UM-8041-C1
System Manual for Radian Motion Sensor

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Document Information

Table 1 Document information

Document Title—Radian Motion Sensor		
Document Reference	**ISSUE**	**ISSUE DATE**
UM-8041-000	A - Rev 1	1 Nov 2006
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Table 2 Document history

Issue	Rev	Date	Comments	Section	Page
A	0		First issue	All	All
B	1	May 2007	CN 9427 Changes to software features	5	All
C	1	Sept 2008	Changes to software features	5	All

1 About This Manual

In this section…

This section contains the following sub-sections:

1.1 Purpose

This is the Technical and User Manual for the Radian Motion Sensor (Attitude and Heading Reference System) manufactured by Sonardyne International Limited. It provides important information concerning the installation and use of the hardware, and offers advice on how to use Radian safely and effectively.

Electronic manual

This manual is supplied electronically as a PDF file, which allows easy navigation among related topics through hyperlinks, and supports the ability to search for words, optionally using advanced features such as ‘word stemming’ and ‘sounds like’. The manual also includes a more conventional index and table of contents.

If required, you can print any part of the manual. However, you cannot select, copy, or change any part of it. Copyright in this manual remains with Sonardyne International Limited at all times.

1.2 How this manual is arranged

This manual is arranged in a series of sections and appendices, each of which covers a major topic:

Section 1 "About This Manual" begins on page 1

Section 1 is about this manual and explains what it contains, who should read it, and how to use it. Section 1 also explains the conventions used throughout this manual.

Section 2 "Radian Overview" begins on page 4

Section 2 explains briefly what Radian is and what it does, and provides some example applications where Radian can be used effectively. It also includes some important cautionary notices and precautions that you must read before you unpack and install Radian.

Section 3 "Quick Start Guide" begins on page 8

Section 3 includes the basic information you need to begin using Radian as quickly as possible, and refers you to the indicated sections of this manual for more detailed information about the relevant topics.

Section 4 "Installation" begins on page 12

Section 4 describes how to install Radian. To gain the best possible performance from Radian, you should plan the installation carefully and follow the instructions and guidance included throughout this section of the manual.

Section 5 "Operation" begins on page 17

Section 5 describes how to operate Radian. One of Radian’s features is its ability to be configured and then left to supply measurements with no further operator intervention. This section explains how to configure the system to operate in this way.

Section 6 "Magnetic Calibration" begins on page 29

Radian uses an internal earth magnetic field sensor, called a flux gate, to detect the earth's magnetic field so that it can deliver measurements of magnetic heading.

The simple self-calibration procedure described section 6 allows Radian to measure and compensate for any static hard iron magnetic effects that would otherwise introduce errors into its heading measurements.

Section 7 "Data Output Formats" begins on page 34

Section 7 describes the data output format that Radian uses to supply digital measurements of heading, roll and pitch to receiving equipment.

Who should read this manual

This manual should remain available for electronic or hard-copy access by anyone who has any involvement with the Radian Motion Sensor. All users of the sensor should ensure they read the relevant sections. If you have a printer connected to the computer that holds this electronic manual, you can print any part of it.

Updates to the manual

If necessary, contact Sonardyne International Limited to check whether you have the latest revision of the manual, or to request printed copies. The document reference number for this manual is **UM-8041-C1** and this is issue **C - Rev 1**.

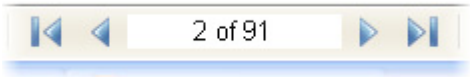
1.3 Navigating the manual

The electronic version of this manual is a PDF file read using Adobe® Acrobat® Reader. Acrobat Reader provides a number of features to help you navigate through the manual, and to find the information you are looking for conveniently.

Note

You will not be able to use the electronic version of this manual unless the computer on which it is installed has the Adobe Acrobat Reader software installed. Visit the Adobe website **www.adobe.com** to download the Reader software if necessary.

Navigation buttons



- You can use the Acrobat navigation buttons to move to the beginning or the end of the manual, or forwards and backwards by a single page. You can also click the page number field and type the number of the page you wish to see.

Bookmarks

- You can click on a section or sub-section title listed in the **Bookmarks** tab to the left-hand side of the Acrobat screen. Alternatively, you can select the **Pages** tab and then click on one of the page thumbnails to take you to that page.

Links

Throughout the manual you will find cross-references that refer to section or sub-section titles, page numbers, figures or tables. For example "See "Navigating the manual" on page 2." These are hyperlinks. When you hover the mouse pointer over them in Acrobat, the pointer changes to a pointing finger. Click on the link with the mouse to jump to the relevant location in the manual.

The Table of Contents, List of Figures, List of Tables, and Index sections all include hyperlinks to the locations listed. Click on the listed page number to make the jump.

Click on the **Previous View** or the **Next View** button to go backwards or forwards through the sequence of pages you have already viewed.

Slider control

You can click and drag the button on the vertical slider at the right-hand side of the display to move forwards and backwards through the pages.

Search

Acrobat Reader includes a powerful facility to find specific words in the text. Click the **Search** button and then type the word that you need to find. The software will then display the first occurrence of that word after the current location.

Hold the **[Ctrl]** key and press **[G]** to find the next and subsequent occurrences of the search word.

Printing

You can print part or all of the manual if you wish. To do this, choose **File > Print** from the Acrobat menu bar.

2 Radian Overview

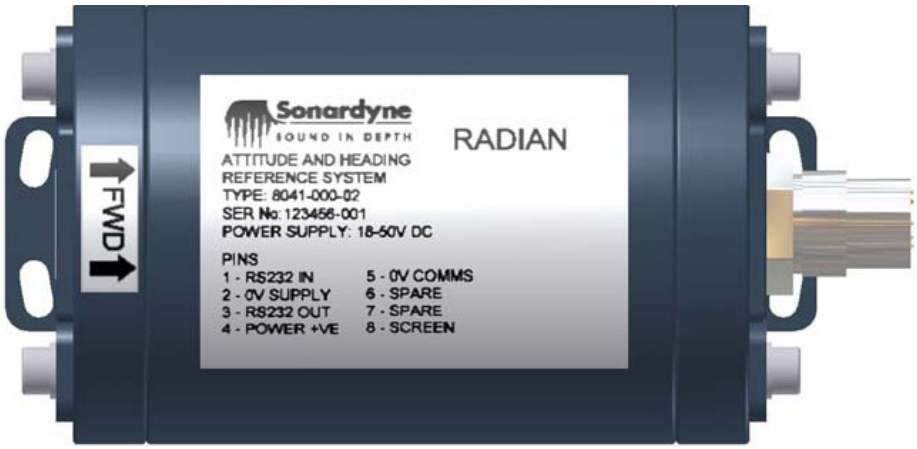
In this section… This section contains the following sub-sections:

2.1 Introduction

This section of the manual explains briefly what Radian is and what it does, and provides some example applications where Radian can be used effectively. It also includes some important cautionary notices and precautions that you must read before you unpack and install Radian.

2.2 Description

Fig 1 Radian AHRS



Radian is a versatile Attitude and Heading Reference System (AHRS) in a small, 300m or 3000m depth-rated pressure housing suitable for use in surface and sub-surface marine applications.

It uses data supplied by three-axis arrays of solid state linear accelerometers, rate-of-turn gyros, and earth magnetic field sensors to calculate and output measurements of gyro-compensated magnetic heading, pitch, roll, heave, rate of turn, and acceleration.

Embedded high-performance processing ensures Radian can continue to deliver high output rates, even in dynamic environments.

Radian is fully compatible with Sonardyne’s sub-sea positioning systems.

Depth rating

Available in two different pressure housings and accepting a wide range of input supply voltages, Radian can be mounted on vessels, ROVs, AUVs and submersible structures. The different pressure housings provide options of depth rating to 300 metres (Type 8041–001–01), or 3000 metres (Type 8041–001–02).

Applications

Typical applications where you can use Radian include:

- inshore hydrographic survey
- motion compensation of echosounders, bathymetric systems and dynamic positioning systems
- compensation of orientation displays and imaging sonar systems on remotely operated vehicles (ROVs), and
- compensation of dead-reckoning and imaging sonar systems on autonomous underwater vehicles (AUVs).

Communications

Radian supports communication through serial RS232 or RS485 communications.

Software supplied by Sonardyne allows you to view Radian's measurements in real time, and to send measurements for use by external receiving systems.

Refer to section 4 "Installation" beginning on page 12 for instructions to connect Radian to receive power and to transmit measurements.

Magnetic calibration

The software also guides you through a magnetic calibration procedure, so that Radian can continue to operate where there are local disturbances in the earth's magnetic field caused, for example, by large ferrous structures. Once calibrated, the resulting compensation table is stored within the device so that output measurements will require no further correction while operating in the same area.

Refer to section 6 "Magnetic Calibration" beginning on page 29 for detailed instructions to calibrate Radian's earth magnetic field sensors.

2.3 Precautions

CAUTION

Radian is a delicate precision instrument and must be treated as such to ensure it continues to perform reliably and to its stated specification. In particular, take note of the precautions described in this sub-section.

Shock and vibration

The accelerometers, rate-of-turn gyros and earth magnetic field sensors are susceptible to damage from high levels of shock or sustained vibration. They cannot be repaired in the field if damaged, and must be replaced in the factory with new components if they fail. Following component replacement, Radian must be re-calibrated fully and re-programmed with the new calibration details.

While waiting to install Radian, leave it in the shock-protective packing used to transport it to you. Remove Radian from its transport packing only when you are ready to mount it at the installation location.

Always handle Radian carefully when you unpack and install it. Choose an installation location where Radian is protected against impact and where it is unlikely there will be sustained and excessive vibration.

Retain the original transit packing and use it to store the system if you ever need to de-mount Radian. Always use proper shock-protective packing for the system if you ever need to transport Radian for any reason.

Magnetic fields

Radian's construction uses only a very small amount of ferromagnetic materials. However, some minor components can become magnetised permanently by exposure to strong magnetic fields. This will not cause permanent physical damage to Radian, but may make it impossible to perform a useful magnetic calibration on the instrument. The effect this will have on Radian's performance will be to cause a very large deviation in its heading measurement. At worst case, the sensors may become saturated.

Take care not to place Radian close to strong magnetic fields, such as those from permanent magnets, loudspeakers, electric motors and so on.

If you suspect permanent magnetisation has occurred to Radian, contact Sonardyne for advice. Refer to section 2.6 "Contact Details" beginning on page 7 for details.

Electrostatic discharge

Components inside Radian are susceptible to permanent and irreparable damage from electrostatic discharge and radiation.

Protect Radian from electrostatic discharges and shield it from any sources of radiation in use on the vehicle.

2.4 Specifications

Radian's specifications are subject to Sonardyne's policy of continual product improvement and may change without prior notice. Refer to Sonardyne for details of current specifications where necessary.

Communication and physical

Table 3 Communication and Physical specifications

Feature	8041–000–01	8041–000–02	8041–000–03	8041–000–04
Depth rating (metres)	300	3000	300	3000
Digital interface	RS232	RS232	RS485	RS485
Dimensions:				
Length (mm)		149		
Diameter (mm)		75		
Weight:				
In air (kg)	0.64	1.21	0.64	1.21
In water (kg)	0.05	0.61	0.05	0.61

Electrical

Table 4 Electrical specifications

Feature	Details
Operating voltage	15 to 50V DC.
Power consumption	<45mA at 24V DC, 1W.

Table 5 Data format specifications

Feature	Details
Industry standard data outputs	Simrad EM1000, and TSS2.
NMEA 0183 data outputs	$PRDID, $HCHDG, $HCHDM, and $PHTRO.
Maximum update rates	
Sensors only	512Hz.
Raw sensor data only	100Hz.

Performance

Table 6 Performance specifications

Feature	Details
Dynamic range	All angles 3D.
Angular resolution	0.05 degrees.
Pitch accuracy	Better than 0.5 degrees.
Roll accuracy	Better than 0.5 degrees.
Heading accuracy	0.5 degrees in ideal conditions. Typically 1 to 2 degrees following calibration in a real marine environment.

2.5 Warranty

Sonardyne warrants Radian against faulty workmanship and materials for a period of one year after delivery.

Faulty units will be repaired free of charge, provided they are delivered at the owner's or user's expense to Sonardyne or to any of its agents, and providing all recommendations with regard to operation and user servicing have been followed.

2.6 Contact Details

If you are in any doubt about the proper use of equipment that is manufactured or supplied by Sonardyne International Limited, contact Sonardyne for advice. The contact details are:

Sonardyne International Limited
Blackbushe Business Park
Yateley
Hampshire
GU46 6GD
England

Telephone: +44 (0)1252 872288

Fax: +44(0)1252 876100

email support@sonardyne.com

3 Quick Start Guide

In this section… This section contains the following sub-sections:

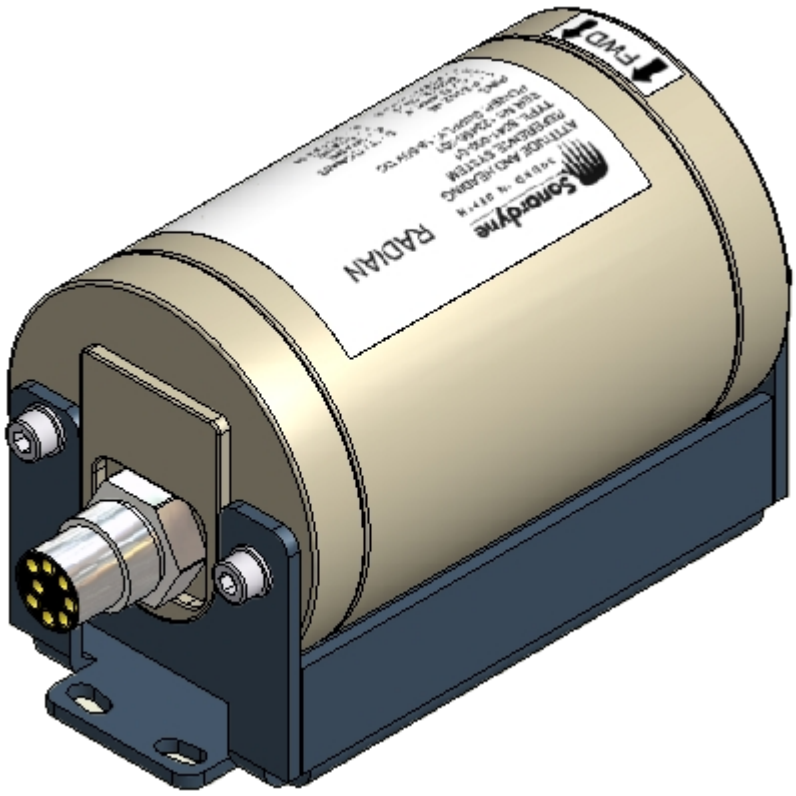
3.1 Introduction

This section includes the basic information you need to begin using Radian as quickly as possible. Refer to the indicated sections of this manual for more detailed information about the relevant topics.

3.2 Description of Supplied Parts

Radian AHRS instrument

Fig 2 Radian AHRS instrument



The Radian instrument, shown in Fig 2 in its 300m depth-rated form, contains all the accelerometers, rate-of-turn gyros, and earth magnetic field sensors together with the supporting electronics.

Note

There are no user serviceable parts inside the instrument housing. Do not open the housing for any reason.

All connections to the Radian instrument pass through a single 8-pin subcon waterproof connector at the forward-facing end of its housing. Refer to sub-section “Electrical Connections” beginning on page 11 for a summary of the connections

required, and to sub-section 4.5 “Electrical connection” beginning on page 15 for detailed instructions to connect Radian.

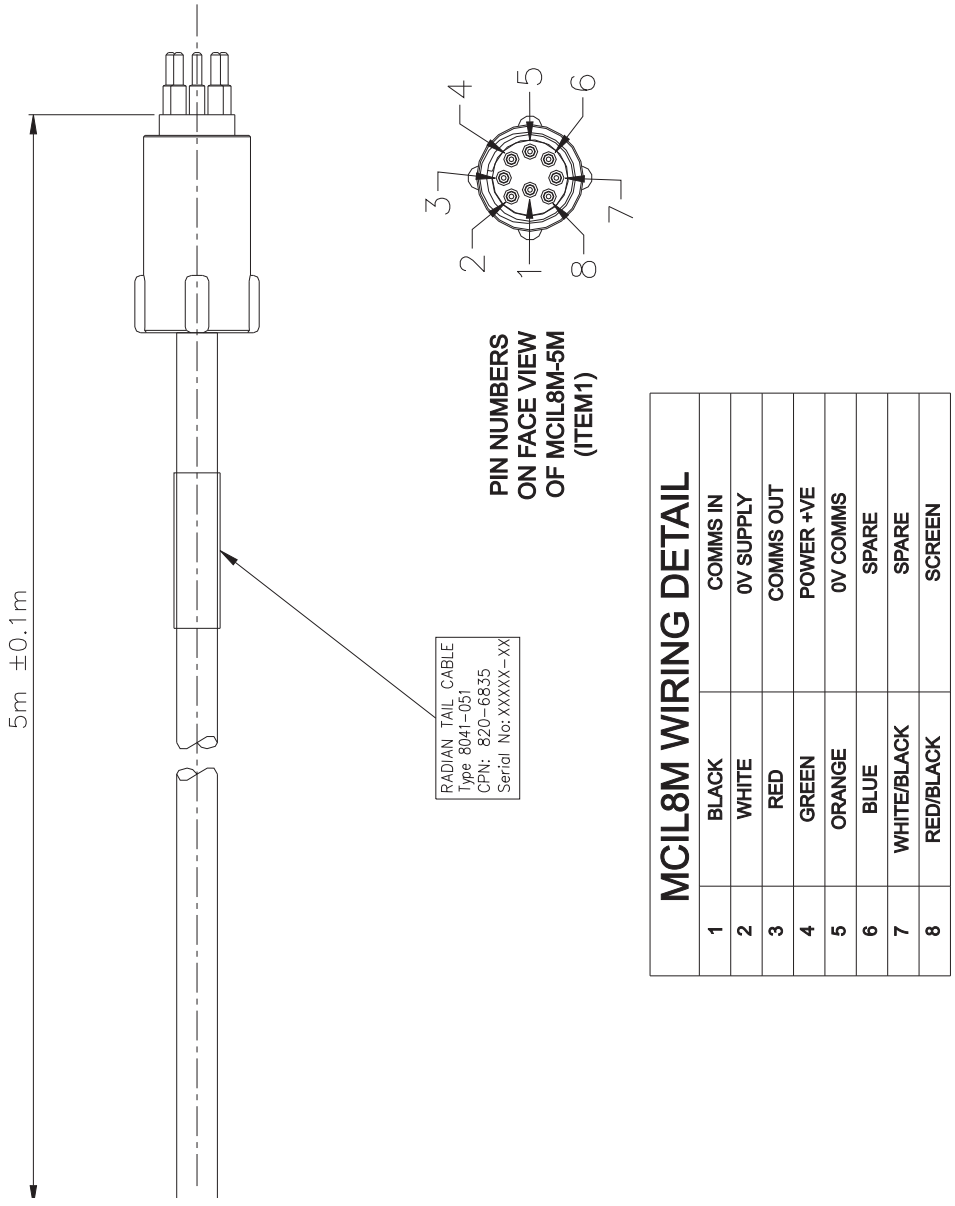
The depth-rated housing is pre-assembled to its mounting cradle. Do not remove Radian from its cradle.

The mounting cradle has brackets that allow you to mount the instrument securely using screws or bolts that you supply. Refer to Fig 6 on page 14 for a dimensioned outline drawing of the Radian instrument and its mounting cradle, and use the information supplied to prepare the installation location. Refer to sub-section 4.2 “Installation Location” beginning on page 12 for an explanation of the requirements needed for Radian’s installation location.

Cables

Sonardyne supply a standard interface tail for the Radian unit, which has a waterproof connector for mating to Radian’s multiway port. This tail is Sonardyne part number 8041–051 and is shown in Fig 3. Radian requires connection to a DC power supply in the range 18V to 50V, and to a serial communications port. The standard communications port is RS232, but an RS485 serial port version of Radian is also available.

Fig 3 Standard interface tail – Sonardyne part number 8041-051

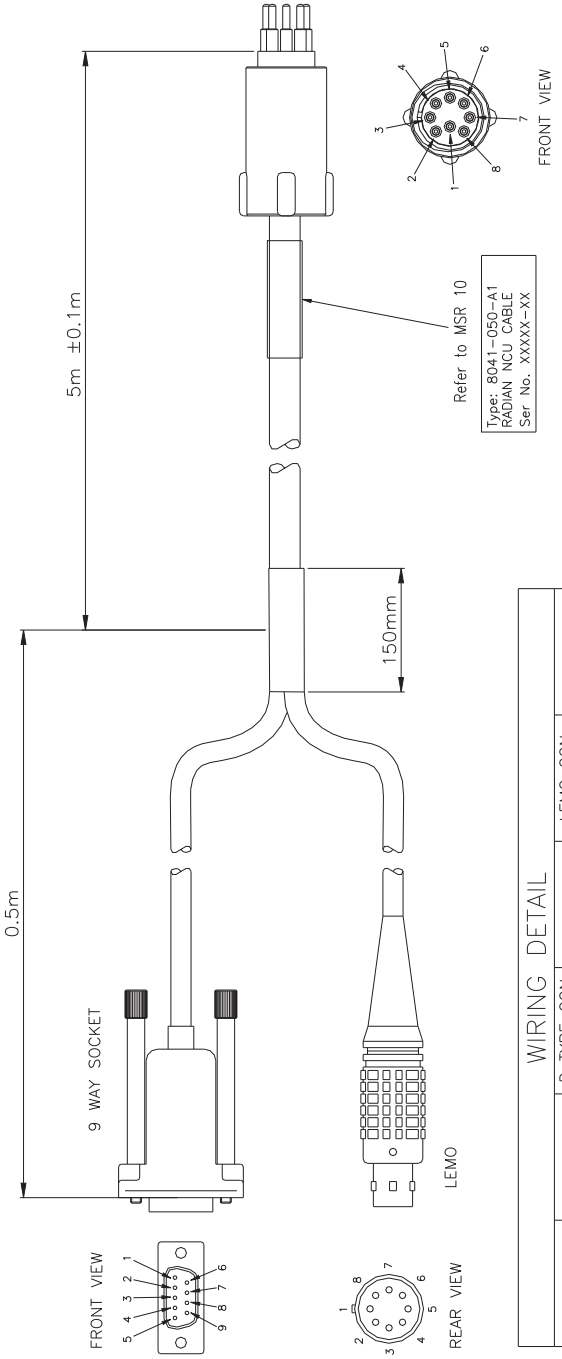


Sonardyne can supply an optional cable that allows Radian to be powered from the auxiliary transceiver port on a Navigation Control Unit (NCU). This cable is Sonardyne part number 8041–050 as shown in Fig 4.

Connect the Lemo connector to the Auxiliary Transceiver port on the NCU, and connect the 9-way socket to a serial port on the NCU. To enable power to the NCU's Auxiliary Transceiver port, authenticate a transceiver via the NCU by using any Sonardyne USBL software. You can then verify power availability by checking the flashing LED on the serial port you are using when Radian is powered on.

To configure Radian with the required settings and perform a magnetic calibration, you must run the Radian Tool on a PC that has the Radian serial connection plugged into one of the PC's ports.

Fig 4 Cable for use with NCU transceiver port – Sonardyne part number 8041–050



WIRING DETAIL

SUBCON PIN	FUNCTION	D TYPE CON CONTACT	FUNCTION	LEMO CON PIN	FUNCTION
1	COMMS IN	3	RS232 OUT	–	–
2	0v SUPPLY	–	–	6 AND 7	TCVR RETURN
3	COMMS OUT	2	RS232 IN	–	–
4	+VE SUPPLY	–	–	8	+48V TCVR
5	0v COMMS	5	0v COMMS	–	–
6	SPARE	–	–	–	–
7	SPARE	–	–	–	–
8	SCREEN	–	–	–	–
–	–	–	–	3 TO 4	DETECT

Electrical Connections

Radian requires connection to a DC power supply in the range 18V to 50V, and to external receiving equipment.

- If you are connecting Radian directly to a Navigation Control Unit (NCU), use cable part number 8041–050. Connect the 9-pin D-type connector to the equipment that receives data from Radian, and connect the Lemo connector to the DC power supply.
- If you are connecting Radian to external equipment indirectly, through a junction box and additional cables, use the cable part number 8041–051. Refer to Fig 4 for details of the cores in this cable.

3.3 Power Supply Requirements

Radian requires DC electrical power in the range 18V to 50V to operate. Power consumption from the supply is less than 1W. Refer to 4.5 “Electrical connection” beginning on page 15 for instructions to connect the DC electrical supply.

3.4 Radian Installation

Radian delivers measurements of attitude and heading that are valid for the platform on which you mount it.

You must take care to install Radian so that the measurements it supplies are correct, by aligning Radian’s housing so that it is level with respect to the mounting location, and its fore-aft axis aligns with the fore-aft axis of the vessel or vehicle.

Refer to section 4 “Installation” beginning on page 12 for full instructions to install Radian.

3.5 Software Installation and Operation

Simple user software supplied with Radian allows you to configure Radian’s settings and to display its measurements. Refer to section 6 “Radian Software” beginning on page 14 for instructions to use the software.

System requirements

The PC on which you install the software must be operating Microsoft® Windows® XP. A PC of sufficient specification to operate Windows XP will have a sufficiently good specification to run the supplied software.

The PC must have a spare serial COM port for the data connection with Radian. Radian can use RS232 or RS485 serial communications. You may need an RS232-to-RS485 converter or a USB-to-RS485 converter if you want to use RS485 communications.

Installation

Insert the CD in the PC’s CD-ROM drive. If installation does not start automatically, select **Start > Run** from Windows, type **D:/setup.exe** and click OK, where D is the drive letter of the CD-ROM drive.

Follow the instructions on screen to install the software, accepting the default settings when necessary. The installation process places a new icon on the PC’s desktop.

4 Installation

In this section… This section contains the following sub-sections:

4.1 Introduction

Installation of Radian is not a demanding or difficult task. However, to gain the best possible performance from Radian, you should plan the installation carefully and follow the instructions and guidance included throughout this section of the manual.

The process of installation involves the following stages:

1. A location is chosen and prepared to install Radian’s pressure housing.
2. Radian is physically oriented and mounted at the location chosen for it.
3. Electrical and communication connections are made between Radian and the external equipment associated with it.

4.2 Installation Location

The location chosen to mount Radian must provide the following:

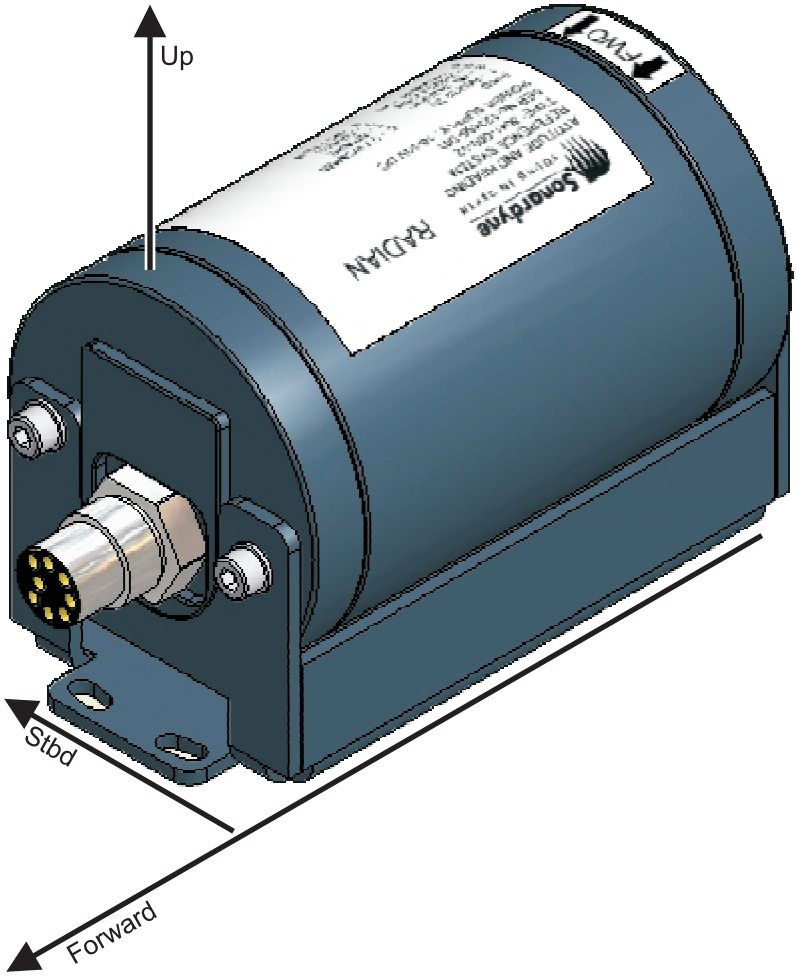
- It must not exceed Radian’s depth rating.
- It must be nominally level with respect to the vessel or vehicle on which Radian is to be installed.
- It must provide protection for Radian so that there is no danger of damage from impact with other equipment or with sub-sea structures around which the ROV is working.
- It must provide a stable magnetic environment, where there are no strong magnetic fields and where the magnetic field of the vessel or vehicle does not change with deployment or operation of equipment or manipulator arms.
- It must not be subjected to extremes of temperature, rapid temperature variations, or excessive vibration or shocks.
- It must allow easy routing of the cable between Radian and the receiving equipment.
- It must allow convenient access to install and connect Radian.

Note

Because Radian does not output measurements of heave or surge, there is no requirement to mount it at or near the centre of rotation of the vehicle on which it is installed. Provided there is no flexing or twisting of the vehicle, Radian’s measurements of heading, roll and pitch will be valid for the entire vehicle.

4.3 Alignment

Fig 5 Radian's orientation requirements



Radian delivers measurements of attitude that are valid for its own body reference frame. This means that its measurements of heading, roll and pitch will all relate to the FWD, UP and STBD axes marked by labels on Radian's housing.

For these attitude measurements to be valid for the vessel or vehicle on which Radian is mounted, it is necessary for Radian to be aligned so that its fore-aft, port-stbd and up-down axis to align with the corresponding axes on the vessel or vehicle. Fig 5 shows Radian's alignment references.

In practice, this means that the physical mounting location should be prepared so that, when mounted, Radian's alignment meets this requirement.

Depending on the application for which Radian is to be used, it may be the case that the attitude measurements may be used to provide motion compensation for external equipment such as sonar imaging systems. In these cases, Radian must be mounted so that its fore-aft, port-stbd and up-down axes align with those of the equipment for which it is supplying measurements.

Pitch rotation

Ideally, you should install Radian on the vehicle with its forward axis aligned with the vehicle's forward axis, as shown in Fig 5. However, if this is not possible for mechanical reasons, you can pitch Radian up or down by 90° as necessary, and rotate the internal axis through software to compensate.

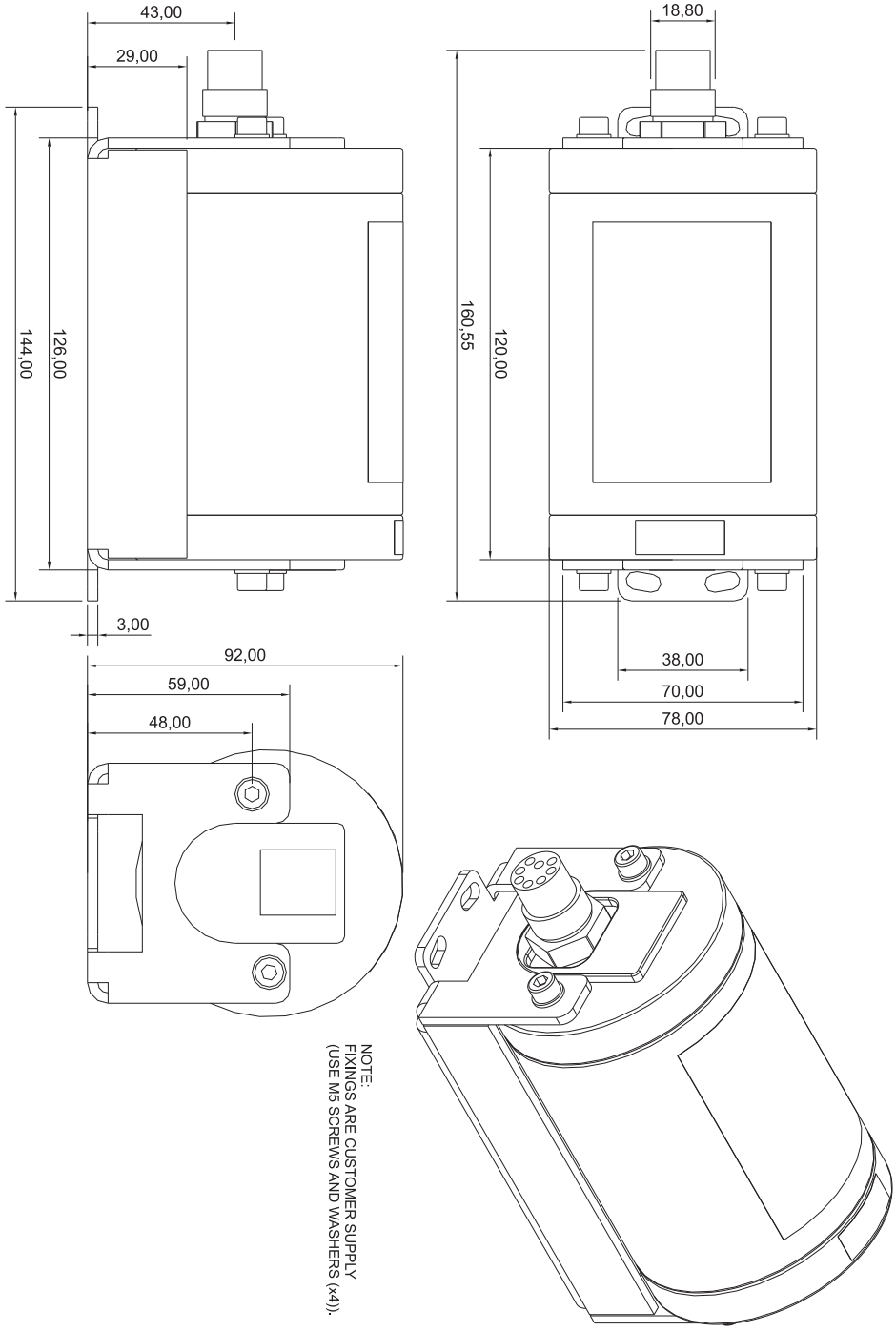
Install Radian as required and open the **Advanced Settings** dialog in the software, shown in Fig 16 on page 24. Click the **Pitch Up 90°** or the **Pitch Down 90°** button

as appropriate for the installation. The **Level** button resets Radian's internal orientation to the normal pitch attitude.

Radian's roll axis must align with the nominal roll axis on the vehicle and cannot be adjusted.

Installation drawing

Fig 6 Dimensioned installation drawing



4.4 Site Preparation

You must use four M5 screws or bolts with shakeproof and plain washers to secure Radian at the location you have chosen for it. Sonardyne does not supply these fixings.

Procedure

Follow the steps below to prepare the Radian mounting location:

1. Identify the location to be used to mount Radian and the orientation to use.
2. Refer to Fig 6 for the mounting dimensions, and drill four holes to take the M5 fixings you will use to mount Radian.

   Make sure the mounting holes allow Radian's fore-aft axis to align with the fore-aft line of the vessel or vehicle. Radian's mounting holes are elongated and will allow a very small degree of rotation to achieve perfect alignment.
3. Remove any burrs or swarf from the holes you have drilled.
4. Mount Radian in the correct orientation, and use the four M5 screws or bolts with shakeproof and plain washers to secure it in position.

4.5 Electrical connection

Connector detail

Fig 7 Radian connection port

The single 8-way female connection port at the forward end of the Radian pressure housing receives power into Radian and passes digital communications out to the receiving equipment.

See Fig 7 for details of the pin numbers for this connector, and Table 7 for details of the connections to make.

Table 7 Connector pin functions

Pin	Function
1	RS232 in.
2	0V supply.
3	RS232 out.
4	DC power +.
5	0V communications.
6	Spare.
7	Spare.
8	Screen.

Make the connection

Follow the steps below to make electrical and communication connections to Radian:

1. Check the contacts for signs of corrosion, and always use the blanking plug supplied before deployment.
2. Ensure the connectors are lubricated, using a lubricant such as Molykote 44 Medium.

Use the lubricant sparingly—it is sufficient to apply a bead about half the size of a match head to each half of the connector before mating them.

Avoid exposing the connectors to heat or sunlight for extended periods.

3. Assemble the connector and screw the connection hand tight only.
4. Route the cable from Radian to the receiving equipment or a junction box.

   Ensure the cable is protected against damage along its length, and does not snag against other items of equipment. Avoid subjecting the cable to sharp bends or points of stress. Secure the cable at regular intervals along its length.
5. Make connections to the receiving equipment or junction box as described in Table 7.

5 Operation

In this section… This section contains the following sub-sections:

5.1 Introduction

One of Radian’s features is its ability to be configured and then left to supply measurements of heading, roll and pitch with no further operator intervention: For the kind of applications where Radian plays a part, the need to ‘operate’ it would represent a significant disadvantage.

Therefore, this chapter concentrates on using the software to configure Radian’s operation. If you have made electrical connections between Radian and external equipment, follow the instructions in this section to configure Radian and then follow the instructions in section 6 to calibrate the earth magnetic field sensor.

5.2 Power-on Radian

Radian has no power switch or other operator controls: It begins to operate and supply measurements after you supply power to it through the single connector.

After power-on, Radian performs a series of self-test routines on its memory and internal circuitry, and then begins to supply measurements required by its current configuration.

The configuration that it uses when it starts to operate is the configuration in effect when powered-off previously, For a new Radian, the starting configuration uses the factory default settings—10Hz sample rate, 9600 baud Display Mode.

Note

There is no need to power-off Radian—it is safe to leave it running continuously. However, if you do need to power-off the system, all you need to do is to switch off the DC power input to it.

5.3 Software Operation

Purpose The purpose of the software is to display measurements from Radian and to configure its settings.

Note

If you have already configured Radian’s settings and have connected it to the receiving equipment, there is no further need to use the software.

Operation Follow the instructions below only if you need to view measurements from a Radian Motion Sensor connected directly to the PC, or if you need to set Radian’s configuration.

Before you begin to operate the Radian display and configuration software, make sure Radian is connected correctly to the computer that is to run the software and is receiving power from the DC supply.

Procedure Follow the instructions below to operate the software:

Start the software

Double-click the Radian software icon on the PC's desktop to start the software.

A splash screen is displayed, showing the software version number and the build date. You will require this information if you need to call on technical support from Sonardyne. The splash screen closes automatically after a short period, and the initial software dialog is displayed.

Note

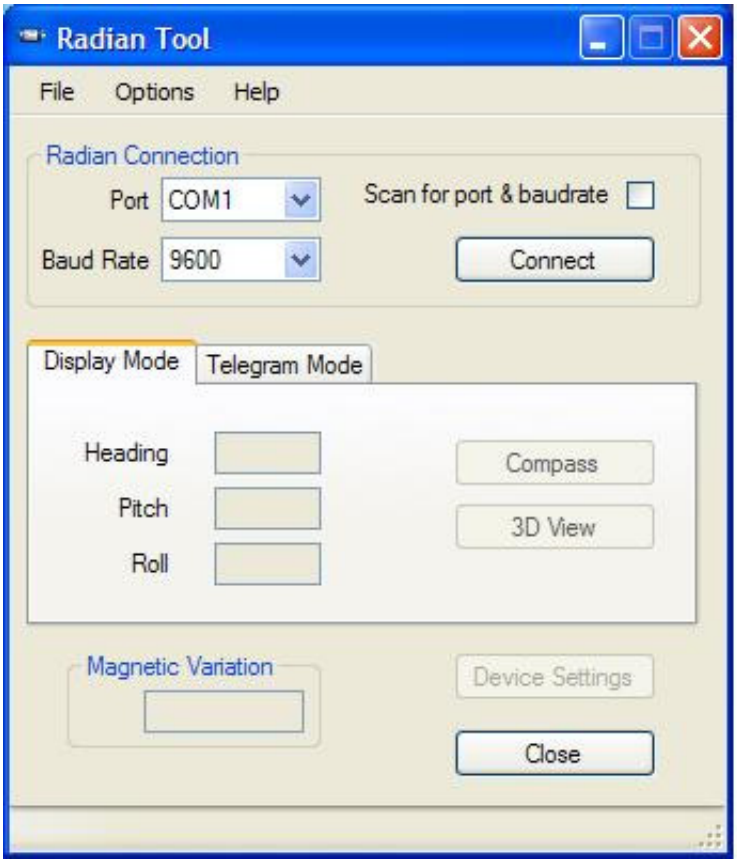
You can display the splash screen again by using **Help > About** from the menu bar.

Fig 8 Radian software's splash screen

Initial display

The initial software dialog displayed when you first launch the software is the same as the dialog displayed if the PC is operating without Radian connected: it shows the default communication settings but no data.

Fig 9 Initial Radian Tool dialog with no connection



Connecting

Select the communication port connected to Radian from the **Port** drop-down list.

Select the transmission rate used for initial communications with Radian from the **Baud Rate** drop-down list.

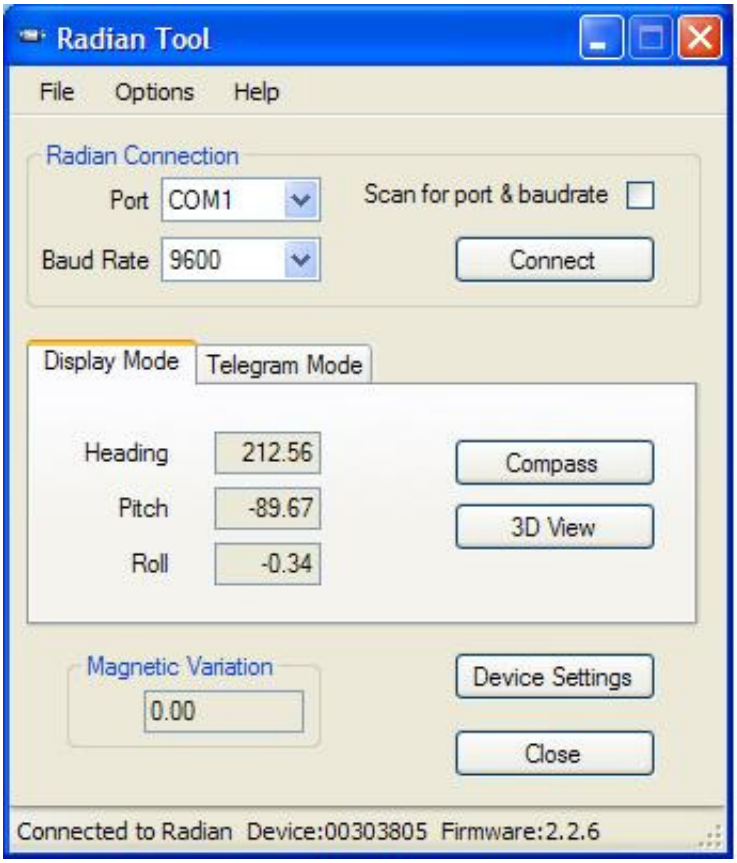
Select the **Scan for port & baudrate** check box to connect to Radian when you are not sure which port is used for the connection, or if you do not know Radian's current baud rate. With this option selected, the software scans through the available ports and baud rates until it detects a connection with Radian.

Click **Connect** to attempt to connect to Radian.

The **Settings**, **Compass**, and **3D View** buttons become active when you establish connection with Radian.

If an attempted connection fails, the Radian Tool will autoscan the ports at each baud rate until it finds a device. This does not always work the first time, but you can click the **Connect** button to try again.

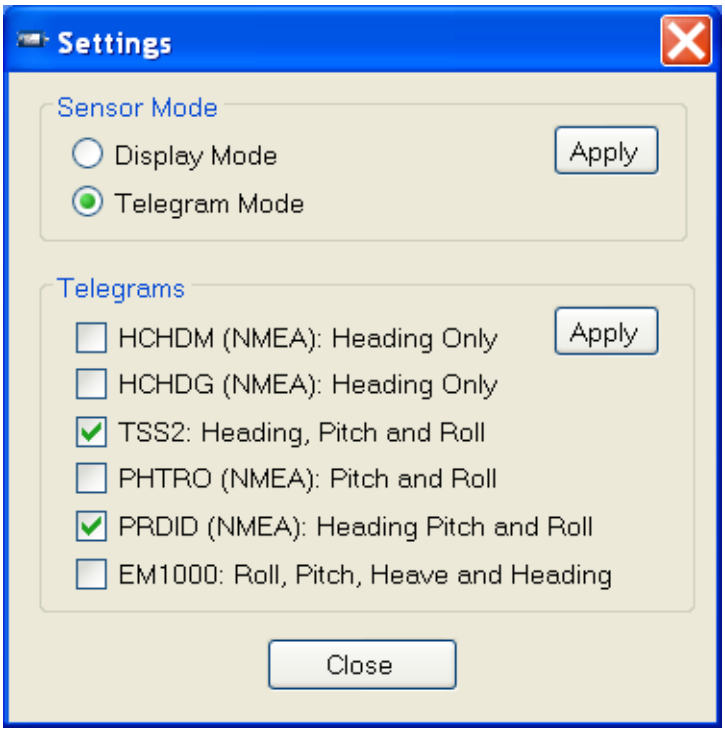
Fig 10 Radian tool with an active connection



Click **Device Settings** to display the **Settings** dialog.

Settings screen

Fig 11 Settings dialog



Radian has two mutually exclusive modes of operation. Once set, Radian will operate in the same mode on each power-up. These modes of operation are:

- **Binary mode**. You must use the Radian Tool to use this mode.
- **ASCII telegram mode**. These are industry-standard telegrams, which can be sent to other equipment.

The Radian Tool can operate in both of these modes. When operating in binary (or display) mode, the Radian Tool can be configured to output many ASCII telegrams to many ports.

Note

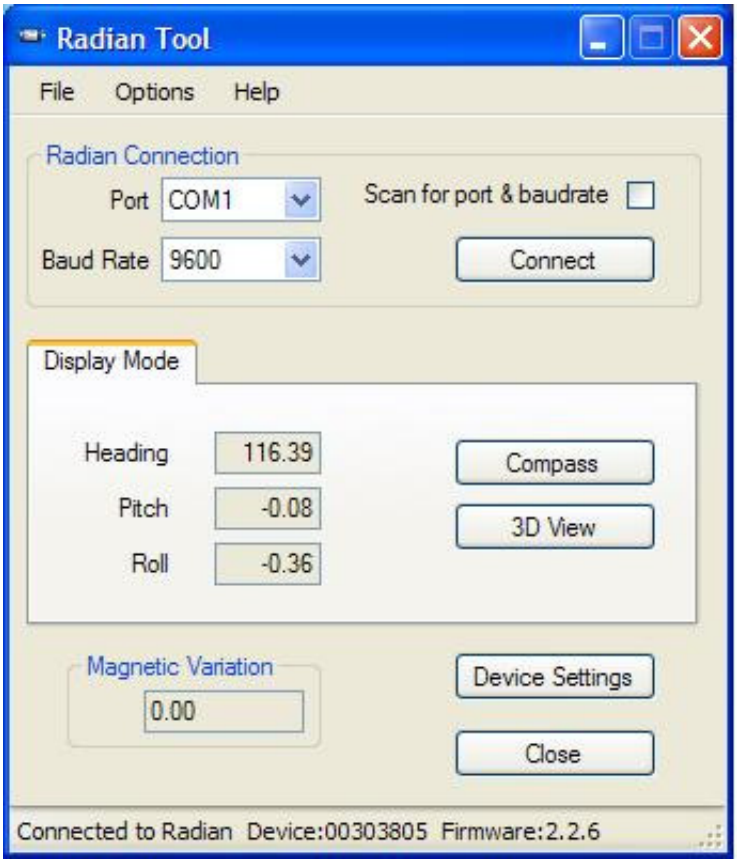
When outputting multiple telegrams to multiple ports this may reduce the update rate. Also, note that certain software packages cannot decode telegrams successfully when certain telegram combinations are output at the same time.

Refer to section 7 “Data Output Formats” beginning on page 34 for a description of the output telegrams and formats.

Make the settings required for your installation on this dialog and click **Close** to return to the **Radian Tool** dialog, where you can select between the **Display Mode** tab or the **Telegram Mode** tab.

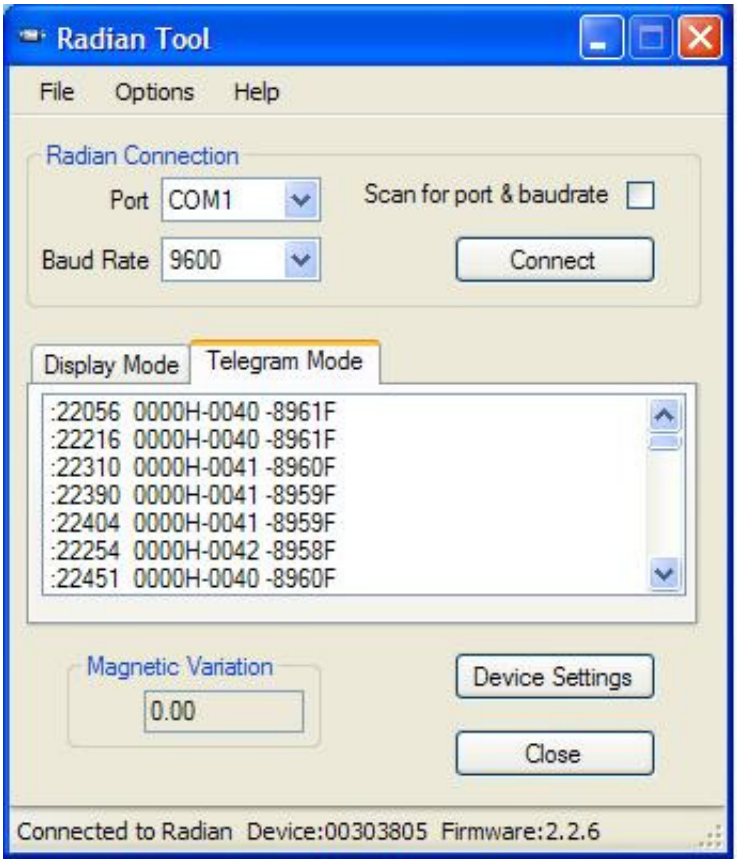
Display mode

Fig 12 Radian Tool dialog showing the Display Mode tab



Telegram mode

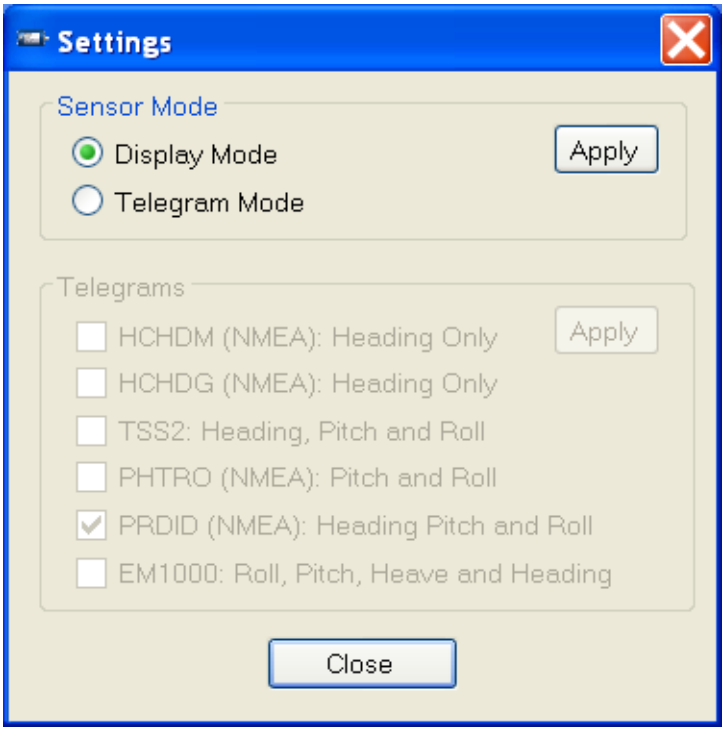
Fig 13 Radian Tool dialog showing the Telegram Mode tab



If you used the **Device Settings** dialog described above to select **Telegram Mode**, the **Telegram Mode** tab will be available on the **Radian Tool** dialog and will show the string outputs you have selected.

However, if you selected **Display Mode** on the **Settings** dialog, the **Radian Tool** dialog will show only the data contained in the internal binary data communications. The **Telegram Mode** tab will NOT be available.

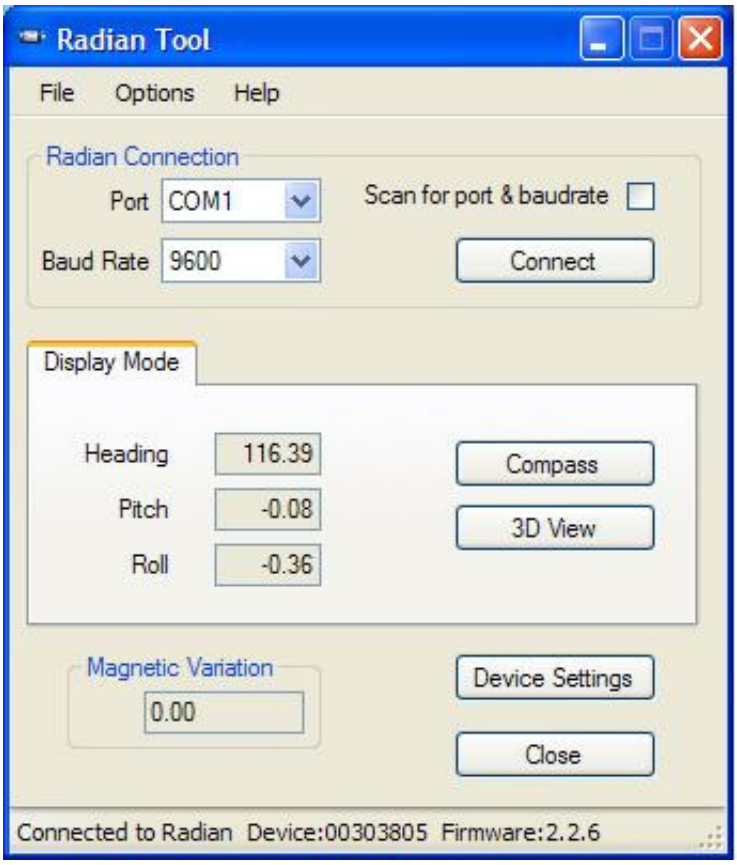
Fig 14 Settings dialog with Display Mode selected



Note

The Display Mode allows you to use the Compass and the 3D View graphical displays, described below.

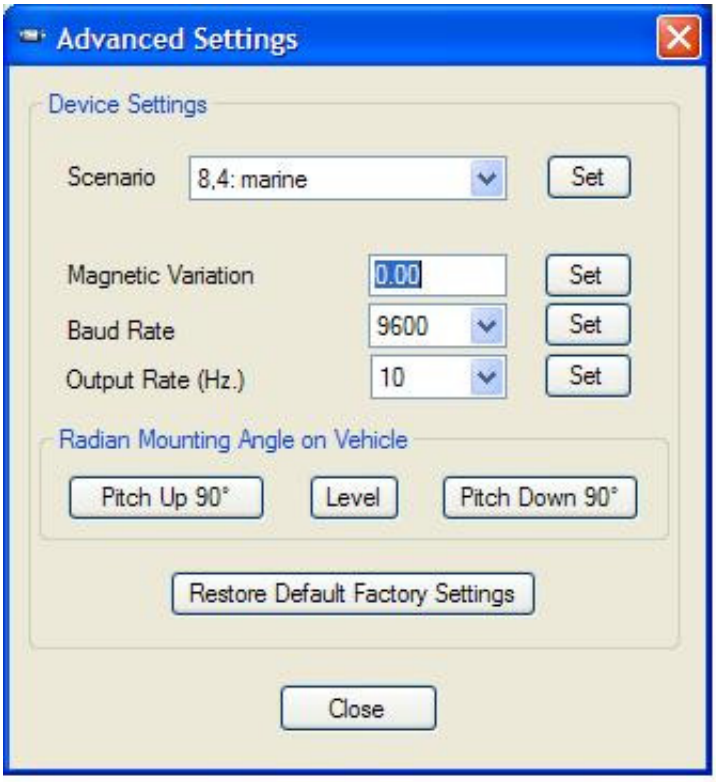
Fig 15 Radian Tool dialog when operating in Display Mode



Advanced settings

Select **Options > Advanced settings** from the menu bar to display the **Advanced Settings** dialog.

Fig 16 Advanced Settings dialog



This dialog has two main regions:

- **Device Settings**—This region allows you to set the filter, sampling and communication parameters used by the earth magnetic field sensors:
  - **Scenario** should always be set to **8.4 Marine**.
  - **Magnetic Variation** is the setting that applies compensation for any static magnetic fields arising from ferromagnetic objects attached to or located near Radian. The setting you establish here is displayed on the **Radian Tool** dialog.
  - The **Baud Rate** setting is the 'new' setting for the sensor port, and is the setting that you want it to become following a reset. If you request a new baud rate, the sensor is reset to the new rate. The baud rate setting on your PC will then be updated automatically. Be very careful not to change the baud rate to a value that is unusable, for example by setting it too high for the PC or cable in use.
  - **Update Rate** is the rate at which Radian updates and transmits measurements. The default settings is 10Hz and you should avoid using higher rates than this if possible. The Radian Attitude Display (described on page 26), and the 3D Attitude Display (described on page 26) work most efficiently when using a 10Hz update rate.

Note

There is usually no need to adjust the Advanced Settings. Do not do so unless you are entirely familiar with the effect your new settings will have on Radian's operation. Make a note of the previous settings so that you can restore them if your changes do not have the desired effect.

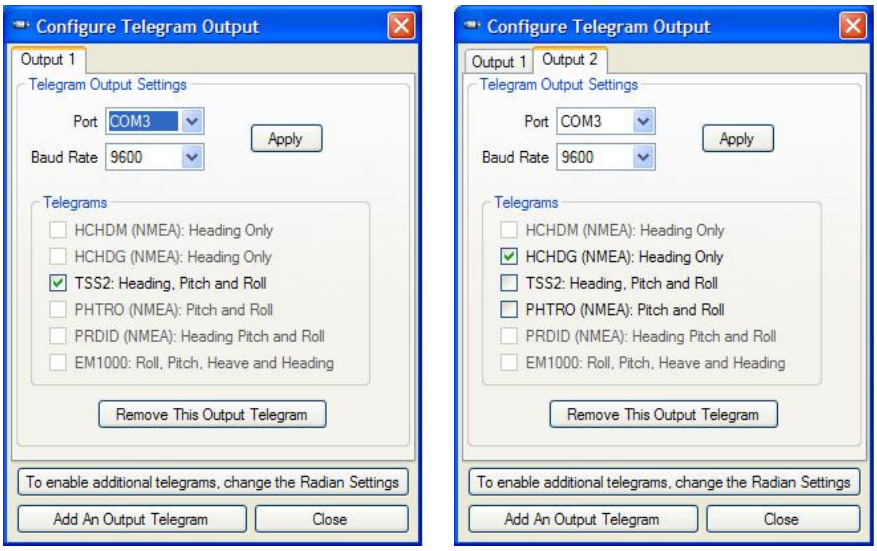
Multiple Telegram Output

The Radian Tool can be configured to output multiple telegrams to multiple ports. Each output has a tabbed property page as in Fig 17.

For each output required, click on the **Add Output** button to display a new tabbed property page. Select each of the outputs required; configure the serial port; and click **Apply**.

Removing the output removes the property page.

Fig 17 Configure Telegram Output 1 and Output 2



Use Radian

Begin to use Radian normally for your operation. Either:

- disconnect Radian from the PC and re-connect it to the receiving equipment, to which it will supply measurements continuously using the settings you have established, or
- use the graphical displays included in the Radian Tool and described below to display Radian's measurements for use in an operation.

Note

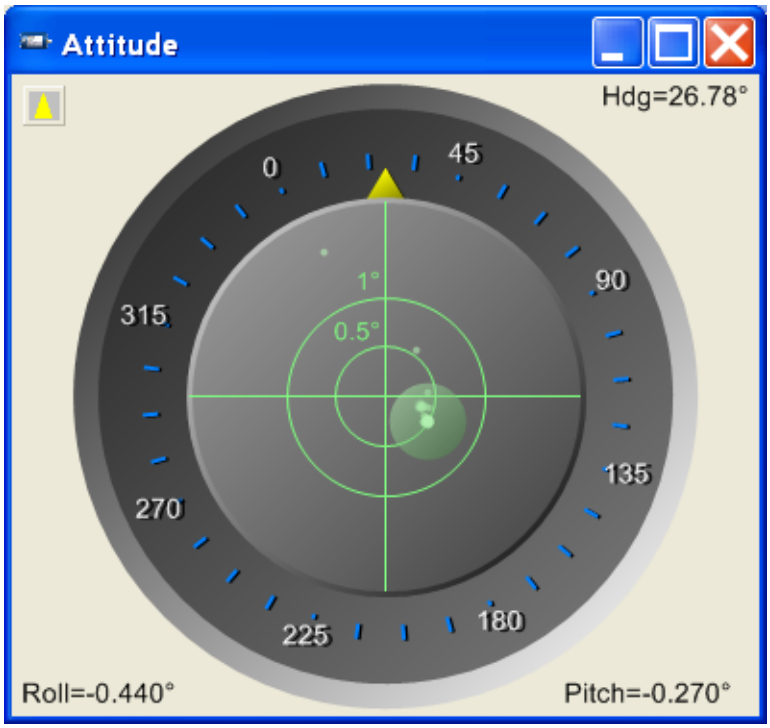
If you connect Radian to receiving equipment, remember that it will begin to supply measurements automatically using the settings you have established each time you power-on Radian subsequently. Use the Telegram mode for this capability.

5.4 Graphical displays

The Radian software has two graphical display screens that you can use. These are available only when you have set Radian to its Display Mode, as described on page 23.

Attitude display

Fig 18 Attitude display in Heading-up mode



The Compass or Attitude display shows measurements from Radian both graphically and as text fields.

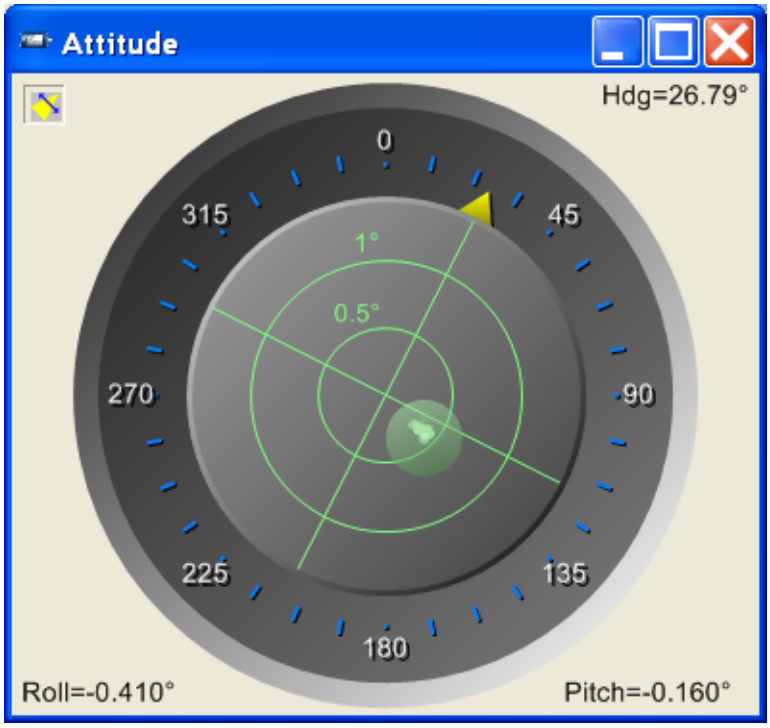
The central part of the display shows a graphical representation of Radian's roll and pitch angles, presented as a 'bubble' display. The central cross-hairs intersect at zero roll and pitch, with 'range rings' representing angles of roll and pitch extending outwards from the centre.

A scale around the outside of the central part of the Attitude display shows the current heading reported by Radian against a radial scale of compass points.

Additional text fields around the edges of the display show actual measurements of heading, roll and pitch.

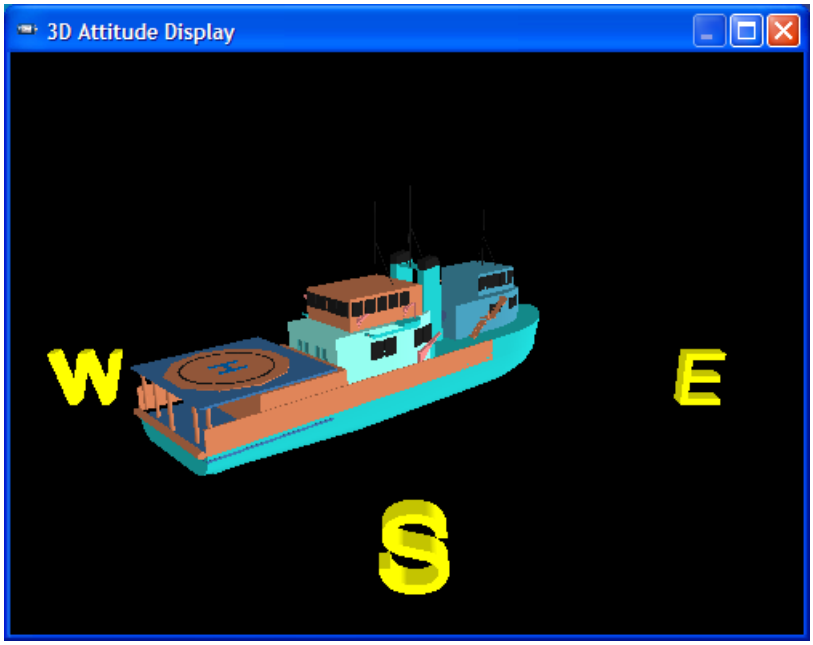
The small yellow triangle in the top left-hand corner of the display allows you to toggle the display between north-up and heading-up modes.

Fig 19 Attitude display in North-up mode



3D attitude display

Fig 20 3D Attitude display options



Radian's 3D Attitude display shows a graphical representation of the ROV on which you have installed Radian, animated to show the changes in heading, roll and pitch angles.

Click the **3D Attitude** button on the **Radian Tool** dialog to display a 3D Attitude display.

The default 3D Attitude display always opens with north at the top. You can use the < and the > keys on the keyboard to rotate the display to place a different heading at the top.

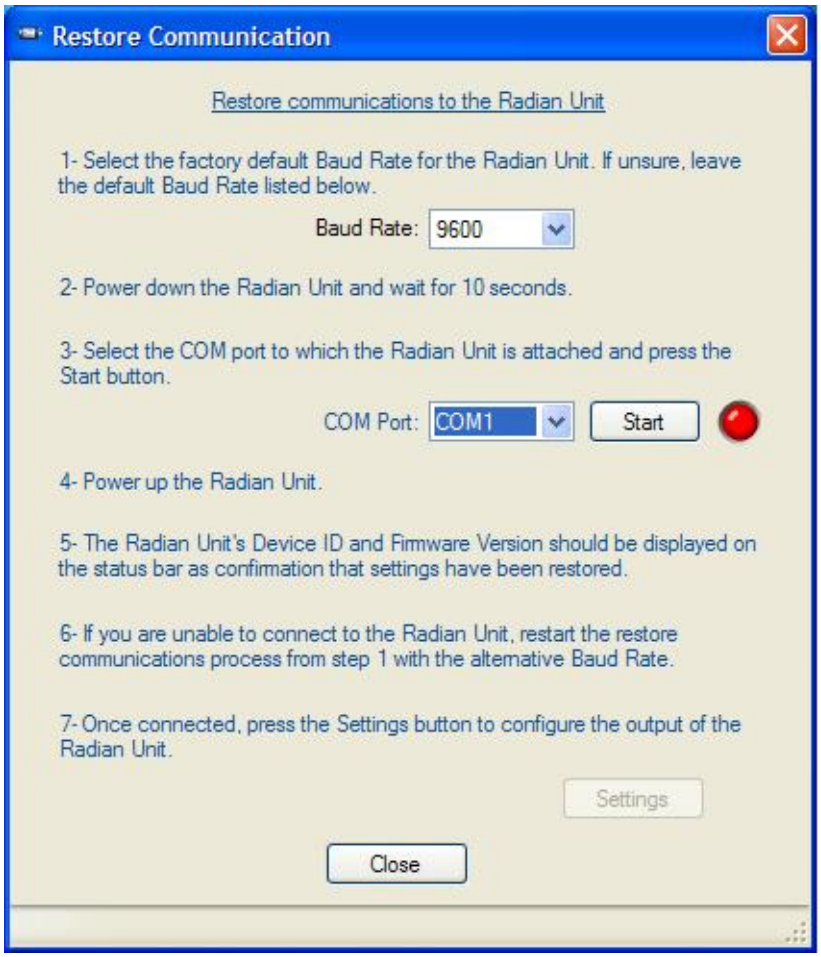
This display may be useful to visualise how the vehicle is moving, but it does not present the actual measurements of attitude to you.

If you intend to use the 3D Attitude display, you should have the Attitude Display open at the same time.

5.5 Communication Failure

If you lose communication between the controlling PC and Radian select **Options > Restore communications** from the menu bar to display the **Restore Communications** dialog.

Fig 21 Restore Communication dialog



Note

If you lose communication with Radian because you have changed the baud rate to be unsuitable for the cable in use, you may have to use a short cable suitable for use at 115200 baud to connect the controlling PC to Radian. You will then be able to recover communications and reset the baud rate to be more suitable for the cable in use. Note that the procedure uses 115200 baud as the factory default setting to recover communications.

Follow the guidance and use this display to try to restore communications with Radian.

6 Magnetic Calibration

In this section… This section contains the following sub-sections:

6.1 Introduction

Radian uses an internal earth magnetic field sensor, called a magneto-resistive thin film device, to detect the earth’s magnetic field so that it can deliver measurements of magnetic heading.

Like any magnetic compass, Radian’s heading measurements will be affected by the presence of any hard and soft iron on the supporting vehicle or platform on which Radian is installed. Hard iron effects are permanent magnetisations; soft iron effects are induced magnetic fields, induced for example by the earth’s fields.

Such effects will cause a local distortion in the earth’s magnetic field, and will degrade the accuracy of heading measurements if left uncorrected.

The simple self-calibration procedure described in this section of the manual allows Radian to measure and compensate for ferromagnetic objects attached to Radian. The effects of any ferromagnetic objects not rigidly attached to Radian, or any constant fields, cannot be compensated. These static effects are compensated by the magnetic variation, which you enter through the Radian Tool **Settings** dialog.

The magneto-resistive devices used by Radian have a sensitivity from –100mT to +100mT. Following a successful calibration, they will be able to respond clearly to the earth’s magnetic field strength of 65mT without risk of saturation.

6.2 Calibration

Note

Any calibration procedure that corrects for the effects of a local static distortion in the earth’s magnetic field must be repeated if that distortion changes for any reason. Typically, this will be necessary if Radian is moved, or if a large part of the vehicle moves.

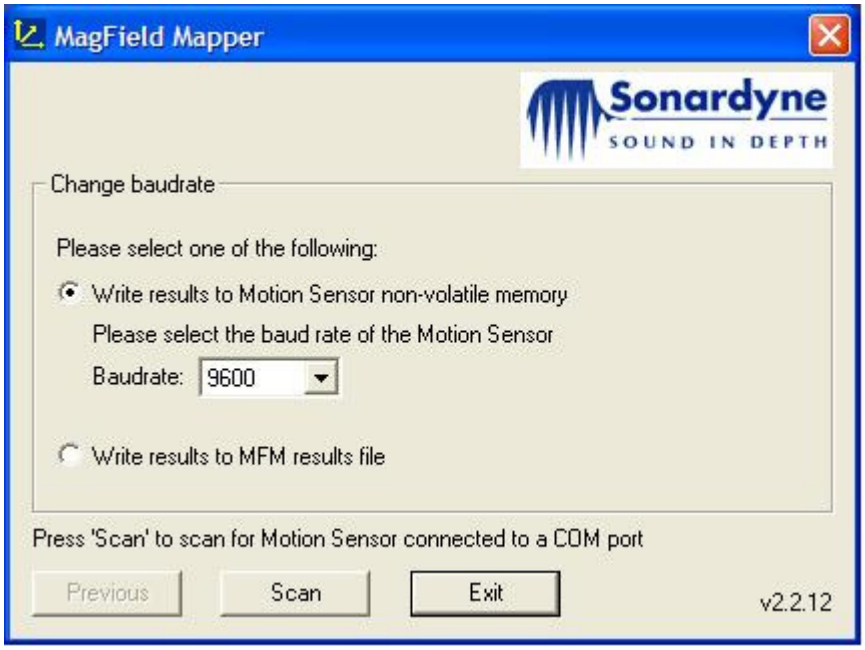
Procedure Follow the steps below to complete a magnetic calibration:

Note

For optimum performance, perform the calibration procedure at the intended operating supply voltage.

1. Make sure Radian is connected to one of the PC’s COM ports and is working correctly.
2. Use the Radian display program to set the baud rate to 115200 as described on page 19, and then close the program.
3. Double-click the **MagField Mapper** icon on the desktop to start the Magfield Mapper program.

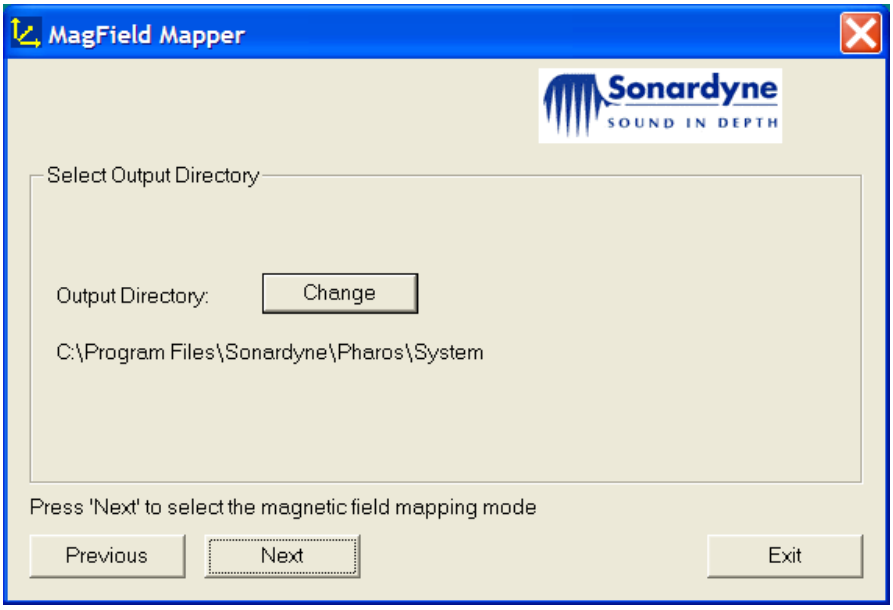
Fig 22 MagField Mapper program



4. Set the baud rate to the preferred rate 115200.
5. Click **Scan**.

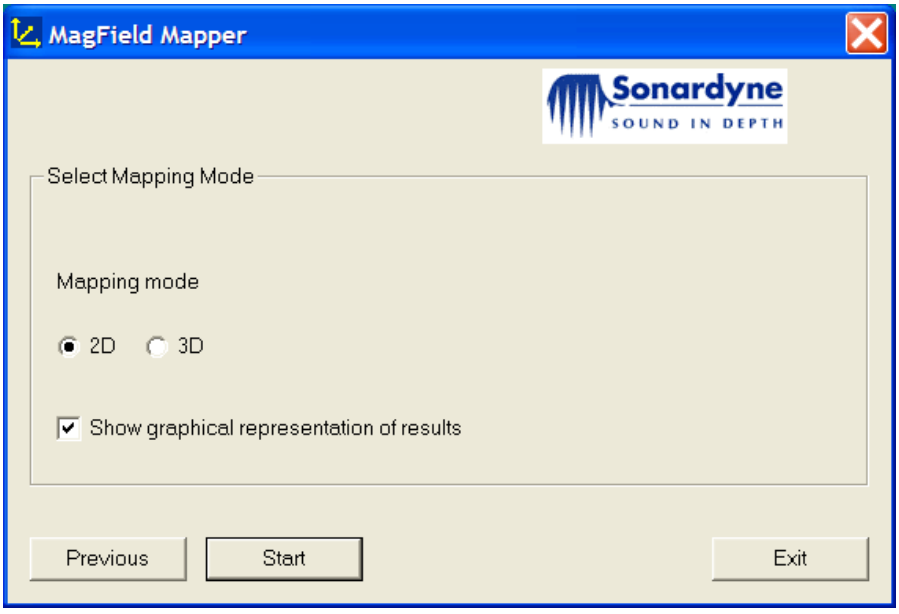
   MagField Mapper scans to find Radian.
6. Click **Next** when MagField Mapper finds Radian to display the **Select Output Directory** screen.

Fig 23 Select Output Directory screen



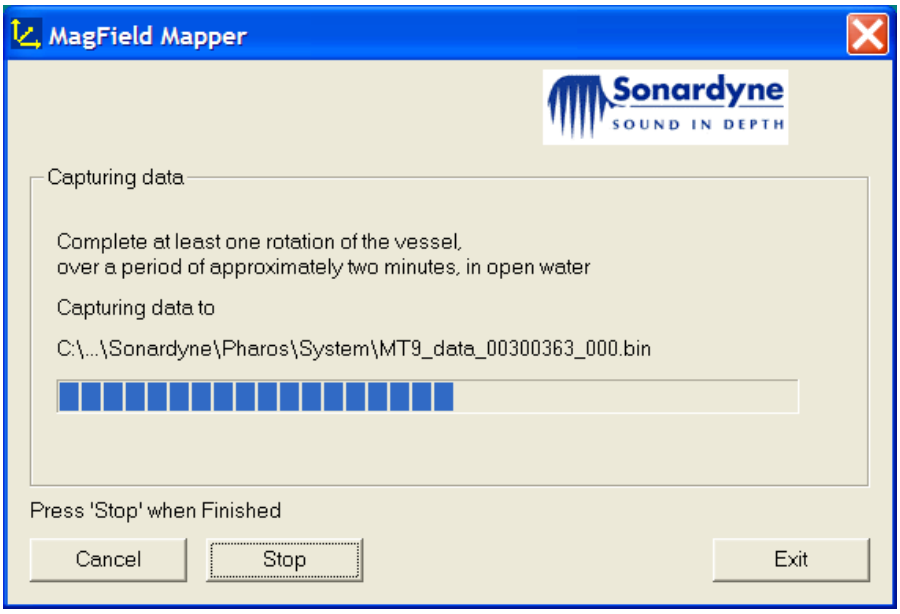
7. Leave the default settings as they are or change them and click **Next** to display the **Select Mapping Mode** screen.

Fig 24 Select Mapping Mode screen



8. Select **2D Mapping mode** and select **Show graphical representation of results**.
9. Click **Start** to begin recording measurements.

Fig 25 Data capture screen



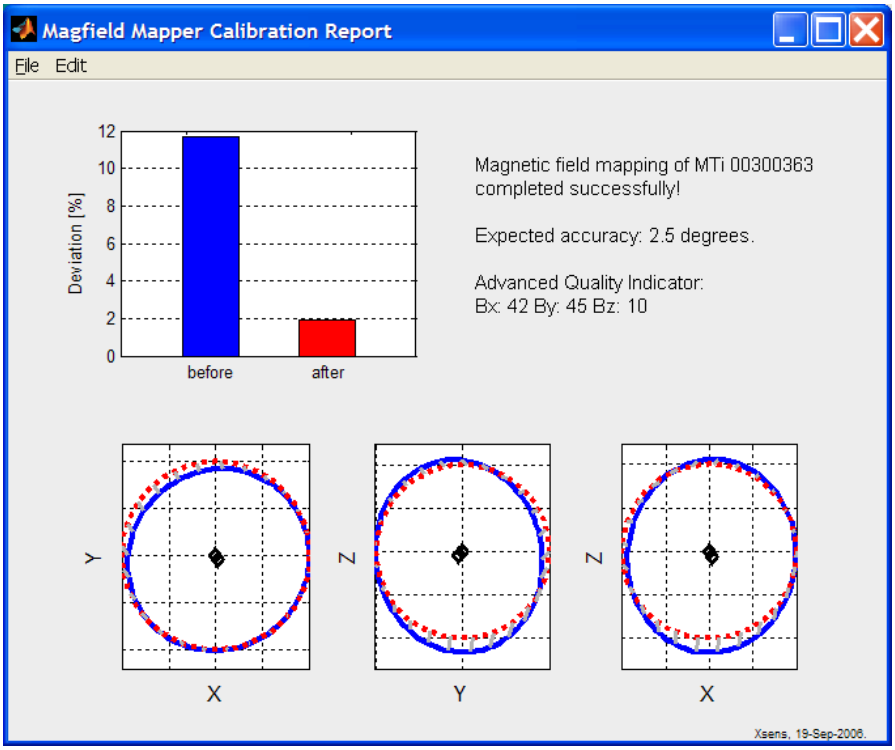
10. While continuing to capture data, manoeuvre the vessel or vehicle in a small circle for approximately two minutes, maintaining a slow but steady speed throughout the manoeuvre.

    You must complete at least one full circle, but you should avoid gathering too much data during this operation.

11. Click **Stop** when you have completed the circular manoeuvre.

    MagField Mapper processes the measurements and displays a **Calibration Report**. Processing may take some time to complete.

Fig 26 Typical MagField Calibration Report screen



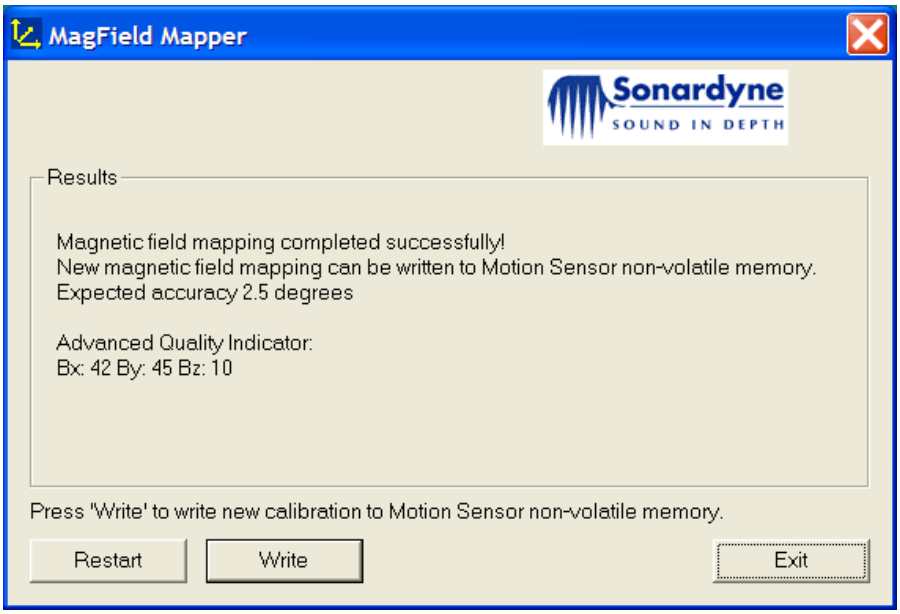
The software will inform you if there is insufficient data or if the data is noisy. If this happens, you must re-start the calibration.

If the calibration has been successful, the report will show how successful it has been.

You can repeat the calibration if you want to try to improve the result. If you cannot obtain a better result, then you can re-process the data file that was saved for the best attempt and then use that. This is an option on the first dialog.

12. Close the **Calibration Report** screen.
13. If the results are acceptable, click **Write** to save the results in Radian.

Fig 27 Results screen



14. Click **Exit** to close the MagField Mapper program.
15. Restart the Radian Tool software.
16. Check for correct operation of Radian, because the MagField Mapper program can leave Radian in a bad state.
17. Set the output to the required string(s) and the required baud rate.

6.3 Troubleshooting

1. Check that Radian is receiving power.
2. Power-off Radian wait for 10 seconds before re-applying power.

   This action resets Radian.
3. Use the PC's Device Manager to make sure the PC serial communications port is working correctly.

   Select **Start > Control Panel > System > Hardware > Device Manager** to use the Device Manager.
4. Make sure that another program is not holding the serial port on the PC.

   If necessary, re-boot the PC to release the port.
5. Try the MagField Mapper program to see whether it has communications with Radian.
6. Use the Radian Tool's Restore Communication tool to re-establish communications.

   See section 5.5 "Communication Failure" beginning on page 28 for information about this software feature.
7. Close the Radian Tool.
8. Delete the **Radian Tool.xml** file to clear all the settings.
9. Restart the Radian Tool.
10. If necessary, re-install the Radian Tool.

7 Data Output Formats

In this section… This section contains the following sub-sections:

7.1 Introduction

Radian supplies measurements of heading, roll and pitch to receiving equipment digitally using one of the available industry standard and NMEA data formats:

Industry standard

- Simrad EM1000, and
- TSS2.

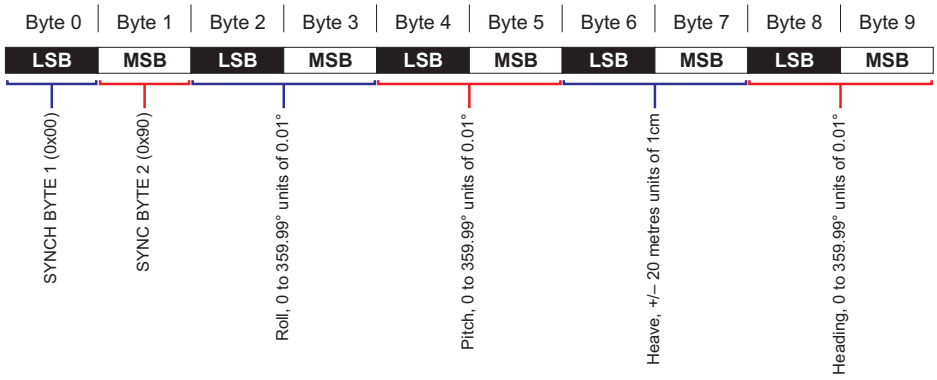
NMEA 0183

- $PRDID
- $HCHDG
- $HCHDM, and
- $PHTRO.

7.2 Industry Standard Formats

Simrad EM1000

Fig 28 Simrad EM1000 data format

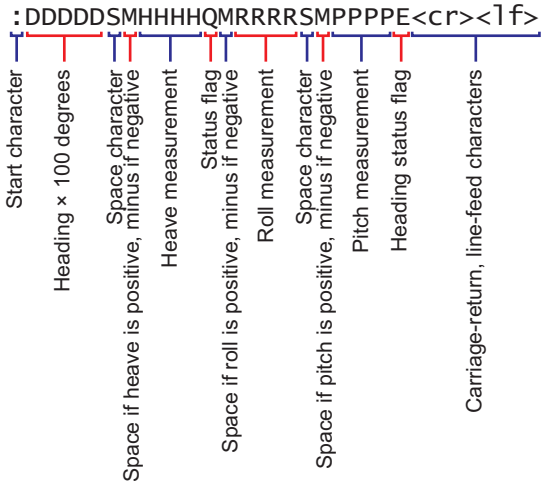


Description This proprietary data format was developed for use with Simrad multibeam echo-sounders. It is a 10-byte message of 16-bit 2’s complement numbers, each expressed as two binary-coded digits.

Notes

- Motion measurements contained in the data string are in real time, valid for the instant when Radian begins to transmit the string.
- The data string has the ability to include heave measurements. However, Radian does not output heave and this data field will always be zero.
- Positive roll is port side up, starboard down.
- Positive pitch is bow up, stern down.
- This data string does not include a status flag.
- Radian updates the heading field in the data string only when it receives new heading information from the earth magnetic field sensor array. There may therefore be a difference between the instantaneous heading and the value included in the output string.

TSS2 Fig 29 TSS2 data format



Description

This format is sometimes called the TSS HHPR2 format. It is a proprietary data string that contains 27 characters in four data fields.

Status flag

The status flag can include any of the following characters:

- **H**—Heading aided, settled condition.
- **h**—Heading aided, settling.
- **F**—Fully aided, settled condition.
- **f**—Fully aided, settling.

When Radian transmits the TSS2 data format, the status flag will always by **F**.

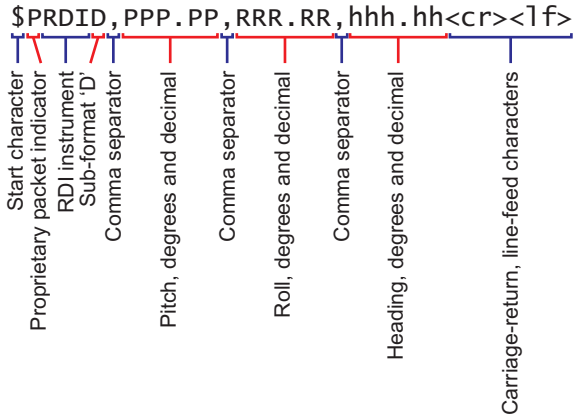
Notes

- All angular measurements are in hundredths of a degree.
- Motion measurements contained in the data string are in real time, valid for the instant when Radian begins to transmit the string. The measurements include ASCII-coded decimal values.
- The data string has the ability to include heave measurements in the range –99.99 to +99.99 metres. However, Radian does not output heave and this data field will always contain zeros.
- Roll and pitch measurements are in the range –99.99° to +99.00°.
- Positive roll is port side up, starboard down.
- Positive pitch is bow up, stern down.

7.3 NMEA 0183 Data Formats

$PRDID format

Fig 30 NMEA 0183 $PRDID data format



Description

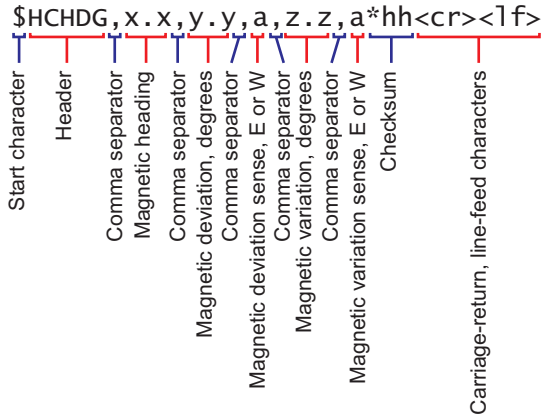
This proprietary telegram from RDI includes roll, pitch and heading information.

Notes

- The data string has variable length, with leading zeros and minus signs added where necessary.
- Roll and pitch angles are in the range +30.0° to –30.0°.
- Positive pitch is bow up, stern down.
- Positive roll is port side up, starboard down.
- Attitude measurements contained in the data string are in real time, valid for the instant when Radian begins to transmit the string.
- There is no status indicator in the string.
- The string does not include the optional checksum allowed within the NMEA 0183 standard.
- The heading field will be null if there is no heading information available.

$HCHDG format

Fig 31 NMEA 0183 $HCHDG data format



Description

The header information includes the mnemonic **HDG** for Heading, Deviation, and Variation.

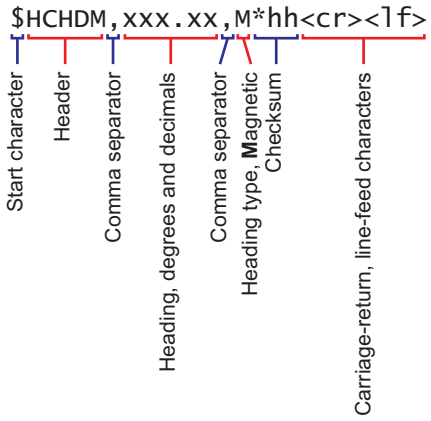
Notes

- If either the deviation or the variation parameters have not been configured in Radian, the corresponding field in the string will be null as defined in the NMEA 0183 standard.
- The direction of deviation and variation are indicated by E or W as appropriate. Refer to the NMEA manual for details.

- The heading field will be null if it cannot be calculated.
- Heading measurements are in degrees and decimals.

$HCHDM format

Fig 32 NMEA 0183 $HCHDM data format



Description

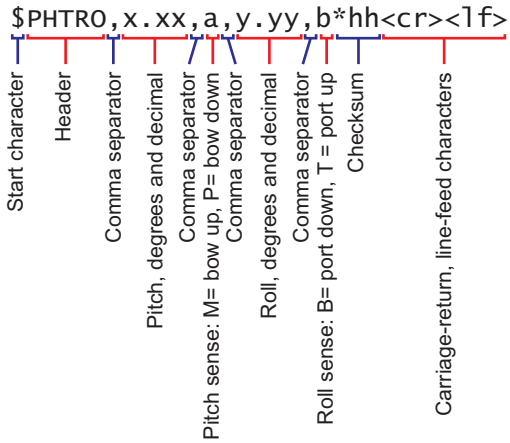
The header information includes the mnemonic **HDM** for Heading, Magnetic.

This telegram format requires deviation to be specified before it can include magnetic heading.

This format has been superseded by the HDG telegram format, described above, but is still widely used.

$PHTRO format

Fig 33 NMEA 0183 $PHTRO data format



Description

This proprietary format from Octans includes pitch and roll information. It is similar to the NMEA 0183 standard. The units for the measurements are degrees, the angles are as described below.

Notes

- The data string has variable length, with leading zeros if magnitude is less than 1, and minus signs added where necessary.
- Positive pitch is bow down, stern up.
- Positive roll is port side up, starboard down.
- Attitude measurements contained in the data string are in real time, valid for the instant when Radian begins to transmit the string.
- There is no status indicator in the string.

8 Maintenance

In this section… This section contains the following sub-sections:

8.1 Introduction

Radian is a sealed depth-rated product that contains no user-serviceable parts. You must not open the housing for any reason.

If you believe Radian has developed a fault, return it to Sonardyne for reapir, with covering documentation.

Always use proper packaging to transport the unit. Refer to section 2.6 “Contact Details” beginning on page 7 for the return address and contact details for Sonardyne.

This section of the manual includes basic routine tasks that you should perform to maintain Radian in a good condition.

8.2 Routine Maintenance

- Immediately after you recover Radian from the sea, wash it using fresh water to remove any contamination or debris.
- Examine Radian’s housing for signs of damage or degradation.
- Check the cable and connector for damage, and make sure the cable remains secured so that it cannot snag other equipment or structures.
- If you disconnect the cable from Radian, always fit the blanking plug to the connector to protect it from damage or contamination. Re-lubricate the connector before you assemble it again for the next deployment.
- Check that the mounting screws or bolts are tight and that Radian is secure.

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