QUADRANS

Product Specification

IXBLUE
DEEP INSIGHT. SHARPER SENSES.

Document Revision History

Edition	Date	Comments
A	05/2017	Creation

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1   INTRODUCTION

This document contains the QUADRANS product specifications.

It provides information on the QUADRANS performance, environmental and dynamic conditions of use.

The QUADRANS is an **Attittude and Heading Reference System (AHRS)**. It delivers heading and attitude information to other systems and displays.

System Design

The QUADRANS is a state-of-the-art naval AHRS, designed to meet the demands of the navy for high performance AHRS.

The QUADRANS enables stealth autonomous navigation for surface or subsea applications, providing very accurate heading, roll, and pitch.

The QUADRANS is based on iXBlue fiber-optic gyroscope (FOG) technology, which has demonstrated superior reliability and navigation performance over many years and thousands of units. iXBlue navigation systems have been chosen as the primary and secondary gyros and INSs by the world's leading navies.

Due to the very high precision of its IMU, QUADRANS is subject to **export regulations.** See *General Information* document *(Ref.: MU-INS&AHRS-AN-007)* and *INS Interface Library (Ref.: MU-INSIII-AN-001)*) for details.

iXBlue's fiber-optic gyros are the result of more than 30 years of research and development, and they address the most demanding applications with performance from 0.1 deg/h to 0.001 deg/h.

Because of iXBlue's full in house mastery of all key FOG components (optical fiber, coil winding, modulator and source) along with advanced modeling of potential environmental sensitivity, iXBlue fiber-gyros are immune to temperature changes and magnetic perturbations and also resiliant to extreme shocks and vibration.

iXBlue has delivered more than 10,000 high performance gyros.

iXBlue FOG solutions have been selected by more than 30 navies, for a full range of vessels from attack craft to aircraft carrier or nuclear submarines.

Being a fully strap down system based on gyroscopes without any moving parts, QUADRANS requires no scheduled maintenance to provide the best performance during the full length of its lifetime. Its modern design integrating state of the art technologies (Ethernet, Web MMI, high baud rate, …) allows easy installation and interfacing to any ship's navigation and/or weapon system.

To deliver the best during operations, QUADRANS is designed to:

- Align at quay and also at sea
- Automatic latitude and speed correction

2   PRODUCT DOCUMENTATION

QUADRANS belongs to the iXBlue inertial products family. The following documents provide information that will be helpful in using your product in the best possible manner:

- **QUADRANS Product Specifications** *(Ref.: MU-QUADRANS-AN-010)* provides information about:
  - ❑ Product performance and settling time
  - ❑ Qualification standards and classification
  - ❑ Life cycle maintenance

- **QUADRANS Interface Control Document** *(Ref.: MU-QUADRANS-AN-011)* provides information about:
  - ❑ General interface specifications
  - ❑ Mechanical specifications
  - ❑ Electrical interface specifications

- **Inertial Products – General Information** *(Ref.: MU-INS&AHRS-AN-007)* provides information about:
  - ❑ Export Regulations
  - ❑ Warranty
  - ❑ Customer Support and iXBlue contacts

- **Inertial Products – Principles & Conventions** *(Ref.: MU-INS&AHRS-AN-003)* provides information about:
  - ❑ Abbreviations
  - ❑ Terminology
  - ❑ Behavior and operational principles
  - ❑ Geometrical conventions

- **Inertial Products – Installation Form** *(Ref.: MU-INS&AHRS-AN-004):* this document is a link between the installation process and the configuration process. It contains blank tables to be filled in.

- **Inertial Products – Network Set-up Guide** (*Ref.: MU-INS&AHRS-AN-005*) provides information about network configuration.

- **Inertial Products – Web-based interface user guide** (*Ref.: MU-INSIII-AN-021)* provides information about:
  - ❑ How to perform the software configuration of the product (which sensor is connected, to which port, …).
  - ❑ Operation: how to use the product.

- **INS – Interface Library** *(Ref.: MU-INSIII-AN-001)* provides information about all the input/output protocols that your product can use.

- **INS – Advanced Configuration** *(Ref.: MU-INSIII-AN-004)* provides all the configuration and monitoring commands which can be used during operation. These commands are sent directly through the repeater port.

- **Inertial Products – System Updater Tool User Guide** (*Ref.: MU-UPDTAPN-AN-001*) describes the procedure to update the QUADRANS firmware.

- **Inertial Products – IP Data Logger Tool User Guide** (*Ref.: MU-IPDATAPN-AN-001*) explains how to use the iXBlue data logger tool.

Depending of the use of your product, the following *Application Notes* can be useful for product installations:

- ❑ **Inertial Products – Application Note – Mechanical Integration of Inertial Systems** (*Ref.: MU-MECHAAPN-AN-001*).

- ❑ **Inertial Products – Application Note – Installation and Configuration of AHRS and INS for Seabed Mapping Measurements** *(Ref.: MU-HEAVAPN-AN-001).*

3 QUADRANS DATA

3.1 Data availability

QUADRANS provides the ship's navigation system and/or weapon system with full navigation data:

- Roll/Pitch and Heading
- Rate of turn and Accelerations (all three axis)
- True course
- Standard deviation of data
- Built In Test Status data

The exhaustive list of output data is detailed in the Interface Library manual document *(Ref.: MU-INSIII-AN-001)*.

Heave measurement/ Center of Gravity of the vehicle (COG)

QUADRANS can output real time heave measurement which provides heave in real time mode. To avoid the effect of transient vehicle/vessel movement on heave measurement, you can define the position of the center of gravity (COG) of the vehicle/vessel. In this case, QUADRANS will compute heave at the COG and add the heave induced by lever arms from the COG to external monitoring points. For more details see:

- *Inertial Products – Application Note - Installation and Configuration of AHRS and INS for Seabed Mapping Measurements (Ref.: MU-HEAVAPN-AN-001)*
- *INS – Marine applications – Web-based interface user guide (Ref.: MU-INSIII-AN-021)*

UTC/Time synchro

All data are accurately time stamped with respect to internal reference time (and can be synchronized to GPS time or any autonomous external clock, see below "Performance" section for accuracy details).

QUADRANS internal clock can be synchronized with data coming from an external reference clock (i.e., GPS clock or autonomous external clock). In this case, time is synchronized with the input coming from the selected interface with appropriate protocol.

For more details on time synchronization setting see *Inertial Products – Web-based interface user guide (Ref.: MU-INSIII-AN-021)*.

3.2   Latitude and speed correction

QUADRANS uses external sensor data to automatically compensate heading from latitude and speed correction factors.

The following external sensors can be connected to QUADRANS:

	External Sensors
GPS (UTC)	1
EM LOG	1

QUADRANS also allows the user to provide a manual input speed or latitude either at the start or during the navigation sequence.

For more details on:

- Electrical connection of the external sensors: refer to *QUADRANS Interface Control Document (Ref.: MU-QUADRANS-AN-011)*
- The configuration of the external sensors: refer to the *Inertial Products* – Web-based interface user guide (*Ref.: MU-INSIII-AN-021*).
- The available input protocols for external sensors: refer to *INS Interface Library (Ref.: MU-INSIII-AN-001).*

4 SPECIFICATIONS

4.1 Performance prerequisites

The performances listed hereafter are achieved at sea under the following conditions (which complements the environmental conditions stated in section 6).

- **Ship's motion does not exceed:**
  - ❑ Heading ± 10° sinusoidal 10 s period
  - ❑ Roll ± 40° sinusoidal 9 s period
  - ❑ Pitch ± 15° sinusoidal 6 s period

- **EM Log sensor:**
  - ❑ Log speed accuracy: 0.5 kt RMS (with respect to water)
  - ❑ Log sensor must only be used outside of harbors

4.2 Equipment Data Dynamic Range

Heading	0° to 360°
Roll	-180° to +180°
Pitch	-90° to +90°
Roll/Pitch/heading rate	±750°/s
Geodetic Latitude	90° S to 90° N
Geodetic Longitude	180° E to 180° W
Altitude (depth)[1]	up to 4000 m
Speed	Up to 80 knots
Linear Acceleration	±5 g

(1) *No limitation for negative altitude (depth)*

4.3 Navigation Data

Heading accuracy
0.23° seclat (RMS) 4 mrad seclat (RMS) 13.8 arc min seclat (RMS)
Attitude (Roll and Pitch or Vertical Reference) accuracy
0.1° (RMS) 1.7 mrad (RMS) 6 arc min (RMS)
Heave
10cm / 10 % whichever is higher

4.4 Input/Output

Baud rate	600 bauds to 460 kbauds
Data output rate[2]	0.1 Hz to 200 Hz
Data input rate	Up to 100 Hz (1 Hz typical)
Time stamping accuracy	< 100 μs

	Serial (All)	Ethernet 1	Ethernet 2
Jitter	< 200 μs	< 400 μs	< 800 μs
Fixed Latency	2.35 ms	2.95 ms	3.45 ms

	Input	Output	Configuration & Repeater
Serial RS232	2	2	1
Ethernet[3]	2	5	1
Max (Serial & Ethernet)	2	5	1
Pulse port	4	2	

Ethernet[3]	UDP / TCP client / TCP server
Pulse port	5 V (TTL level)
Input/ output formats	industry standards: NMEA 0183, ASCII, BINARY
Alarm pulse	Open collector output to drive a relay

(2)   200 Hz update rate for attitude data (Heading, roll, pitch, surge, sway). Update rate for position is performed at 100 Hz.
(3)   All inputs and outputs are available on the Ethernet link. Output can be duplicated both on serial and Ethernet port.
       QUADRANS supports the input of: GPS, Speed Log for ease of operation and full heading accuracy at high speed

4.5 Power supply

Power supply / consumption	24 V_{DC} (15 to 36 V) / < 15 W

4.6 Mechanical

Dimensions (l x w x h)	160 mm x 160 mm x 113,5 mm
Weight	2,5 kg

4.7 Export limitations

QUADRANS is a dual use product and is thus submitted to export limitations on the provided data, and to export restrictions to some countries (*Ref.: MU-INS&AHRS-AN-007*).

	Limitations
Rotation rate resolution	3.6°/h
Acceleration resolution	1mg
Heading, Roll, Pitch resolution	0.001°
Speed saturation	80 knots
Altitude saturation	4,000 m
Acceleration saturation	5 g
Rotation rate saturation	750°/s
Post-processing data output	Available

5 SETTLING TIME

5.1 Power up

Power up is automatic, as soon as current is applied to the system.

5.2 Restart or Power Down

Equipment can be restarted either through the Web MMI, in the maintenance menu or sending a start command. To power down the equipment, you need to disconnect it from its power source.

5.3 Initialization: Alignment Phase

The system must be initialized before it will provide fully accurate information.
This initialization is performed using external sensor data, during several phases.

5.3.1 COARSE ALIGNMENT

Coarse alignment phase is the first step of the alignment of the product.
Refer to Principle & Conventions (Ref.: MU-INS&AHRS-AN-003) for further detail on the coarse alignment phase.

5.3.2 COARSE ALIGNMENT AT QUAY

QUADRANS Coarse alignment can be performed at quay with latitude information.
In this case the EMLOG must be disabled as it is usually not reliable in the harbor (refer to section 4.1). The EM log can be set to ON again, once the vessel is out of the harbor.

5.3.3 COARSE ALIGNMENT AT SEA

The Coarse alignment can also be performed at sea with speed and latitude information. This alignment needs also to be aided by a speed sensor.
Refer to *Principle & Conventions (Ref.: MU-INS&AHRS-AN-003)* for further detail on the coarse alignment phase.

	GPS & EM Log
Data availability	5 min
Roll/Pitch 0,1° RMS	5 min
Heading 0,23° seclat RMS 12 arc min seclat RMS	30-45 min

6 CERTIFICATION & QUALIFICATIONS

Except where specifically stated, QUADRANS meets or exceeds the environmental conditions specified hereafter.

QUADRANS is certified with the International Maritime Organization for gyrocompasses and ISO 8728.

QUADRANS is certified with the International Maritime Organization for gyrocompasses for High Speed Craft and ISO 16328.

For any other certification request, please contact us.

6.1 Conformity to European and/or international legislations

This product applies to the applicable European directives.

Under the approach:

- The product is certified Marine Equipment Directive (MED). It has a wheelmark marking. In this way, it complies with the IMO resolutions and standards referred to in the directive. The product is systematically delivered with its declaration of MED conformity. This product category is "protected from the weather" (according to IEC 60945 §4.4 and to IMO resolution A694/5).

- The product applies with the essential requirements of the relevant European health, safety and environmental protection legislations. It has a CE marking. In this way, it complies with the relevant harmonized standards in relation to its applications. The EC declaration of conformity is delivered upon customer request.

- For the end-of-life product management, refer to section 7.3.

6.2 Qualifications

Temperature		
Operating	ISO 8728:2014(E), ISO16328:2014(E)	0 to +45°C
Transport and Storage	-40 °C to + 80 °C (7 cycles of 24h with steps at -40°c and 80°C)	
Vibration		
Vibration in operating	ISO 8728:2014(E), ISO16328:2014(E)	5-40Hz 0.51g sinus max
Magnetic Field		
Operating	1 Gauss	

7 LIFE CYCLE

7.1 Packaging, Handling, Storage, Transportation requirements

During storage and transportation, QUADRANS should be kept locked in its transportation packaging.

7.2 Built-in test

QUADRANS includes a Continuous Built-In Test (CBIT) that covers internal sensor status verification, system status and algorithm status The Interface Library document details the complete list of parameters that are monitored. Refer to *INS Interface Library (Ref.: MU-INSIII-AN-001)* for further detail.

7.3 Reliability & maintainability

Due to the technology used in its design, QUADRANS is a fully strapdown / solid-state equipment. It does not use any gas filled cavity that could leak nor any moving mechanical part that would wear out.

As a consequence, QUADRANS does not require any kind of preventive maintenance.

The QUADRANS does not have any life limited parts and as such, QUADRANS has no predicted life limitation.

The entire QUADRANS is the Line Replacement Unit (LRU).

MTBF		
Operational	Based on in-the-field repair statistics	100,000 Hours

7.4 End-of-life product management

When the product is at the end of its life, it must be returned to iXBlue where it will be oriented to a treatment facility appropriated to WEEE.