully ATEX approved, IP67 enclosure rating and designed for heavy duty applications such as MWD depth monitoring.

### hookload tensiometer (HLT)

- The Azimuth Hookload Line Tensiometer is designed to be fully compatible with the Negative Pulse Depth system. Measuring the Hookload on the dead line anchor, the HLT eliminates the need to connect a hydraulic sensor into system and simplifies the rig-up and rig-down process. The unit is designed to accommodate loads up to 75t, and available with operating ranges to 30t and 45t also. The unit is fully ATEX certified and sealed to IP67.

### hookload pressure transmitter

- The Hookload Pressure Transmitter provides an option to measure the hookload by hydraulic means, in order to determine the ‘slips’ status. The transducer is all Stainless Steel construction, fully ATEX approved and IP68 enclosure rating – nominally rated at 1.5kpsi (other ranges available). The Hookload transducer is supplied with a robust flying lead tail with the appropriate connector for coupling to the Azimuth depth system.

### standpipe pressure transducer (SPT)

- The Standpipe Pressure Transducer is a robust 4-20mA output, 6kpsi pressure transducer suitable for direct coupling to the standpipe via a WECO Hammer Union. The hammer union Pressure Transmitter is fully ATEX approved, IP68 enclosure rating and can withstand extreme vibration and impact.

- The sensor is also available as an electrically insulated Standpipe Transducer - designed to provide complete electrical isolation between rig and signal detection ground in your decoding system. This reduces the interference observed on the SPT signal in cases where rig electrical noise is significant.
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