**NAVIGAT 2100 Fiber-Optic Gyrocompass and Attitude Reference System**

**Fiber-Optic Sensor Unit (without cover)**

**NAVIGAT 2100** is Sperry Marine’s unique Fiber-Optic Gyrocompass and Attitude Reference System in digital, solid-state, fully electronic, strapdown technology for marine navigation and control applications.

This state-of-the-art product was also designed for high-speed, fast-maneuver vessels, and its compact size makes it ideal for integrated bridge configurations.

The fundamental principle of the fiber-optic gyrocompass is the invariance of the speed of light and the so-called Sagnac effect. Here, a fiber-optic coil is used as a very sensitive rate sensor, which is capable of measuring the speed of rotation of the earth. A combination of three such fiber-optic coils (also called fiber-optic gyroscopes) and a dual-axis electronic level sensor can be used to determine the direction of true north. From the three rate-of-turn signals (about the x, y and z axes) and the information from the electronic level sensor, a complex Kalman filter computes the direction of the rotation of the earth from which geographical north is derived.

**Cover: SuperSpeed II, equipped with NAVIGAT 2100 & NAVIGAT X MK 1 Gyrocompass Systems.**

Designed in strapdown technology, the fiber-optic gyrocompass sensor is attached directly to the vessel, eliminating the use of a gimbal system. This arrangement provides heading information and also roll, pitch and rate of turn about all three axes (x, y and z).

The fiber-optic gyrocompass can also be used as a sensor for ship stabilizer systems, not only on merchant marine vessels but also on catamarans and hydrofoils. The extremely short settling time of only 30 minutes is of great advantage for fast ferries.

The very high dynamic accuracy in all conditions at all latitudes coupled with the absence of any north speed error much increase the safety of all vessels, particularly so on high-speed craft at high latitudes during frequent maneuvers at high speed.

The fiber-optic gyrocompass is a complete solid-state design with no rotating or other moving parts. It has high reliability (MTBF) and is maintenance-free during its service life.

In addition to the sensor unit, a basic NAVIGAT 2100 system comprises a control and display unit and an interface and power supply unit (see page 5). Analogue and digital repeaters and other peripheral equipment are supplied with output data through serial interfaces.

It is also possible to expand the system by adding a NAVITWIN IV Heading Management System with a second gyrocompass (NAVIGAT 2100 or NAVIGAT X MK 1) and/or a transmitting magnetic compass system (TMC).

The NAVIGAT 2100 is the ideal solution for High-Speed Craft such as the STENA VOYAGER.
The North-Seeking Element

The north-seeking element of the NAVIGAT 2100 gyrocompass system is the fiber-optic sensor unit. It is a solid-state design with no moving parts. Designed in strapdown technology, it is attached directly to the vessel, eliminating the use of a gimbal system. The sensor unit contains three fiber-optic rate sensors, a dual-axis electrolytic level sensor, a navigation processor unit and a power supply.

The three rate gyros are arranged orthogonally and measure thus the rotation of the sensor unit about a vessel’s x, y and z axes. The electrolytic level sensor measures the inclination of the x and y axes relative to the horizontal.

This configuration is known as an “analytical platform.” On the basis of the vessel-referenced sensor data and the external speed and position (lat. & lon.) inputs, the navigation processor uses a complex Kalman filter algorithm to determine the direction of true north.

To initialize the Kalman filter parameters, a so-called alignment procedure is carried out when the system is energized. During the alignment procedure and during normal operation, the system continually and simultaneously performs two essential tasks which make it north seeking, namely horizontal alignment and north orientation. After power-up, the system establishes a virtual plane, the so-called inertial plane.

By processing the data from the external speed and position inputs, the system is able to calculate the component of the earth’s rotation which acts on the virtual horizontal plane and in so doing determines the rate at which the horizontal plane has to be inclined to maintain it in a position horizontal to the earth’s rotating surface.

By evaluating the plane’s movement over time, it is possible to determine the direction of true north. This is accomplished by mathematically rotating the plane until the earth’s rotation will no longer cause its north-south axis to incline.

Since horizontal alignment and north orientation are carried out continually, the NAVIGAT 2100 is not subjected to loss of accuracy due to the effects of drift that occur in other inertial navigation systems, such as those used in aviation which merely summate the changes in attitude over time.

By transforming the data from the rate sensors, the system is also able to determine how the movement of the vessel and the earth’s rotation act on the virtual horizontal plane.

By evaluating the plane’s movement over time, it is possible to determine the direction of true north. This is accomplished by mathematically rotating the plane until the earth’s rotation will no longer cause its north-south axis to incline.
Major Features

- No moving parts.
- No maintenance during service life.
- High dynamic accuracy 0.7° secant latitude under all conditions.
- Very short settling time.
- Heading, roll, pitch and rate sensor.
- Meets all IMO recommendations including high-speed code.
- High MTBF > 40,000 hours.
- Compact and low weight design.
- Low power consumption.
- Data transmission by serial interface.
- NMEA 0183 FAST output.
- RS 422 SUPER FAST output.
- Will drive a maximum of 12 analogue repeaters.
- Self-synchronizing repeater compasses.
- Additional analogue outputs for all rate-of-turn signals.
- Automatic emergency power changeover to GMDSS.
- Independent, short-circuit proof repeater outputs.
- Built-in test equipment.
- Basic system comprises only three units.
- Type approved to the High-Speed Craft Code in accordance with EC Council Directive 96/98/EC.
- The rate-of-turn output is type approved to the High-Speed Craft Code in accordance with EC Council Directive 96/98/EC and also fulfills IMO Resolution A.526(13).

Control and Display Unit

The control and display unit features a large multicolour display (TFT LCD) on which the following data is shown:

- True heading.
- Speed, manual or auto.
- Position in LAT and LON.
- Date and time, manual or auto.
- All system associated alarms.

Liberty of the Seas, passing under the Great Belt Bridge in Denmark, is equipped with a complete Sperry Marine Integrated Bridge System incorporating a dual NAVIGAT 2100 Fiber-Optic Gyrocompass System.
**NAVIGAT 2100 Basic System**

**SYSTEM CONFIGURATION**

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**Sensor Unit**
- RS 422
- 24 VDC Power Supply

**Interface and Power Supply Unit**
- 115/230 VAC
- 18-36 VDC
- 200 pulses/nm
- RS 422 or NMEA 0183

**Control and Display Unit**
- Navigation data printer
- Status

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**Accessory Equipment**
- Universal Digital Repeater
  - Weight: 1 kg with cable
- Bearing repeater compass with 360° card in a bulkwork console
  - Weight: 10.3 kg
- Prismatic azimuth device PV 23
  - Weight: 1 kg
- Bearing repeater compass with 360° card in a stand with azimuth device PV 23
  - Total weight: 16.1 kg
- NAVIPRINT
  - Weight: 8 kg
- Bulkhead repeater compass with 360° card
  - Weight: 2.9 kg
- Console repeater compass with 360° card
  - Weight: 1.5 kg
- Steering repeater compass for console mounting with 360° and 10° compass cards
  - Weight: 1.5 kg
PERFORMANCE (under all conditions)

**Heading**  
≤ 0.7° secant latitude

**Roll/pitch angle**  
≤ 0.5°

**Rate of turn**  
≤ 0.4°/minute

**x/y rate**  
≤ 0.4°/minute

Secant latitude = 1/cosine latitude


**RANGE**

**Heading**  
0° to 360°

**Roll & pitch (optional)**  
±45° (±180° with reduced accuracy)

**Rates (X, Y, Z)**  
±80°/sec.

**SETTLING TIME**

**Static conditions**  
≤ 30 minutes

**Sea conditions**  
≤ 45 minutes

**Rate of turn**  
≤ 4 minutes

**ENVIRONMENTAL CONDITIONS**

In accordance with EN 60945 (IEC 945+A1)

**Ambient temperature**

Operation  -15°C to +55°C

Storage  -35°C to +70°C

**SIGNAL OUTPUTS**

- NMEA (TTL) heading output  12 repeaters
- NMEA (TTL)  2 all data
- NMEA (RS 422)  2 all data
- NMEA (RS 422) FAST  1 HDG, ROT, ROLL, PITCH
- NMEA(RS 422) SUPER FAST  1 all data
- 6 steps/degree  2 heading outputs (24 VDC/0.25 A each)
- Analogue ±10 V  3 rate signals
- Analogue 4 to 20 mA  1 rate signal

**SIGNAL INPUTS**

- Position  NMEA 0183
- Speed  NMEA 0183/200 pulse/mm (max. 100 kts)

**POWER REQUIREMENTS**

115/230 VAC 50/60 Hz and/or 24 VDC (18 V-36 V)  
Includes automatic switcher to 24 V emergency power supply in accordance with GMDSS Rules for INMARSAT/SES Terminals.

**POWER CONSUMPTION**

- Startup and operation (DC)  45 W
- Each repeater compass  7 W

**DIMENSIONS**

- Sensor Unit  
  Width  292 mm  
  Depth  340 mm  
  Height  170 mm  
  Weight  11.5 kg

- Reduced magnetic clearance to  
  standard magnetic compass  0.80 m
  steering magnetic compass  0.65 m

- Magnetic clearance to  
  standard magnetic compass  0.50 m
  steering magnetic compass  0.40 m

- Protection grade  IP23

**CURRENT CONSUMPTION**

- 115 VAC  450 mA
- 230 VAC  225 mA
- 24 VDC  1.9 A

**OVER 200 LOCATIONS WORLDWIDE**

Sperry Marine, with worldwide headquarters in Charlottesville, VA, and major engineering and support offices in Melville, NY, New Malden, England, and Hamburg, Germany, is part of the Northrop Grumman Electronic Systems sector.

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