Marksman MRAMS (Marine Riser Angle Monitoring System) is a highly accurate solution for monitoring the differential angle between a riser and BOP in order to reduce excessive wear on wellhead components. Designed for use on both dynamically positioned (DP) and moored drilling rigs, Marksman MRAMS benefits from Sonardyne’s low risk, field proven 6G® acoustic technology to maintain an uninterrupted wireless data link between the vessel and BOP, even in the high noise environment typically associated with drilling operations.

**System Overview**

MARKSMAN MRAMS is part of Sonardyne’s 6G (Sixth Generation) product family. 6G systems use digital ultra-wide bandwidth acoustic signals offering fast, robust transmission of data, precise ranging and greater immunity to both environmental noise and interference from other acoustic systems operating nearby.

6G technology is simple and intuitive to operate allowing users to quickly gain confidence, thereby reducing risk. Low power electronics enable transponders to be deployed for extended periods, reducing the need for recovery to replace batteries.

An MRAMS system is configured from just four key components. The Navigation Computer manages the system and displays real-time riser and BOP angular data. This is connected to the Navigation Sensor Hub (NSH) which in-turn is connected to HPT, a hull-mounted acoustic transceiver. Together, the NSH and HPT transmit, receive and decode acoustic commands and sensor data from a pair of DPTi 6 transponders; one is mounted on the riser and the other mounted on the BOP. Each transponder is fitted with high accuracy, dual-axis inclinometers.

During drilling operations, the riser and BOP angles are continuously measured by each DPTi 6 and the differential riser/BOP angle calculated. The angles are transmitted
Marksman MRAMS
MARINE RISER ANGLE MONITORING SYSTEM

up to the vessel above using high speed digital acoustic telemetry, where they are received by the HPT transceiver, decoded, and then displayed on the bridge or drill floor. The vessel’s position and bearing relative to the BOP is also calculated and the information displayed to the dynamic positioning operator or barge engineer. They use the data to steer the rig and return the riser flex joint back to vertical.

**MRAMS integration with Marksman**
In addition to its stand-alone capability in accurately monitoring the riser and BOP differential angle during drilling operations, MRAMS integrates seamlessly with Sonardyne’s dynamic positioning (DP) reference system, Marksman, to provide reliable and accurate vessel positioning for mobile drilling units.

Using the same vessel hardware as MRAMS, Marksman calculates vessel position by measuring two-way ranges and horizontal and vertical angles between a transceiver on the vessel and a transponder array on the seabed. The system combines the performance of Long BaseLine (LBL) positioning, where accuracy is virtually independent of water depth, with the convenience of Ultra-Short BaseLine (USBL).

The combined technique, Long and Ultra-Short BaseLine (LUSBL), offers a high level of positional repeatability with a fast system calibration. The robustness and stability of the positioning solution has made Sonardyne Marksman systems the primary reference on many installations, particularly in fields off Brazil and West Africa where DGPS can be affected by scintillation (sunspot activity).

Marksman can be installed in single and dual independent configurations and is compatible with all makes of dynamic positioning system including; GE, Kongsberg, MT, Navis, Rolls-Royce and Wärtsilä.

**System Configuration**

**Bridge / Drill Floor Hardware and Software**
The MRAMS software running on the Navigation Computer interfaces to the vessel transceiver via the Navigation Sensor Hub. In addition, the NSH accurately time stamps incoming data from external reference sensors (where fitted) such as gyro, VRU and GPS. The equipment is typically installed close to the vessel’s dynamic positioning or mooring line control system, allowing operators to continually monitor the MRAMS system and manoeuvre the vessel accordingly. For moored rigs where a VRU, gyro or GPS input is not available, MRAMS is able to utilise the HPT’s own internal pitch and roll sensor or apply a manual heading input.

On command from the NSH, the HPT transmits an acoustic interrogation signal to each DPTi 6 requesting their current angle of inclination. The angles are measured, transmitted back up to the surface, decoded and displayed on the bullseye-style software display. If the differential angle between the riser and BOP exceeds a specified limit, MRAMS alerts the operator via an onscreen alarm. It also recommends a course heading for the rig to be steered in order to return the angle to an acceptable tolerance.

The Marksman MRAMS software is simple to learn, set-up and operate and allows users to get to work without delay.

**MRAMS Alarm Signal Tower**
Designed for installation on the drill floor, the MRAMS Alarm Signal Tower provides an audio and visual ‘traffic light’ system for warning operators when the angle between the riser and BOP surpasses the specified acceptable tolerance.
Vessel Transceiver

HPT is a combined acoustic positioning and modem transceiver which enables transponders to be accurately and precisely positioned.

Sonardyne’s directional HPT 7000 transceiver is recommended for when MRAMS is used on dynamically positioned vessels as it is optimised to receive transponder signals arriving within a ±50° cone below the vessel. Any noise generated outside of this area, for example by thrusters to the side, is significantly attenuated, therefore improving positioning accuracy. HPT 5000 is suitable for moored and acoustically quiet rigs.

Optimal HPT performance is achieved by ensuring that the mechanical installation of the transceiver is as rigid as possible. Sonardyne’s through-hull deployment machine has a stiff, one piece Inconel clad steel pole that hydraulically lowers and raises the transceiver through a gate valve. A sea chest with inspection hatch allows for ease of installation and cleaning of the transceiver. Sonardyne also offers a through-tube and over-the-side method of transceiver deployment.

Dynamic Positioning Transponder with Inclinometer (DPTi 6)

DPTi 6 is a 3,000 metre or 5,000 metre depth rated, high power directional transponder fitted with dual-axis internal inclinometers to accurately measure the pitch and roll motion of a subsea structure in real-time.

The DPTi 6 supports Sonardyne Wideband 2 acoustic ranging and telemetry protocols providing high accuracy positioning and robust performance in noisy and multipath conditions. These features help de-risk subsea operations and save vessel time and cost.

To ensure there is a clear line-of-sight acoustic communications path up to the surface, the DPTi 6s are mounted in ‘buckets’ on arms extending from the riser and BOP. Sonardyne’s design of transponder bucket simplifies maintenance procedures (e.g. battery changing), allowing DPTi 6s to be recovered, re-installed and aligned using an ROV whilst the stack is deployed.

Uninterrupted Monitoring

A major benefit of MRAMS is that riser and BOP angles can be monitored when high currents prevent the rig’s own ROV diving to inspect the BOP’s bullseye target.
MRAMS System Performance Summary

Operating Depth Range: 3,000 metres (5,000 metres option)
Frequency Band: Sonardyne Medium Frequency (18-36 kHz)
Acoustic Communications: Sonardyne Wideband®
- Robust two way communications
- 500+ unique channel
- High data rates
- Fast position updates

Transponder Sensors and Performance
- High Accuracy Inclinometer: Range: ±90°
  Accuracy: 0° to ±15° = ±0.05°; 0° to ±45° = ±0.2°
- Temperature: ±0.1°C
- Tilt Switch: ±30-45°
- Strain Gauge Pressure Sensor: ±0.01%
- High Precision Strain Gauge (Optional): ±0.01% (Presens or Keller)

Recommended External Reference Sensor Inputs
- Gyro, VRU, GPS

DP / Survey Output Telegram Format: Sonardyne 'PSONMRAMS'

MRAMS System Equipment List

Key: ● = Required ○ = Optional

- Software Marksman
- Marksman MRAMS
- Type 8026 Navigation Computer
- Type 8098 Navigation Sensor Hub
- Type 8198 Alarm Signal Tower
- Type 8142 HPT USBL Transceiver
- Type 7950 Deployment Machine
- Type 8301 DPTi 6 Transponders
- Type 8132 Mounting Bucket
- Type 8026 Navigation Computer
- Type 8098 Navigation Sensor Hub
- Type 8198 Alarm Signal Tower
- Type 8142 HPT USBL Transceiver
- Type 7950 Deployment Machine
- Type 8301 DPTi 6 Transponders
- Type 8132 Mounting Bucket

Other Drilling Systems from Sonardyne
- Marksman LUSBL
- Marksman DP-INS
- Emergency BOP Controller
- Downhole Data Logger
- Riser Profiling System

MRAMS Key Technology

Wideband 2®
Sonardyne Wideband is an ultrawide bandwidth signal architecture that delivers reliable acoustic navigation and telemetry of subsea data in all operating environments. The technology is proven to offer a host of benefits; fast and robust transmission of data, precise ranging, wide area coverage, mitigation from multipath signals and greater immunity to noise from vessels and other acoustic systems.

Battery Life
Do more for longer. 6G products are designed using the latest low power electronic architecture saving you time and money by not having to recover equipment to recharge or replace transponder battery packs.

Drilling
MRAMS integrates seamlessly with Sonardyne’s family of acoustic and inertial DP reference systems to provide reliable and accurate vessel positioning, integrated riser monitoring, down-hole data logging and backup control for BOP systems.

Inclinometer Sensor
Dual axis, high resolution inclinometers provide pitch and roll measurements of the transponder’s orientation when installed on a subsea structure, seafloor or BOP. Accuracy +/-0.05 deg.

Support
Need to get in touch? Sonardyne’s customer support team are available around the clock to get you the answers you need. From advice on which product to use to operational support, it’s all part of the service.