# SI-TEX®

## Owner's Guide & Installation Instructions

## Heading Sensor
### with Rate Gyro and Accelerometer

## Model HDK-11
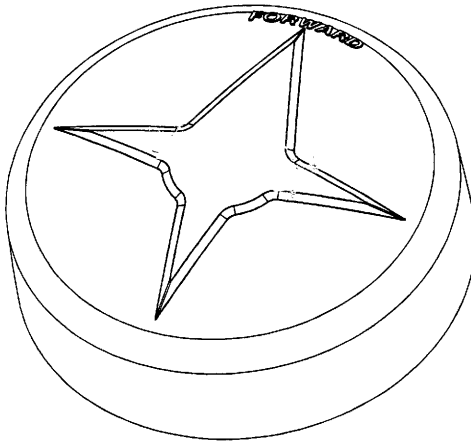
> **IMPORTANT**: Please read the instructions completely before proceeding with the installation. These instructions supersede any other instructions in your instrument manual if they differ.

## Introduction

Thank you for purchasing the **SI-TEX** solid-state Heading Sensor. This exciting product is actually three sensors in a single unit—a three-axis magnetic compass, a three-axis accelerometer, and a three-axis rate gyro. The compact housing is waterproof with a single removable cable. Data is output in digital NMEA 0183 and NMEA 2000® formats.

## Functions

- Magnetic compass heading
- Angle of vessel pitch (attitude)
- Angle of vessel roll (attitude)
- Rate of Turn

## Features

- Waterproof housing
- Waterproof cable system
- Fast response time
- Simultaneously outputs data in NMEA 0183 and NMEA 2000® formats
- Stable and accurate data in dynamic conditions
- Can be programed to compensate for an installation that is not aligned to the bow of the vessel and/or level
- Can be calibrated to compensate for magnetic deviation caused by ferrous metals and other electro-magnetic fields
- Bracket or flush mount

# Table of Contents

**WARNING: Correct Installation Important**

The Heading Sensor must be installed and operated according to the instructions in this owner's guide. Failure to do so may result in poor product performance, damage to the boat, and/or personal injury.

**WARNING: Compass Safe Distance**

The compass safe distance for standard and steering compasses is 1.2m (4'). Observe this distance from ferrous metals and anything that can create a magnetic field to prevent interference to the magnetic compass. Failure to do so may result in poor product performance, damage to the boat, and/or personal injury. Do not install in a steel vessel (magnetic hull). Use Airmar's model GH2183, a combination GPS and compass that can be mounted above the deck.

**WARNING: Calibrating the Compass**

The internal compass must be calibrated. Failure to do so may result in inaccurate compass readings, contributing to damage to the boat and/or personal injury.

**WARNING: Electrical Safety**

The power supply voltage must be 12VDC (±3VDC). Any other voltage may damage the product and/or result in fire, damage to the boat, and/or personal injury.

**WARNING: Fuse or Circuit Breaker**

A safe installation requires a 1 amp fast-blow fuse or circuit breaker. Failure to do so may damage the product and/or result in fire, damage to the boat, and/or personal injury.

**WARNING: Installation Safety**

Always wear safety goggles and a dust mask when installing to avoid personal injury.

**CAUTION: Disassembly**

Do not disassemble the sensor. Removing the screws from the sensor (part A) will damage the waterproof seal, thus voiding the warranty.

**IMPORTANT: Battery**

Make power connections to a 12 VDC power source that is isolated from the engine start battery(s). Voltage drops may cause the Heading Sensor to lose information and/or change operating mode.

# Cables & Converting/Connecting Hardware

The Heading Sensor can be connected in several ways. **You must have the correct cable and any needed hardware before beginning the installation.**

## Sensor Cables

*NOTE: Additional cable lengths are available.*

| | | |
|---|---|---|
| • NMEA 0183 Cable | 10m | Part No. 33-862-02 |
| • NMEA 2000® Cable | 6m | Part No. 33-1029-02 |
| • NMEA 2000® Cable | 10m | Part No. 33-1029-06 |

## Converting/Connecting Hardware

| | | |
|---|---|---|
| • NMEA 0183 to USB Converter | | Part No. 33-801-01 |
| • NMEA 0183 Combiner | | Part No. 33-800-01 |
| • NMEA 2000® CAN to USB Gateway | | Part No. 33-727-01 |
| • NMEA 0183 & NMEA 2000® Splitter | 15m | Part No. 33-641-02 |
| • NMEA 0183 & NMEA 2000® Splitter | 30m | Part No. 33-641-03 |

### Tools & Materials

Safety goggles
Dust mask
Torpedo level
Pencil
Electric drill
Drill bits and hole saws:

| | |
|---|---|
| Pilot hole | 3mm *or* 1/8" |
| Bracket screw holes | 4mm, #23, *or* 9/64" |
| Flush mount stud holes | 6mm *or* 1/4" |
| Flush mount cable hole | 38mm *or* 1-1/2" |

Phillips screwdrivers
Marine sealant (aluminum hull)
Loctite® 242® *or* other removable thread locker (Flush Mount installation)
Deck gland (some installations)
Grommets (some installations)
Cutting pliers (some installations)
Heat-shrink tubing (some installations)
Wire strippers (some installations)
Cable ties (some installations)
Multimeter

### Where to Purchase Parts

Obtain parts from your instrument manufacturer or marine dealer. Lost, broken, or worn parts should be replaced immediately.

## Choosing the Mounting Location

**WARNING**: Do not install the Heading Sensor H2183 in a steel vessel (magnetic hull). For a steel vessel, use Airmar's model GH2183, combination GPS and compass that can be mounted above the deck.

For accurate readings, selecting the best location for the sensor is very important. It can be mounted on either a vertical or a horizontal surface. Choose a location that balances the requirements below.

- Mount the Heading Sensor as close to the boat's center of gravity as possible. The lower it can be mounted, the more stable it will be, thus giving more accurate compass readings.
- Mount near the center of the vessel's fore-aft axis. This will give more accurate pitch and roll readings. Avoid the areas near the bow and the stern.
- To prevent interference to the magnetic compass, mount the sensor 1.2 m (4') away from any structures or equipment that contains ferrous metals. *Do not install in a steel vessel (magnetic hull).*
- To prevent interference to the magnetic compass, mount the sensor 1.2 m (4') away from anything that may create a magnetic field such as: magnetized materials, electric motors, electronic equipment, power/ignition cables, and batteries.
- Choose a surface with minimal vibration for more stable data.
- Mount reasonably level with the waterline for accurate pitch and roll readings.
- Be sure the cable(s) can be routed to reduce electrical interference from other electrical wiring and any on-board equipment with strong magnetic fields such as radar equipment, radio transmitters, boat engines, generators, etc. Separate the cables by at least 1 m (3').

# Installing

**WARNING**: Always wear safety goggles and a dust mask to avoid personal injury.

**CAUTION**: The word "FORWARD" on the sensor must be facing forward and parallel to the centerline of the boat for accurate compass readings.

**CAUTION**: Mount the sensor near the center of gravity of the boat and reasonably level with the waterline for accurate pitch and roll readings.

**IMPORTANT**: Plan the cable route between the sensor and the display and/or network before beginning the installation.

## Mounting on a Vertical Surface
### Mounting the Bracket

1. At the selected mounting location, draw a level line using a torpedo level (see Figure 1).
2. Holding the bracket even with the level line, trace the outline of the two vertical slots. *Do not mark the location of the two interior screw holes at this time.*
3. Using a 3mm or 1/8" bit, drill the pilot holes in the CENTER of the slots. This will allow you to adjust the bracket up and down.
4. Using a 4mm, #23, or 9/64" bit, drill the two mounting holes.
   **Fiberglass**—Minimize surface cracking by running the drill in reverse until the gelcoat is penetrated.
5. Lightly fasten the bracket to the mounting surface with two of the stainless steel screws supplied. Place the torpedo level on the top of the bracket. Adjust the bracket until it is level. Tighten the screws.
   **Aluminum hull**—Apply marine sealant to the threads of all four stainless steel screws before fastening them in place. This will prevent electolytic corrosion between the dissimilar metals.
6. Using a 3mm or 1/8" bit, drill the pilot holes for the two center screws. Then use a 6mm or 1/4" bit to drill the holes.
7. Fasten the remaining two stainless steel screws in the center holes to lock the bracket in place.
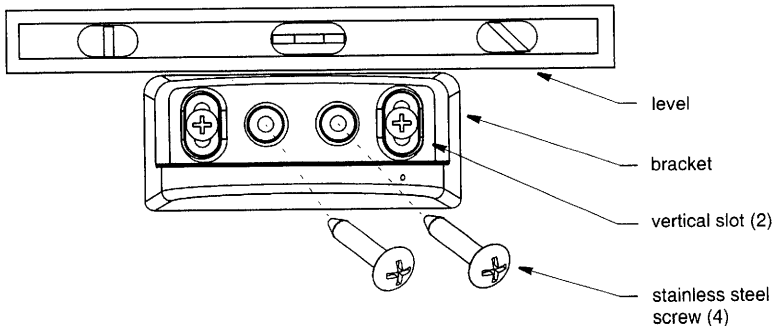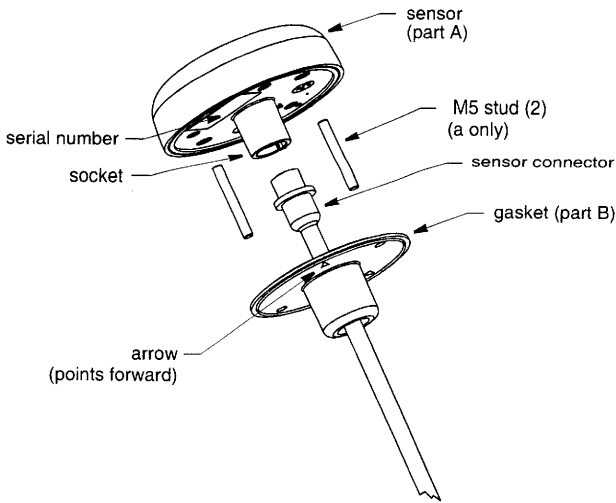


Figure 1. Mounting the bracket

Figure 2. Preparing the sensor

## *Preparing the Sensor*

1. Remove the label from over the sensor's socket (part A) (see Figure 2).
2. There are two ways to attach the sensor to the bracket. Choose either a or b.

   **WARNING**: Do not use the studs if there is any danger that a person may be injured by the protruding metal.

   a. **Studs**—It is easier to install and adjust the sensor using the M5 studs. However they will protrude about 20mm (3/4") below the bracket after installation. Apply *removable* thread locker to the two studs. Screw the studs into the underside of the sensor.
   b. **Screws**—Omit the studs. After the sensor is aligned in the bracket, use the brass machine screws supplied to fasten it in place. The sensor will be flush with the bracket when the installation is complete.
3. Remove the protective cap from the *sensor* connector on the cable. (Save the cap to protect the connector, when the sensor is removed.)
4. Pass the *instrument* connector-end of the cable through the center of the gasket.
5. Plug the sensor connector firmly into the sensor. It fits one way only.
6. Push the gasket (part B) against the sensor (and onto the studs if applicable). Be sure to orient the gasket so that the groove fits over the alignment tab on the connector and the sensor's socket. The screw holes in both the sensor and the gasket must be aligned. (It may be helpful to hold the gasket in place with double-sided tape.)

   *NOTE: The arrow on the gasket will face the same direction as the word "FORWARD" on the sensor.*
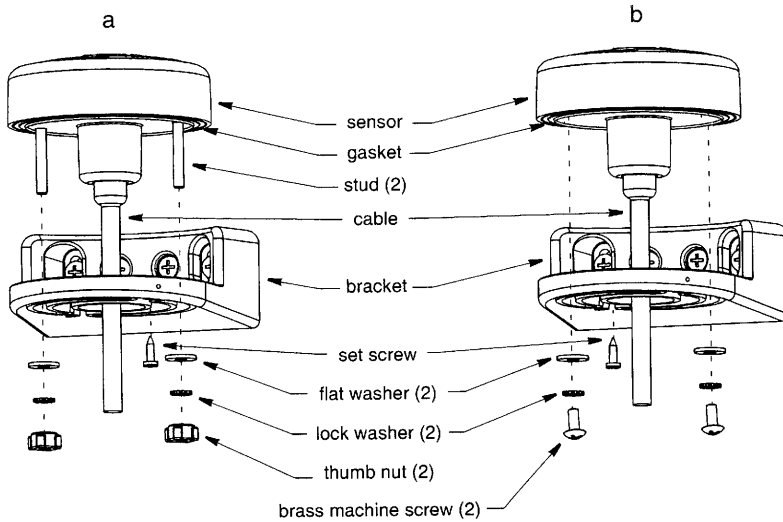
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Figure 3. Installing the sensor in the mounting bracket

### *Attaching the Sensor to the Bracket*

1. Feed the cable through the mounting bracket (see Figure 3).
2. Align the word "FORWARD" pointing forward and parallel to the centerline of the boat while holding the gasket firmly against the sensor.
   a. **Studs**—Push the studs through the mounting bracket. Fasten the sensor to the bracket with a flat washer, a lock washer, and a thumb nut (with the metal side against the washer) on each stud. **Hand-tighten** only. *Do not* over tighten.
   b. **Screws**—Place the sensor on the bracket, being sure the screw holes in both the sensor and the gasket are aligned. From the underside of the bracket, fasten the sensor with the two flat washers, lock washers, and brass machine screws supplied.
3. Be sure the word "FORWARD" on the sensor is pointing forward and parallel to the centerline of the boat. To prevent the sensor from rotating after it is aligned in the bracket, fasten the 1/2" pan-head set-screw into the most convenient of the two alternative holes.

## Flush Mounting on a Horizontal Surface

1. Remove the label from over the sensor's socket (part A) (see Figure 4).

2. Apply *removable* thread locker to the two studs supplied. Screw the studs into the underside of the sensor.

3. Using a torpedo level, check that the mounting surface is reasonably level. If necessary, use shims to level the surface or choose another mounting location.

4. Using the gasket (part B) as a template, position it at the selected mounting location *upside down with the arrow facing forward and parallel to the centerline of the boat.* Mark the position of the two mounting holes and the center cable hole.

5. Using a 3mm or 1/8" bit, drill the pilot holes. Using a 6mm or 1/4" bit, drill the two mounting holes for the studs. Drill the cable hole with a 38mm or 1-1/2" hole saw. **Fiberglass**—Minimize surface cracking by running the drill in reverse until the gelcoat is penetrated.

6. Pass the *instrument* connector-end of the cable through the center of the gasket and down through the center mounting hole in the boat.

7. Plug the sensor connector firmly into the sensor's socket.

8. Orient the gasket with the arrow facing in the same direction as the word "FORWARD" on the sensor. Push the gasket onto the studs and slide it over the connector.

   *NOTE: The gasket fits one way only. A groove in the gasket fits over the alignment tab on the connector.*

9. With the word "FORWARD" pointing forward and parallel to the centerline of the boat, push the studs through the mounting surface. *Check to be sure the gasket is tucked under the lip of the sensor.* From underneath the mounting surface, slide a flat washer and lock washer onto each stud. Fasten them with the thumb nuts: metal side touching the washer. **Hand-tighten** only. *Do not* over tighten.
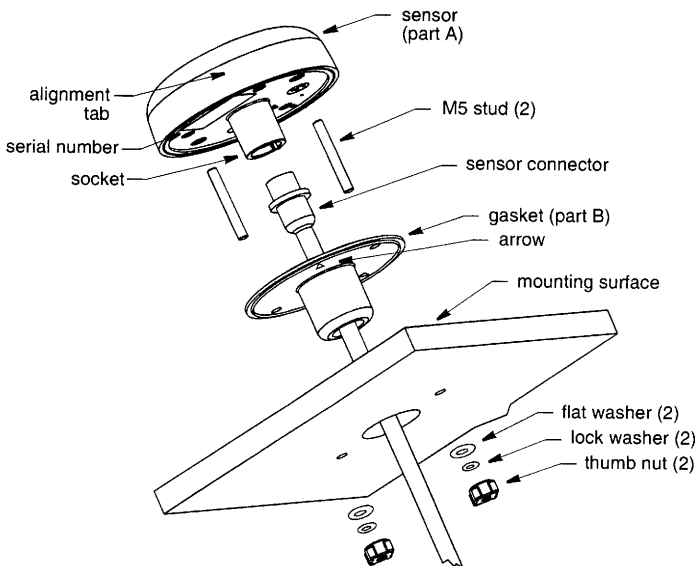


Figure 4. Flush mount

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# Cable Routing & Connecting Guidelines

**WARNING**: Always wear safety goggles and a dust mask to avoid personal injury.

**CAUTION**: To reduce electrical interference from other electrical wiring and any on-board equipment with strong magnetic fields such as radar equipment, radio transmitters, boat engines, generators, etc., separate the cables by at least 1m (3').

**CAUTION**: Do not remove the waterproof connector(s) to ease cable routing. If the cable must be cut and spliced, use Airmar's splash-proof Junction Box No. 33-035 and follow the instructions supplied. Removing the waterproof connector or cutting the cable, except when using a water-tight junction box, will void the sensor warranty.

**CAUTION**: Be careful not to tear the cable jackets when passing them through bulkheads and other parts of the boat. Use deck glands and grommets to prevent chaffing.

**CAUTION**: Use a multimeter to check the polarity and the connections to the 12 VDC power supply before applying power to the sensor.

**CAUTION**: Coil any excess cable(s) and secure with cable ties to prevent damage.

## Connecting to an NMEA 0183 Display

1. Route the sensor cable to the display. *Do not fasten the cable in place at this time.*
2. Connect the sensor to the display in one of two ways.
   a. **Connector**—If your sensor cable has a connector on the display end, and it can be plugged into the port on your NMEA 0183 display, do so now. Coil any excess cable and secure it with cable ties to prevent damage. Fasten the cable in place.
   b. **No connector**—If your sensor cable does not have a connector on the display end, it must be hard wired. Refer to the owner's manual that came with your display and connect the colored wires as shown in the table below and Figure 5.

| Sensor Function | Sensor Cable Wire Color | Display Function |
|---|---|---|
| NMEA input A/+ | Yellow | NMEA output A/+ (see Note 2) |
| NMEA input B/– | Orange | NMEA output B/– |
| NMEA output A/+ | White | NMEA input A/+ |
| NMEA output B/– | Blue | NMEA input B/– |
| 12 VDC + | Red (see Note 1) | 12 VDC + (see Note 3) |
| 12 VDC –/ground | Black | 12 VDC –/ground |
| Shield | Bare | Shield |

**NOTE 1**: *The sensor must be supplied with 12 VDC (±3 VDC) at 0.5 amp.*

**NOTE 2**: *If your display does not have NMEA 0183 output connections, the yellow and orange wires are not needed and their ends should be taped separately. (Alternatively, yellow and orange wires can be connected to an external sensor.)*

**NOTE 3**: *The display power may be wired directly to the sensor cable, or it may be wired separately.*

## No Connector—Wiring

1. Allowing an extra 25 cm (10") for wiring ease, cut the cable to length.
2. Strip 60 mm (2-1/2") of the outer jacket and foil shielding from the cut end of the cable (see Figure 4).
3. Strip 10 mm (3/8") of conductor insulation from the end of each colored wire.
4. Protect the cable's foil shielding from causing a short by using heat-shrink tubing around the jacket where the wires emerge from the cable. The tubing must overlap the wires a minimum of 6 mm (1/4").
5. Connect the wires to the display (see Figure 5).
6. Fasten the cable in place.
7. Your installation is complete. To begin receiving data, refer to the owner's manual that came with your display.
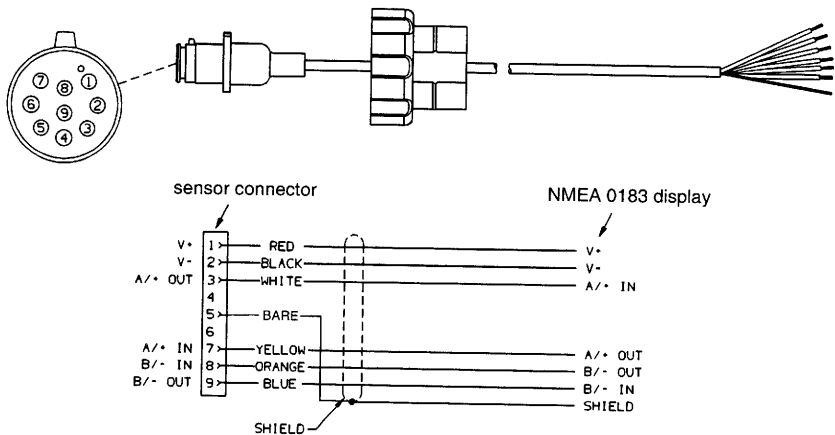


Figure 5. NMEA 0183 Sensor Cable

# Connecting to an NMEA 2000® Network

**CAUTION**: Only two termination resistors are required on an NMEA 2000 network. More than two will degrade the bus performance.

Route the sensor cable to the NMEA 2000 network. Plug the NMEA 2000 connector into the network node (see Figure 6). Coil any excess cable and secure with cable ties to prevent damage.
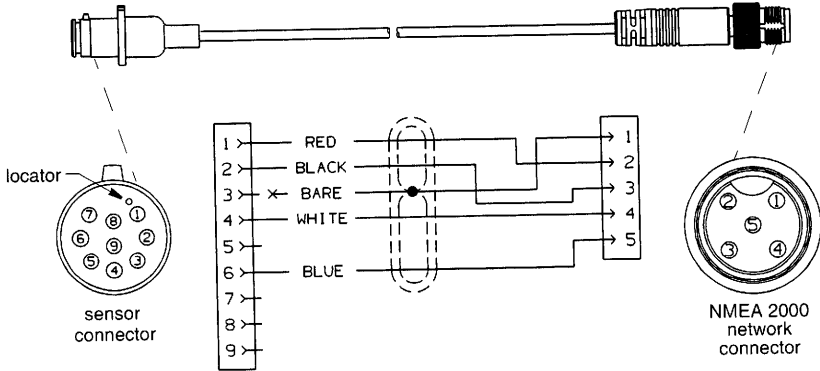


Figure 6. NMEA 2000® Sensor Cable—6 m (20') shown

*NOTE*: Sensor cables longer than 6 m (20') have a termination resistor built into the sensor connector (see Figure 7).
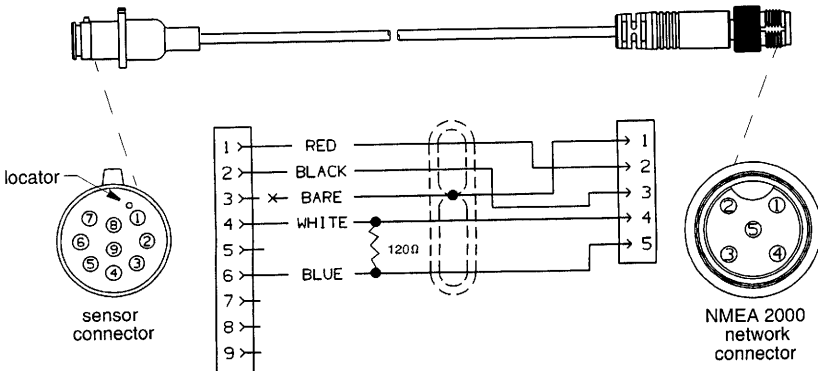


Figure 7. NMEA 2000® Sensor Cable—10 m (33') shown

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# Calibrating the Compass

**WARNING**: The internal compass must be calibrated on the water after the sensor is installed. Failure to do so may result in inaccurate compass readings, possibly contributing to damage to the boat and/or personal injury.

**CAUTION**: Compass calibration needs to be done in calm seas in a 0.8 km (0.5 mile) open area away from other boats or ferrous objects (structures or aids to navigation). Avoid congested areas and waters with strong currents as calibration will be difficult and possibly hazardous.

**IMPORTANT**: Calibration requires the vessel to complete 2 to 3 circles.

The compass must be calibrated for maximum accuracy from the sensor. Calibration can be done in one of two ways.
- Calibrate the compass using the WeatherCaster™ software and a PC.
- Follow the AutoCalibration Procedure below.

## AutoCalibration Procedure

1. Navigate the vessel to an open area of water, 0.8 km (0.5 mile) of open space away from other boats or ferrous objects (structures or aids to navigation). Choose calm seas.
2. Select the display page on the vessel's NMEA instrument that shows Heading.
3. Shut OFF and then turn ON the DC power that is connected to the sensor.
4. Within 2 minutes of recycling power to the sensor, start the vessel in a slow [4 to 6 knots (4.5 to 7 MPH)] circular turn that takes about 2 to 3 minutes to complete.*

   If the vessel completes 1.5 circles within 3 to 4.5 minutes, AutoCalibration will begin. Heading will stop being reported on any NMEA 0183 or NMEA 2000 display until the calibration is finished.
5. Keep turning the vessel in the same circle for 1 to 2 more complete circles. *Do not change the vessel speed or rate of turn through the circle.*
6. When calibration is completed successfully, Heading will return to the display.

   If calibration fails, the display will flash Heading ON and OFF in 10 second intervals for 60 seconds. (Display times may vary by manufacture.)

   *IMPORTANT: In the event of a calibration failure, repeat the procedure.*

* The optimum rate of turn is 180°/ minute: 3°/second, 30°/10 seconds, 45°/15 seconds, and 90°/30 seconds.

# Maintenance & Updates

## Firmware Revisions

Airmar may release updated versions of the firmware. The latest revision will be available for download through an email to you, from Airmar's website, www.airmar.com, or a CD can be mailed by Airmar's technical support personnel.

# Troubleshooting

- Is there power to the sensor?
- Are all the connections tight?
- Is the cable-run free of kinks or damage?
- Is the sensor wired correctly?
- Is there damage to the sensor?
- Is the sensor exposed to excessive vibration?

## Problems with the Compass

- Is the sensor installed facing forward and parallel to the centerline of the boat?
- Is the compass calibrated?
- Is there interference from ferrous metals, electronic equipment, electric motors, batteries, or cables that are creating a magnetic field?
- Is the sensor mounted near the boat's center of gravity?

## Problems with the Rate Gyro or Accelerometer

- Is the sensor installed reasonably level with the waterline?
- Is the sensor mounted near the center of the vessel's fore-aft axis?

# Specification

NMEA 2000® Load Equivalency Number (LEN)..................3

# Trademarks

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**SI-TEX**《

## Marine Electronics
## 25 Enterprise Zone Drive, Ste. 2
## Riverhead, NY  11901