ST290 Instrument System

Owner's Handbook

Document number: 81183-2
Date: 15 May 2003

Raymarine
ON BOARD

Important information

Safety notices

WARNING: Product installation
This equipment must be installed and operated in accordance with the Raymarine instructions provided. Failure to do so could result in personal injury, damage to your boat and/or poor product performance.

WARNING: Electrical safety
Make sure you have switched off the power supply before you start installing this product.

WARNING: Navigation aid
Although this product is designed to be accurate and reliable, many factors can affect its performance. It should therefore only be used as an aid to navigation and should never replace common sense and navigational judgement. Always maintain a permanent watch so you can respond to situations as they develop.

EMC conformance

All Raymarine equipment and accessories are designed to the best industry standards for use in the recreational marine environment. The design and manufacture of Raymarine equipment and accessories conform to the appropriate Electromagnetic Compatibility (EMC) standards, but correct installation is required to ensure that performance is not compromised.

Handbook information

To the best of our knowledge, the information in this handbook was correct when it went to press. However, Raymarine cannot accept liability for any inaccuracies or omissions it may contain.

In addition, our policy of continuous product improvement may change specifications without notice. As a result, Raymarine cannot accept liability for any differences between the product and the handbook.

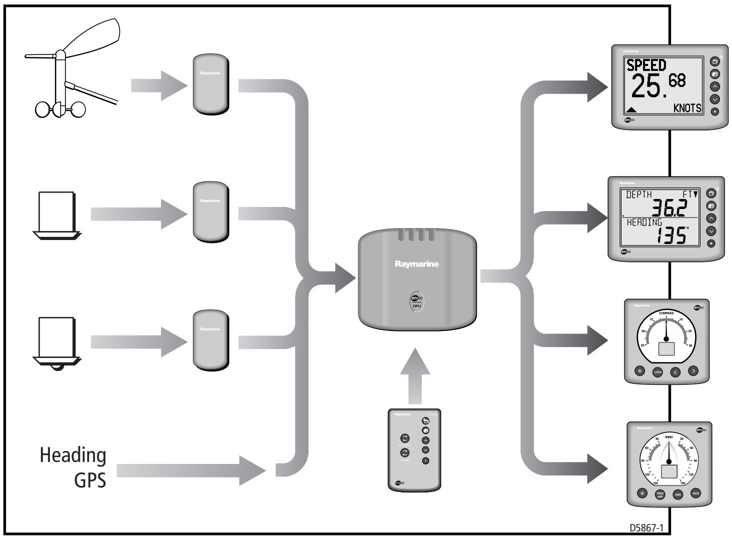
Raymarine, SeaTalk and SeaTALK^2 are registered trademarks of Raymarine Limited.

Contents

Introduction

Thank you for purchasing your new instrument system from Raymarine, the world's leading manufacturer of specialist marine electronic systems. The ST290 instrument system is a comprehensive and versatile instrument system, intended to facilitate the operation of both sail and power vessels. The use of state-of-the-art technology ensures powerful performance and future-proofing.

ST290 products are designed to provide reliable performance, even under the most demanding conditions, and we are sure your ST290 system will give you many years of trouble-free operation.



Note: *This handbook contains important information about the installation, operation and maintenance of your Raymarine product. To get the best from the product, please read this handbook thoroughly.*

Warranty

To register your new Raymarine product, please take a few minutes to fill out the warranty card. It is important that you complete the owner information and return the card to the factory to receive full warranty benefits and to be kept informed of new features.

Section 1: An Introduction to ST290

Contents

An Introduction to ST290

The Raymarine ST290 system is a comprehensive and versatile instrument system, intended to facilitate the operation of both sail and power vessels. Data is provided by a range of transducers and displayed on digital and analog instruments. Control and interfacing for the entire system is provided by a Data Processing Unit (DPU).

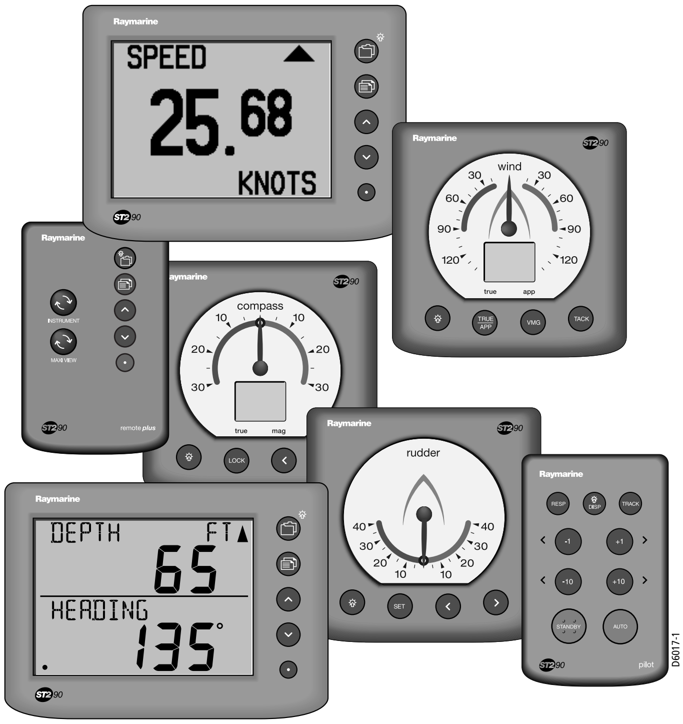


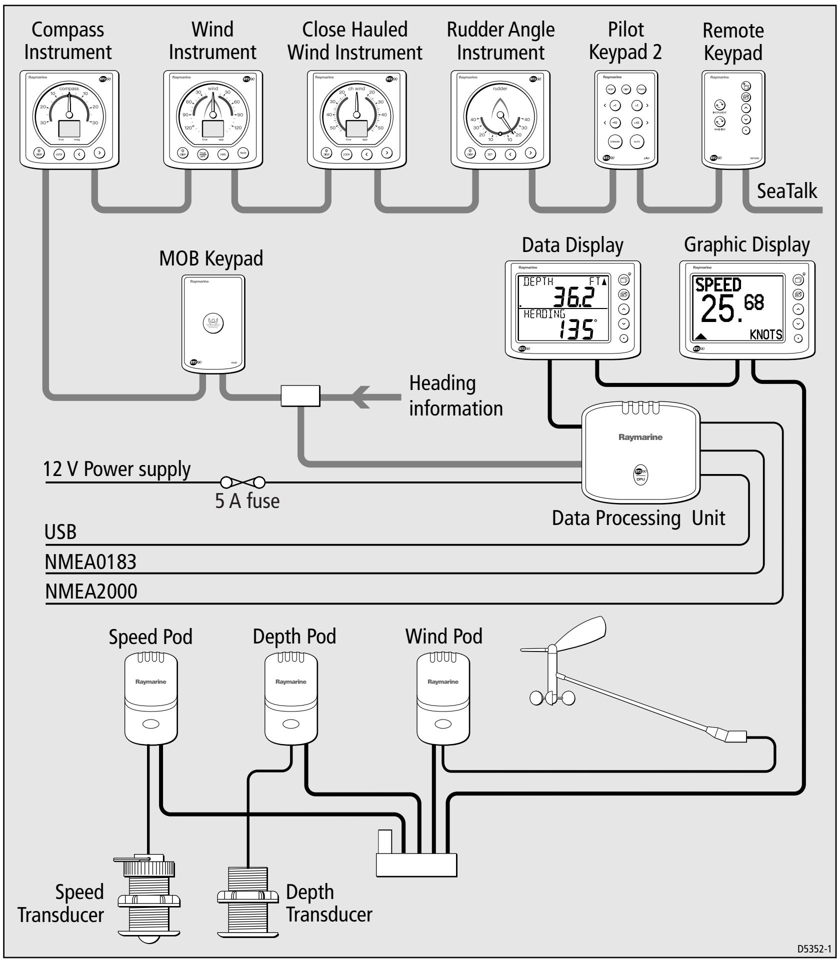
Figure 1-1: ST290 Instruments & keypads

WARNING:

We supply this product calibrated to default settings. To ensure optimum performance on your boat, this product MUST be calibrated before use. Do NOT use the product until it has been calibrated using the instructions supplied.

1.1 System overview

A typical ST290 system, showing the relationship of the major system components is shown in the following illustration.



The ST290 system uses a range of instrument and transducer types to provide a comprehensive range of information, including speed, depth, wind and compass data. For a full description of the available data, refer to *Section 2, Using Digital Instruments*.

The system components communicate with one another over Raymarine SeaTalk and SeaTALK^2 buses.

Both digital and analog instrument types are available.

System buses

The ST290 products are connected via Raymarine SeaTalk and SeaTALK^2 buses to form a single, integrated system. On each bus, the ST290 products are linked by means of a single cable, which feeds both power and data. Details of bus/product compatibility are given in *Section 6, Installation.*

SeaTalk and SeaTALK^2 communicate with one another via the Data Processing Unit.

Digital instruments

ST290 digital instruments can display a wide range of system data, on both Graphic and Data Displays:

- Graphic Displays use dot-matrix screens.
- Data Displays use preformed, segmented characters.

Information on both digital instrument types is organized in ‘chapters’ and ‘pages’ to enable you to easily find the data you want.

Graphic Displays provide the most versatile way of presenting data, as they can show dynamic graphs and other animated information, in addition to the alphanumeric information available on both digital instrument types. They are also used to calibrate the system transducers.

For a description of the functions and operation of the ST290 digital instruments, refer to *Section 2*, *Using Digital Instruments*.

Analog instruments

Analog instruments are available to show:

- Wind
- Close Hauled Wind
- Compass
- Rudder angle

For a description of the functions and operation of the ST290 analog instruments, refer to *Section 3*, *Using Analog Instruments*.

Data Processing Unit

The Data Processing Unit (DPU) performs all system calculations and coordinates the overall operation of the ST290 system. The DPU also provides:

- The interfaces between the various system components.
- The power input connections for the entire ST290 system.
- A means of interfacing with equipment from other manufacturers.

The DPU is splash proof but not waterproof, so must therefore be fitted below decks. It has a removable clip-on cover to allow easy access to terminals.

Connections

The DPU connects to the SeaTalk and SeaTALK^2 buses. It also enables ST290 to communicate with external systems via the following internationally-accepted protocols:

- NMEA0183.
- NMEA2000.
- Universal Serial Bus (USB).

A connector for an external alarm is also provided.

System data inputs

Basic speed, depth and wind data for the system are provided by transducers. The data from each transducer is fed via a dedicated interface Pod, to SeaTALK^2.

Heading information is provided by a Raymarine Smart Heading System.

Other system data is obtained from external systems, such as a Raymarine autopilot or GPS, when available.

Get-you-home mode

In the unlikely event that a fault occurs with the DPU, the digital instruments are able to independently decode the speed, depth and wind information to provide emergency navigation information until the DPU can be restored to full operation.

Remote operation

The ST290 system can be operated either from the individual instruments or from Remote Keypads.

Autopilot control

A Pilot Keypad enables you to control, setup and calibrate, compatible Raymarine Autopilots (see *Section 8, Autopilots*), connected to the ST290 system. Autopilot information can be displayed on any Graphic Display.

Backlighting

At each instrument, you can set the system backlighting to one of three preset lighting levels, or switch it off. In User Setup, you can set the brightness of each level for each individual instrument.

Contrast

You can adjust the contrast of the digital instrument displays. This is a particularly useful function for the Data Display, as it enables you to vary the viewing angle of the display.

Alarms

The ST290 system alarm functions provide warnings when certain data values occur, for example Shallow Water, Off Course, Waypoint Arrival etc. For details of the available alarms, refer to *Section 2, Chapter 2* and *Section 2, Chapter 3*.

When an alarm occurs, a beep sounds at each instrument and a flashing bell symbol is displayed. For anchor alarms, an anchor symbol is also displayed (see *Figure 1-2*).

TO SILENCE AN ALARM, PRESS ANY FRONT PANEL BUTTON.

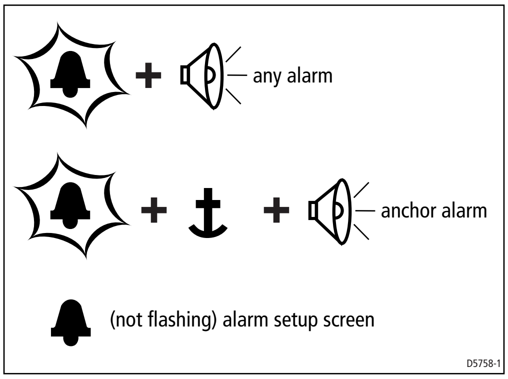


Figure 1-2: Alarm indications

If an alarm condition persists, (for example, if you remain in shallow water after silencing a Shallow Water alarm) the alarm will sound again after a short period.

You can disable or enable each alarm function, and you can set a threshold level for each enabled alarm. Refer to *Section 2, Chapters 2* and *3,* for alarm setup instructions for Graphic and Data instruments, respectively.

Operating profiles

An operating profile is a set of instrument chapters and pages which suit a specific purpose.

Because of the high level of functionality provided by ST290, you can set an appropriate profile for each digital instrument, to suit your requirement. For example, you may be interested in racing, in which case you could create a profile containing data with particular relevance to racing.

When the system is first switched on after installation, a select profile screen is displayed at each instrument, to enable you to choose the profile for the instrument. It is recommended that before you do this, you refer to *Section 2* of this handbook, which gives more details on profile types and structures.

Using instrument buttons

Instruments are controlled by means of front panel buttons. Throughout this handbook, the following terminology is used to describe how to use the buttons:

- **'Press'** means to press a button until it clicks, then immediately release it.
- **'Hold down'** means to press and hold down a button for a finite time, normally stated in the accompanying text.

1.2 Setup requirement

In order to ensure optimum performance on your vessel, your system must be set up in accordance with the procedures in *Section 7, System Setup,* before it is first used after installation.

Do NOT use your system until the setup procedures have been satisfactorily completed.

Transducer calibration

WARNING:

It is imperative that transducer calibration is completed before the system is used, to ensure safe navigation.

The transducer calibration procedures optimize the performance of the transducers with the rest of the system, and so are a mandatory part of the User Setup procedures. They must be completed in accordance with the procedures in *Section 7* of this handbook.

Autopilot setup

WARNING:
It is imperative that autopilot setup is completed before the autopilot is used, to ensure safe navigation.

Your ST290 autopilot must be set up in accordance with the procedures in *Section 8* of this handbook.

Using with RayTech

You can connect a Personal Computer running Raymarine RayTech software to your ST290 system and display RayTech information on ST290 Graphic Displays.

1.3 System upgrades

New features and functionality can be easily incorporated to the ST290 system, by loading the appropriate software upgrades, via the DPU.

1.4 Specifications

System:

Supply Voltage	10 V to 15 V dc

Digital instruments:

Data Display

Current consumption	75 mA (illumination off)
Connectors	2 x SeaTALK^2 (5-pin plug)
Dimensions:	6.7 in x 4.9 in x 1.9 in (170 mm x 124 mm x 46 mm),
Weight:	1.4 lbs (620 g)
Display Size:	4.5 in x 3.25 in (114 mm x 82 mm)
Display type	Upper and lower display areas each comprising a 5-character, 7-segment LCD, a 13-character Raymarine Starburst display plus discrete icons

Graphic Display

Current consumption	75 mA (illumination off)
Connectors	2 x SeaTALK^2 (5-pin plug)
Dimensions:	6.7 in x 4.9 in x 1.9 in (170 mm x 124 mm x 46 mm),
Weight:	1.4 lbs (620 g)
Display Size:	4.5 in x 3.25 in (114 mm x 82 mm)
Display type	168 x 130 pixel dot-matrix display

Analog instruments

Wind

Current consumption	65 mA (Illumination off)
Connectors	2 x SeaTalk (3-pin plug)
Dimensions:	4.9 in x 4.9 in x 1.7 in (124 mm x 124 mm x 41 mm)
Weight:	1 lb (453 g)
Display:	Analog dial plus inset LCD display

Close Hauled Wind

Current consumption	65 mA (Illumination off)
Connectors	2 x SeaTalk (3-pin plug)
Dimensions:	4.9 in x 4.9 in x 1.7 in (124 mm x 124 mm x 41 mm)
Weight:	1 lb (453 g)
Display:	Analog dial plus inset LCD display

Compass

Current consumption	65 mA (Illumination off)
Connectors	2 x SeaTalk (3-pin plug)
Dimensions:	4.9 in x 4.9 in x 1.7 in (124 mm x 124 mm x 41 mm)
Weight:	1 lb (453 g)
Display:	Analog dial plus inset LCD display

Rudder angle

Current consumption	65 mA (Illumination off)
Connectors	2 x SeaTalk (3-pin plug)
Dimensions:	4.9 in x 4.9 in x 1.7 in (124 mm x 124 mm x 41 mm)
Weight:	1 lb (453 g)
Display:	Analog dial plus inset LCD display

Remote Keypad

Current consumption	65.3 mA maximum
Connectors	2 x SeaTalk (3-pin plug)
Dimensions:	4.9 in x3.1 in x 1.7 in (124 mm x 78.5 mm x 41 mm)
Weight:	0.51 lb (230 g)

Pilot Keypad

Current consumption	58.0 mA maximum
Connectors	2 x SeaTalk (3-pin plug)
Dimensions:	4.9 in x3.1 in x 1.7 in (124 mm x 78.5 mm x 41 mm)
Weight:	0.51 lb (230 g)

MOB Keypad

Current consumption	47.2 mA maximum
Connectors	2 x SeaTalk (3-pin plug)
Dimensions:	4.9 in x3.1 in x 1.7 in (124 mm x 78.5 mm x 41 mm)
Weight:	0.51 lb (230 g)

Data Processing Unit

Current consumption	250 mA maximum
Dimensions:	5.9 in x 5.12 in x 1,53 in (150 mm x 130 mm x 39 mm)
Weight:	0.52 lb (235 g)
Connectors	SeaTALK^2 (spring retention connectors) SeaTalk (spring retention connectors) Power input (spring retention connectors) NMEA 2000 (spring retention connectors) NMEA 0183 (spring retention connectors) Auxiliary alarm (spring retention connectors) USB (series B plug)

Transducer Pods

Current consumption	50 mA nominal
Dimensions:	2.6 in x 4.62 in x 1.44 in (66 mm x 117.5 mm x 36.5 mm)
Connectors	2 x SeaTALK^2 (spring retention connectors) Transducer connectors (spade terminals)
Weight:	0.31 lb (140 g)

Approvals

CE - conforms to 89/336/EEC, tested to BS EN 60945.

Section 2: Using Digital Instruments

Contents

Chapter 1: An Introduction to Digital Instruments

1.1 Overview

The ST290 system uses Graphic and Data Display digital instrument types. The Graphic Display uses a dot-matrix screen, which gives flexibility in the way data can be displayed, and offers a wide range of display formats, including graphs and animations. The Data Display has a clear, easy-to-read LCD screen, with upper and lower display areas.

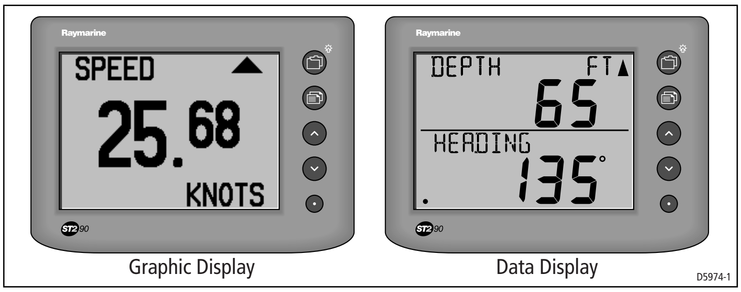


Figure 1-1: Typical digital instrument displays

Chapter & page structures

Information on both digital instrument types is organized in 'chapters' and 'pages', to enable you to easily find the data you want. Details on the chapter and page structures of the profiles available for each instrument type are given in *Section 2, Chapter 2, Graphic Display* and *Chapter 3, Data Display.*

In this handbook it is assumed that all instrument chapters and pages are available. However, **it is important to realize that some chapters and pages may not be available,** for one or more of the following reasons:

- The relevant transducers may not be fitted on your vessel, or transducer data may not be available.
- Some chapters and pages may have been disabled during customization (see *Section 7, System Setup*).
- Some chapters and pages may not be supported by the operating profile applied to the instrument you are using. See *Operating profiles* on page 2-1-6 of this chapter.

Instrument controls.

The digital instrument controls are shown in *Figure 1-2* .

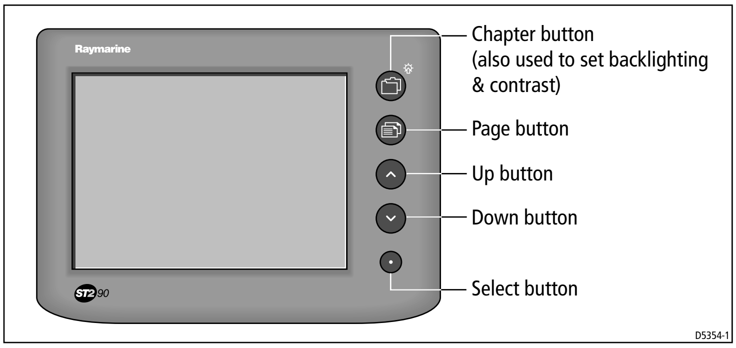


Figure 1-2: Digital instrument controls

1.2 General operating information

First switch on after installation

When a digital instrument is first switched on after installation, a new instrument PROFILE screen is displayed.

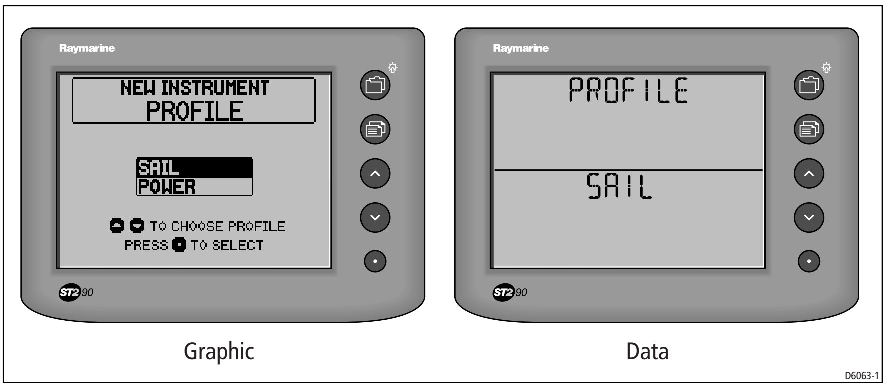


Figure 1-3: Initial profile select

Select the most appropriate profile for your boat, as follows:

1. Use the ∧ or ∨ button to select either SAIL or POWER profile.
2. Press the ⊙ button to apply the profile.

Once you have applied a profile, it is retained in the instrument and does not need to be re-applied when the instrument is switched on in the future.

Custom profiles are also available, but it is recommended you become familiar with the preset SAIL or POWER profile before attempting to set up a custom profile.

If you want to use a different operating profile, or edit a custom profile, refer to *Section 7, System Setup*.

Operating modes

Where the basic operation of both the Graphic and Data Displays is similar, the operating procedures for both are given in this chapter. Detailed instructions specific to the Graphic and Data Displays are given in *Section 2, Chapters 2 and 3*, respectively.

The basic operating modes are used by both instrument types, and the button presses required to change modes, are summarized in *Figure 1-4* . All button presses are momentary unless otherwise stated.

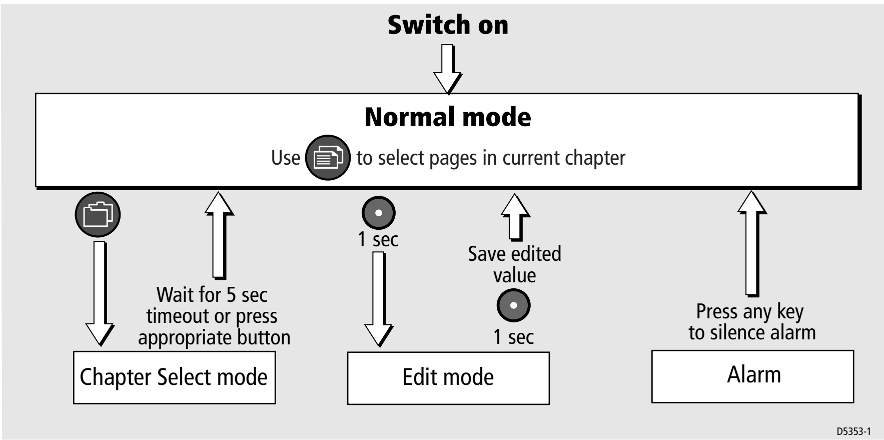


Figure 1-4: Basic operating modes

Normal mode

When first switched on, a digital instrument is in Normal mode, and the page that was in use when the instrument was last switched off, is displayed.

When using the instrument in Normal mode, you can cycle through the pages in the currently-selected chapter, using the button. Successive presses of the button will display successive pages. If the button is held down, successive pages in the selected chapter will again be displayed, but in reverse order.

If you want to change the displayed Chapter, press the button, to enter Chapter Select mode. If you take no further action after entering Chapter Select mode, the instrument will automatically return to Normal mode after 5 seconds.

In Normal mode, if you hold down the button, you enter backlighting adjust mode (see *Adjusting backlighting* on page 2-1-8). If the backlighting is off, it switches on as you enter backlighting adjust mode.

Chapter select mode

The Chapter Select mode enables you to select which chapter is displayed.

Within 5 seconds of entering Chapter Select mode, press the button, to cycle through the chapters:

- Press the button, to cycle through in one direction.
- Hold the button down for 1 second or more, to cycle through in a reverse direction.

When you have selected the required chapter, either wait for 5 seconds, or use the appropriate front panel buttons, to return to Normal mode (see *Section 2, Chapter 2 or 3*, as appropriate).

Edit mode

The Edit mode enables you to change values, as required. Typical examples are:

- Setting alarm levels.
- Resetting average speed reading to zero.
- Setting an alarm clock time.

Alarm mode

When an alarm occurs, the display will show the Alarm identity and data (if any) associated with the alarm. At the same time, an alarm beep will sound.

TO SILENCE AN ALARM, PRESS ANY INSTRUMENT BUTTON.

You can disable or enable each alarm function, and you can set levels for enabled alarms. Refer to *Section 2, Chapters 2* and *3,* for alarm setup instructions for Graphic and Data Displays, respectively.

Waypoint arrival alarm

When the waypoint arrival alarm is enabled, an alarm occurs when your boat reaches a distance you define, from a waypoint. On Graphic Displays, this distance is shown as a circle around the waypoint.

Man Overboard alarm

If the Man Overboard (MOB) alarm is triggered (from the Man Overboard Keypad (see *Section 4, Chapter 3*), the distance and bearing to the MOB location are displayed.

1.3 Instrument setup

ST290 digital instruments have a wide range of customizing and setup features, to enable you to set up the best configuration for you and your boat. The setup features are summarized here, but for details of how to implement them, refer to *Section 7, System Setup*.

Most of the setup and customization features are particular to individual digital instruments, so the chapter and page structure at any one instrument may well be different from other instruments.

User Setup chapter

A USER SETUP chapter enables you to enter User Setup mode, to set:

- Response times.
- Favorite pages.
- Which operating profile is applied.
- Display options.
- The units used for displaying data.
- Backlighting values.
- Remote control configuration.

User Setup is also used to calibrate the transducers and setup the autopilot system.

Refer to *Section 7, System Setup,* for further details on User Setup.

Operating profiles

Preset and customizable profiles enable you to select the most appropriate ranges of chapters and pages at each instrument, to best suit your methods of operation.

Preset profiles

Each instrument has the following in-built PRESET profiles:

- Full profile, which makes available all the ST290 functions appropriate to the instrument type.
- Sail boat profile.
- Power boat profile.

You CANNOT edit a PRESET profile, but you can edit custom profiles (see below).

Diagrams showing the chapter and page structures for the preset profiles for the Graphic and Data Displays are given in *Section 2, Chapter 2,* and *Chapter 3,* respectively. In these diagrams, the chapters and pages are represented thus:

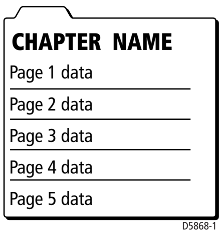


Figure 1-5: Chapter & page representation

Custom profiles

CUSTOM profiles are available at each instrument, and you can edit these to create the chapter and page combinations you require. You can create appropriate profiles for different activities (e.g. racing, cruising) or for different users.

Favorite chapter

At each digital instrument, a Favorite chapter provides a powerful feature which enables you to group together in one chapter, information that you use most often. You can include information from any chapter, to form up to five Favorite pages.

If you choose the appropriate information for your Favorite pages, it should be possible to carry out many of your day-to-day operations using just the Favorite chapter.

If your ST290 system is connected to a computer running Raymarine RayTech, you can use the Favorite pages to display RayTech data.

The manner in which Favorite pages are used with Graphic and Data Displays, is described in *Section 2, Chapter 2* and *Chapter 3* respectively.

Transducer calibration

WARNING:
It is imperative that transducer calibration is completed before the system is used, to ensure safe navigation.

Transducer calibration can be carried out from any Graphic Display. Refer to *Section 7, Chapter 2* for details.

Autopilot setup

WARNING:
It is imperative that autopilot setup is completed before the autopilot is used, to ensure safe navigation.

If a Pilot Keypad is fitted to your ST290 system, it is essential that the autopilot setup and commissioning procedures are completed before you attempt to use the autopilot (see *Section 8, Autopilots* for details). Autopilot setup can be carried out from any Graphic Display.

1.4 Backlighting & contrast adjustment

Introduction

You can set the backlighting of ST290 instruments to one of three preset lighting levels, or switch it off. In User Setup (see *Section 7, System Setup*), you can set the brightness level of each preset at each individual instrument, to any percentage value of the brightest value of the preset level.

For example, you might wish to set different backlighting levels, for instruments below and above decks.

Adjusting backlighting

Note: *Changing the backlighting level at one instrument will change the level at all other instruments in the system.*

To set the required backlighting level:

1. At any instrument operating in Normal mode, hold down the button for 1 second, to enter the Backlight Adjust mode.
2. Use the ∧ or ∨ button to set the required level, either OFF, or level 1, 2 or 3.
3. To return to normal operation, either wait for 5 seconds or press the button or the ⊙ button.

Adjusting Contrast

To adjust the display contrast:

1. With the instrument operating in Normal mode, hold down the button for 1 second, to enter the Backlight Adjust mode.
2. While in Backlight Adjust mode, hold down the button for a further 1 second, to enter Contrast Adjust mode.
3. Use the ∧ or ∨ button to set the required level.
4. To return to normal operation, either wait for 5 seconds or press the button or the ⊙ button.

1.5 Icons

The alarm and anchor alarm icons are described in *Section 1* of this handbook. Other icons used on digital instrument displays are shown in *Figure 1-6* .

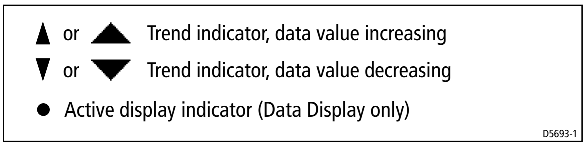


Figure 1-6: Digital instrument icons

Chapter 2: ST290 Graphic Display

2.1 Introduction

The ST290 Graphic Display uses a dot matrix display to show information in a range of different formats.

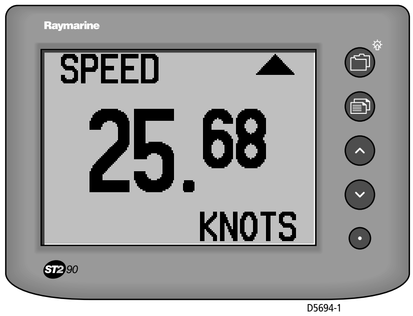


Figure 2-1: Typical Graphic Display

Chapter and page selection options

You can use either of the following options to select chapters and pages:

- **Menus option** (option 1). When you press the button during Normal operation, a menu of available chapters is displayed, and you highlight the chapter you want. A subsequent press of the button displays the pages of the selected chapter as menu items. **This is probably the best option for people with limited experience of operating marine instruments**.
- **Pop-up option** (option 2). When you press the button during normal operation, the current chapter name is displayed as a pop-up. This option is suitable for people with some previous experience of Raymarine instruments (e.g. ST80).

Use the procedures in *Section 7, System Setup* to set the required option.

Available information

The information you can see on your instrument depends on which profile is selected and on which transducers are fitted to your boat.

The chapter and page structures of the Full, Sail and Power operating profiles for the Graphic Displays are shown in diagrams at the end of this chapter. These diagrams assume that a full range of data is available (i.e. that all necessary transducers are fitted).

If you want to use a different operating profile, or edit a custom profile, refer to *Section 7, Chapter 2, Setting Up Graphic Displays*.

2.2 Operation

Getting started

At power up, each instrument is in Normal mode, using the operating profile that was in use when it was last switched off.

Note: *When an instrument is switched on for the first time after installation, an operating profile must first be selected. See Section 2, Chapter 1 for details.*

Chapter & page selection methods

The manner in which chapters and pages are selected for viewing depends on which selection option you are using (see *Introduction* above).

Menus option

Selecting chapters

When you are using the menu selection option, use the following procedure to select a new chapter:

1. Press the button to enter Chapter Select mode. The chapter menu is displayed (*Figure 2-2*).

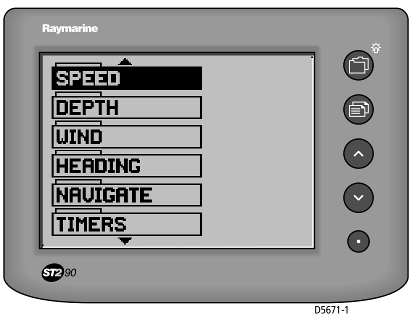


Figure 2-2: Chapter menu

Note: *The Chapter Select mode will time out to Normal operation after 5 seconds without any button presses.*

2. While in Chapter Select mode, use either the , or ∧ or ∨ button to highlight the chapter name.
3. Either press to display the page menu for the selected chapter, or press the button, to return to Normal operation and enter the selected chapter.

Selecting pages

During Normal operation, you can select pages in the selected chapter either:

- By using the button, to move to the next page:
  - Press it, to display the next page in the chapter.
  - Hold it down for 1 second, to display the previous page in the chapter.

  or
- By using the Page menu, to select pages, as follows:
  1. Press to display the chapter select menu
  2. Use the , or ∧ or ∨ button to highlight the required chapter.
  3. Press to display the Page menu for the selected chapter (see *Figure 2-3*).
  4. Use , or ∧ or ∨ to highlight the name of the page you want to display.
  5. Either press the button or wait for 5 seconds, to display the page. The instrument returns to Normal operation with the selected page displayed.

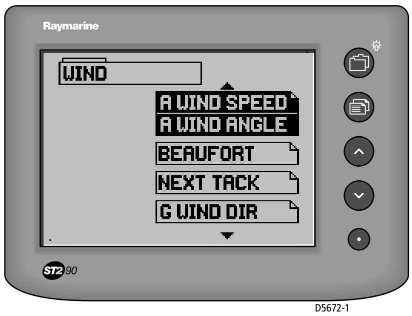


Figure 2-3: Page select menu

Pop-up option

Selecting chapters

When you are using the pop-up selection option, use the following procedure to select a new chapter:

1. Press the button to enter Chapter Select mode.
2. Use the button to cycle to the required chapter.

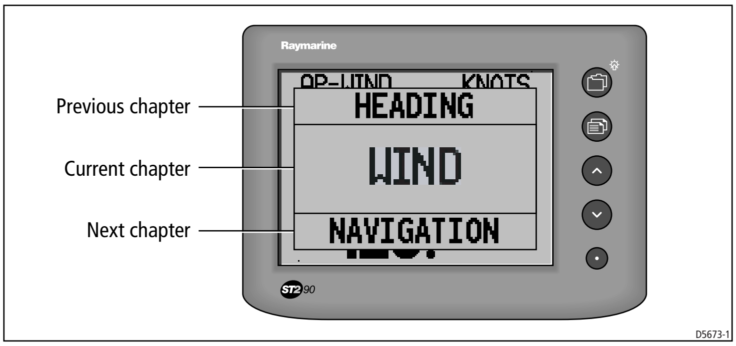


Figure 2-4: Pop-up chapter selection

3. Press either the button or the button, or wait for 5 seconds, to return to Normal operation. The display shows either the page that was last used in the selected chapter, or the top page of the selected chapter, depending which PAGE VIEWED option is set (see *Section 7, System Setup*).

The instrument returns to Normal operation.

Selecting pages

To select another page in the selected chapter during Normal operation, either press the button, to cycle through the pages in one direction, or hold it down, to cycle through the pages in the opposite direction.

2.3 Using display pages

Formats

The ST290 Graphic Display supports various page formats, so that a single page on the Graphic Display can comprise either 1, 2, or 4 data elements, arranged as shown in *Figure 2-5* .

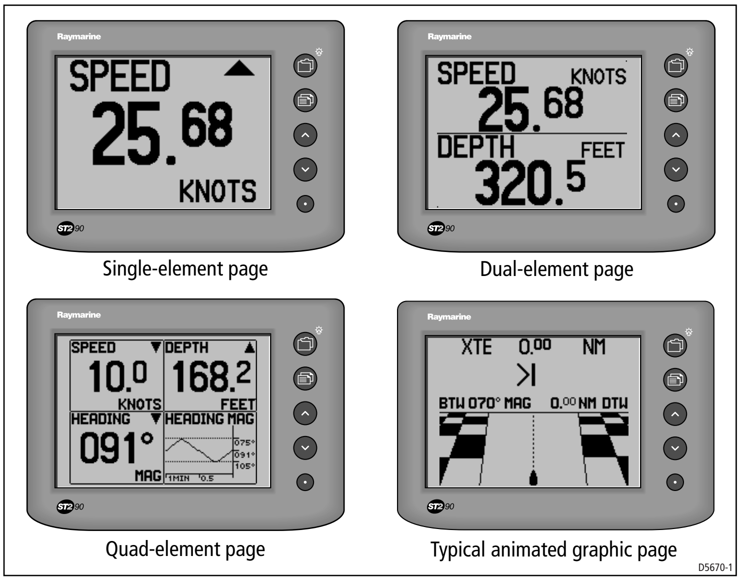


Figure 2-5: Typical Graphic pages

You can display data either alphanumerically, or as animated graphics, or in tabular form. However, some data types and some methods of showing data are not supported by all page formats.

Changing displayed values

Some Graphic Display pages have values you can change (e.g. to set alarm levels).

Note: *Animated graphic pages use pop-up menus and these are described under Animated graphic pages on page 2-2-6.*

To change editable values on Graphics Display pages:

1. Press the ⊙ button to highlight the field you want to edit. If there is more than one editable field or if you are displaying more than one element (e.g. quad-element) on which there are different editable values, use repeated presses of the ⊙ button, to move the highlight around the screen, to the field you want to change.
2. When the required field is highlighted, hold down the ⊙ button for 1 second, so the highlighted field flashes, to show it is in Edit mode.
3. Use either the ∧ or ∨ button to change the value as required.
4. Hold down the ⊙ button for 1 second to return to Normal operation.

Animated graphic pages

Animated-graphic pages are used to show:

- Graphs
- Rolling road
- Wind shift information
- Docking information

On some animated graphic pages, you can display a popup menu to change information on the screen.

Graphs

Graphs show the history of various data types, and are accessible from within the relevant chapters (see *Chapter & page details* on page 2-2-11). The vertical scale adjusts automatically to the magnitude of the data being displayed.

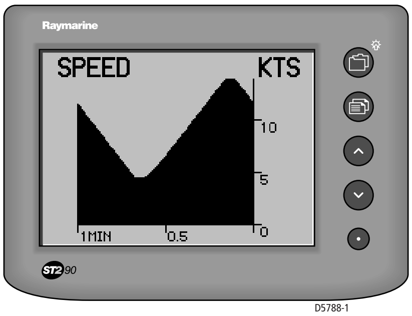


Figure 2-6: Graph

You can change the scale of a graph's horizontal axis. To do this:

1. Hold down the ⊙ button for 1 second to display the pop-up menu. This shows the horizontal scale options.
2. Use either the ∧ or ∨ button to highlight the required scale value .
3. Hold down the ⊙ button for 1 second to apply the selected value.

Rolling road

A rolling road display (in the NAVIGATION chapter) shows your boat's progress towards a waypoint.

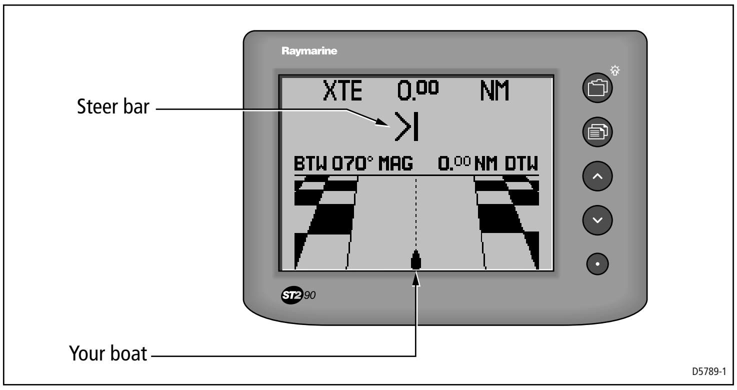


Figure 2-7: Rolling road display

If you deviate from the optimum course, the steer bar shows how to steer to return to the correct course:

- The number of arrows is proportional to the amount of correction required.
- The direction of the arrow(s) indicates the direction to steer.

You can change the data displayed at the top of the page (XTE in *Figure 2-7*). To do this:

1. Hold down the ⊙ button for 1 second to display the pop-up menu. This shows the options for the data you can display, namely XTE, SPEED, SOG, VMG TO WP, ETA, TTG, HEADING,COG or WAYPOINT.
2. Use either the ∧ or ∨ button to highlight the required data.
3. Hold down the ⊙ button for 1 second to display the selected data.

Wind shift display

A wind shift display (in the WIND chapter) enables you to set an angle for the required apparent wind speed, and shows a real time representation of your vessel with respect to this setting. The head or lift value is indicated. A steer bar near the top of the screen shows how to steer, to achieve the required wind angle:

- The number of arrows is proportional to the amount of correction required.
- The direction of the arrow(s) indicates the direction to steer.

You can set the required apparent wind angle to either a specified value or to the current wind angle.

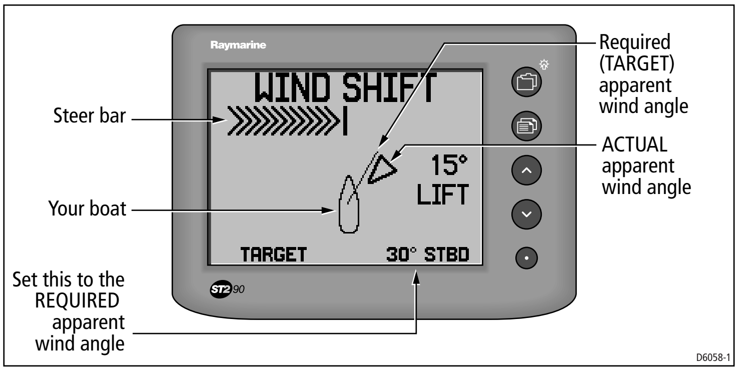


Figure 2-8: Wind shift display

To set the required apparent wind angle to a specified value:

1. Hold down the ⦿ button for 1 second, to enter edit mode. The TARGET value flashes.
2. Use either the ∧ or ∨ button to set the required apparent wind angle, as the TARGET value.
3. Hold down the ⦿ button for 1 second to leave edit mode.

To set the required apparent wind angle to the current wind angle, press the ⦿ button.

Docking display

A docking display (in the WIND chapter) shows the prevailing wind and tide conditions with respect to your vessel, and a rudder angle indicator, to aid docking.

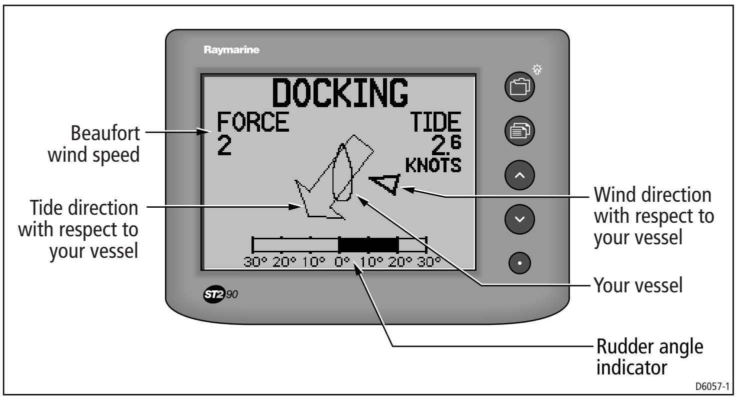


Figure 2-9: Docking display

Using Favorite pages

The Favorite chapter enables you to group together in one chapter, information you use most often. You can include information from any other chapter, to form a Favorite chapter of up to five pages.

To see the Favorite pages, use the button to select the Favorite chapter and the button to select the required Favorite pages.

Note: *If the Favorite chapter is set to operate with an automatic rollover, the button has no effect.*

Setup overview

You can set each Favorite page to any one of the Graphic Display standard formats, shown in *Figure 2-5* :

- Single element.
- Dual element.
- Quad element.

You can set each page element to show any type of available data. All the data in the Graphic Display Full profile is available.

In addition, if ST290 is connected to a computer running Raymarine RayTech, you can allocate RayTech pages as Favorite pages.

Note: *To determine which RayTech pages are available, refer to your RayTech handbook.*

To define how many pages are in the Favorite chapter and whether an automatic, timed rollover is applied to your Favorite pages, use the procedures in *Section 7, Chapter 2*.

Setting the contents of Favorite pages

To define the content of the Favorite pages:

1. Select the Favorite chapter.
2. Use the button to display the Favorite page you want to configure.
3. Hold down the ⊙ button for 1 second to enter Favorite page edit mode, with the Favorite page setup menu displayed (*Figure 2-10*).

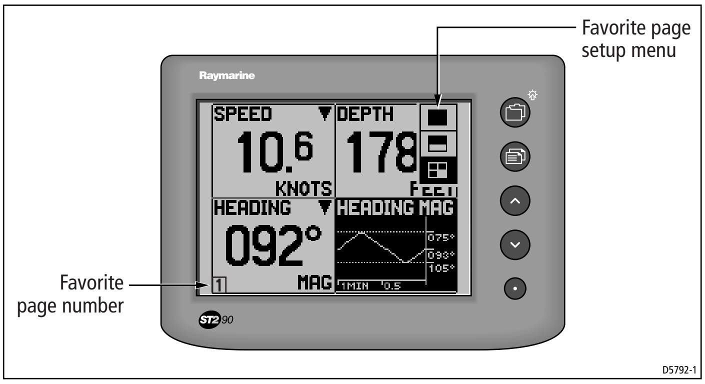


Figure 2-10: Favorite page format menu

4. Use the ∧ or ∨ button to highlight the required display layout on the the Favorite page setup menu. The page layout changes to match your selection, and the editable page area is highlighted.
5. If you are setting-up a dual- or quad-element page, press the ⊙ button to highlight the page area you want to change.
6. Use the button to select the required page element in the highlighted page area, so the data you want is displayed.
7. If you are setting-up a dual- or quad-element page, repeat this procedure as necessary from step 5, for the remaining page elements.
8. Hold down the ⊙ button for 1 second to save the data for this Favorite page and leave edit mode.
9. Repeat the procedure in steps 2 to 8 for each Favorite page.

2.4 Chapter & page details

The salient points of the Graphic Display chapters and pages are summarized here. Use the **Glossary** in *Section 9* of this handbook as necessary, for descriptions of the abbreviations used.

Speed chapter

The chapter menu title is SPEED and the pages are summarized in *Table 2-1* .

Table 2-1: SPEED chapter pages

Page content	Description
SPEED	Boat speed, in KNOTS, miles per hour (MPH) or kilometers per hour (KM/H)
AVG SPEED	Average speed, in KNOTS,MPH or KM/H
MAX SPEED	Maximum speed, in KNOTS,MPH or KM/H
TOTAL LOG	Total log, in statute miles (SM), kilometers (KM) or nautical miles (NM)
TRIP LOG	Trip logs, 1 to 5. Each shows distance in SM, KM or NM
VMG TO WIND	Velocity made good to windward, in KNOTS,MPH or KM/H
VMG TO WP	Velocity made good to waypoint, in KNOTS,MPH or KM/H
SPEED (graph)	Graph showing speed history

Resetting speed values

To reset the average speed, maximum speed or trip log:

1. In the Speed chapter, select the appropriate page (AVG SPEED, MAX SPEED or TRIP LOG).
2. Hold down the ⊙ button for 2 seconds. After 1 second the displayed value flashes and after 2 seconds it resets. AVG SPEED and MAX SPEED reset to the current speed value; TRIP LOG resets to zero

If you decide not to reset a value, release the ⊙ button before 2 seconds has elapsed, to retain the current value.

Depth chapter

The chapter menu title is DEPTH. The pages are summarized in *Table 2-2* .

Table 2-2: DEPTH chapter pages

Page content	Description
DEPTH	Current depth
MIN DEPTH	Minimum depth
MAX DEPTH	Maximum depth
DP OFFSET	Depth transducer offset shown in numeric form (METERS, FEET or FATHOMS).
DEPTH (graph)	Graph showing depth history

Resetting depth values

To reset the minimum depth or maximum depth value:

1. In the Depth chapter, select the appropriate page.
2. Hold down the ⊙ button for 2 seconds. After 1 second the displayed value flashes and after 2 seconds, it resets to the current depth value.

Depth transducer offset

Depths are measured from the Depth transducer to the seabed. However, you can apply an offset to the actual distance measured so that the displayed depth reading represents the depth either from the waterline (positive offset) or from the bottom of the keel (negative offset).

WARNING:
The use of incorrect offset values could result in misleading depth information being displayed with a consequent risk of running aground.

Before using your ST290 system, ensure the correct depth transducer offset has been set, as detailed in *Section 7, System Setup*.

Heading chapter

The chapter menu title is HEADING. The pages are summarized in *Table 2-3* .

Table 2-3: HEADING chapter pages

Page content	**Description**
HEADING	Compass bearing
COG	Course over ground (not shown when operating with FULL profile)
TACK HEADING	Heading on next tack
LOCKED HDG	Locked heading plus steer bar graphic
HEADING (graph)	Graph showing history of heading values

There are no adjustable values in the Heading chapter.

Wind chapter

The chapter menu title is WIND. The pages are summarized in *Table 2-4* .

Table 2-4: WIND chapter pages

Page content	**Description**
A WIND SPEED	Apparent wind speed
A WIND ANGLE	Apparent wind angle, in degrees, relative to vessel
T WIND SPEED	True wind speed
T WIND ANGLE	True wind angle, in degrees, relative to vessel
WIND DIR	True magnetic wind direction (compass bearing)
WIND FORCE	Beaufort wind force
CARDINAL	Cardinal wind direction
WIND SHIFT	Head or Lift in degrees
DOCKING	Active graphic showing wind direction relative to plan view of vessel
A WIND SPEED (graph)	Graph showing history of apparent wind speed

Table 2-4: WIND chapter pages (continued)

Page content	Description
A WIND ANGLE (graph)	Graph showing history of apparent wind angle
T WIND SPEED (graph)	Graph showing history of true wind speed
T WIND ANGLE (graph)	Graph showing history of true wind angle
WIND DIR (graph)	Graph showing history of magnetic wind direction

There are no adjustable values in the Wind chapter.

Navigation chapter

The chapter menu title is NAVIGATION. The pages are summarized in *Table 2-5* .

Table 2-5: NAVIGATION chapter pages

Page content	Description
LATITUDE	In the format134º 2.320W
LONGITUDE	In the format 50º 2.310N
TIME	Local time (not shown when operating with FULL profile)
COG	Course over ground, in degrees, MAG(netic) or TRUE
SOG	Speed over ground, in KNOTS,MPH or KM/H
BTW	Bearing to waypoint, in degrees, MAG(netic) or TRUE
CMG	Course made good, in degrees, MAG(netic) or TRUE
DMG	Distance made good, in SM, KM or NM
WP NAME	Waypoint name
BTW	Bearing to waypoint, in degrees, MAG(netic) or TRUE
DTW	Distance to waypoint, in SM, KM or NM
ETA	Estimated time of arrival (at waypoint)
TTG	Time to go (to waypoint), in hours (HRS)

Table 2-5: NAVIGATION chapter pages (continued)

Page content	Description
XTE	Cross track error
ROLLING ROAD	Rolling road graphic, BTW and DTW, plus either XTE, SPEED, SOG, VMG TO WP, ETA, TTG, HEADING,COG or WAYPOINT, selectable by user.

There are no adjustable values in the Navigate chapter.

GPS chapter

The chapter menu title is GPS. The pages are summarized in *Table 2-6* .

Table 2-6: GPS chapter pages

Page content	Description
FIX SATELLITES HDOP	Fix status Number of satellites Horizontal dilution of position

There are no adjustable values in the GPS chapter.

Pilot chapter

The PILOT chapter shows the status of the autopilot. Examples of PILOT status screens are given in *Section 8, Chapter 2*.

If an autopilot is not connected to the ST290 system, the PILOT chapter is not available.

Timers chapter

The chapter menu title is TIMERS. The pages are summarized in *Table 2-7*

Table 2-7: TIMERS chapter pages

Page content	Description
LOCAL TIME	Local time
DATE	Date

Table 2-7: TIMERS chapter pages

Page content	Description
ALARM CLOCK	Alarm clock
COUNTDOWN	Countdown timer
STOPWATCH	Stop watch
RACE START	Race start, gun 1 time
RACE START	Race start, gun 2 time
RACE START	Race start, gun 3 time
RACE TIMER	Count up timer

Alarm clock

Setting the alarm clock off/on

To turn the alarm clock off or on:

1. In the Timers chapter, select the ALARM CLOCK page.
2. Press the ⊙ button momentarily to display either ON or OFF, as required.

Setting the alarm time

To set the alarm time:

1. In the Timers chapter, select the ALARM CLOCK page.
2. Hold down the ⊙ button for 1 second, to enter Edit mode. The minutes value flashes.
3. Use the ∧ or ∨ button to set the required minutes value in the alarm time.
4. Press the ⊙ button, to edit the hours.The hours value flashes.
5. Use the ∧ or ∨ button to either set the required hours value in the alarm time,
6. Hold down the ⊙ button for 1 second, to leave the edit mode.

Countdown timer

Setting the countdown time

To set the countdown time:

1. In the Timers chapter, select the COUNTDOWN page.
2. Hold down the ⊙ button for 1 second, to enter Edit mode. The seconds value flashes.
3. Use the ∧ or ∨ button to set the required seconds value.
4. Press the ⊙ button, to edit the minutes. The minutes value flashes.
5. Use the ∧ or ∨ button to set the required minutes value.
6. Hold down the ⊙ button for 1 second, to leave the edit mode.

Starting & stopping the countdown timer

To start or stop the countdown timer:

1. In the Timers chapter, select the COUNTDOWN page.
2. Press the ⊙ button. If the countdown timer was running, it stops. If the countdown timer was stopped, it starts counting.

Stopwatch/lap timer

The following description of how to use the stopwatch/lap timer, assumes a typical operational sequence:

- Starting the stopwatch from a stopped condition.
- Obtaining lap times while the stopwatch is running.
- Stopping and resetting the stopwatch.

Starting the stopwatch

To start the stopwatch from a stopped condition:

1. In the Timers chapter, select the STOPWATCH page.
2. Press the ⊙ button. The stopwatch starts counting up.

Obtaining lap times

To obtain a lap time:

1. In the Timers chapter, select the STOPWATCH page.
2. With the stopwatch counting up, press the ⊙ button. The lap time is displayed, and the stopwatch continues counting up in the background.
3. To return to the real time count, press the ⊙ button again.

Stopping & resetting the stopwatch

1. In the Timers chapter, select the STOPWATCH page.
2. Hold down the ⊙ button for 1 second. The stopwatch stops counting. To reset the stopwatch to zero, hold down the ⊙ button for 2 seconds.

Race timers

There are three RACE START countdown timers, and one RACE START count up timer. Each of the countdown timers counts down from a value determined during set up (see *Section 7, System Setup*). The race timer counts up from the start of the race.

To start or stop a race gun timer:

1. In the TIMERS chapter, select the required RACE START countdown timer.
2. Press the ⊙ button. The timer then counts down from its preset value to zero. After the countdown time out, the count up timer starts counting up, to show elapsed race time.

Engine chapter

Note: *In order to display engine information, the appropriate manufacturer's interface must be installed.*

The chapter title is ENGINE. The pages are summarized in *Table 2-8* .

Table 2-8: ENGINE chapter pages

Page content	Description
RPM	Number of revolutions per minute
FUEL RATE	Fuel rate, in liters per hour (L/H) or gallons per hour (G/H)
COOLANT	Coolant level, in liters (LTR) or gallons (GAL)
FUEL LEVEL	Fuel level, in either LTR or GAL
ENGINE TEMP	Engine temperature, in either °C or °F
EXHAUST	Exhaust gas temperature, in either °C or °F
BATTERY	Battery voltage
BOOST	Boost pressure, in pounds per square inch (PSI)
ENGINE LOG	Engine hours

There are no adjustable values in the Engine chapter.

Alarms chapter

The chapter menu title is ALARMS and for each alarm page, a 🔔 icon is displayed. The alarm pages show the status (OFF or alarm level) of the system alarms. The alarms are summarized in *Table 2-9* .

Table 2-9: ALARMS chapter pages

Page content	**Description**
SHALLOW	Shallow water alarm level, in MTR, FT or FTM
DEEP	Deep water alarm level, in MTR, FT or FTM
SHALL ANCHOR	Shallow anchor alarm level, in MTR, FT or FTM
DEEP ANCHOR	Deep anchor alarm level, in MTR, FT or FTM
OFF COURSE	Off course alarm, in degrees
AWA HIGH	Apparent wind angle high alarm, in degrees
AWA LOW	Apparent wind angle low alarm, in degrees
AWS HIGH	Apparent wind speed high alarm
AWS LOW	Apparent wind speed low alarm
TWA HIGH	True wind angle high alarm, in degrees
TWA LOW	True wind angle low alarm, in degrees
TWS HIGH	True wind speed high alarm, in KTS or M/S
TWS LOW	True wind speed low alarm, in KTS or M/S
SPEED HIGH	Boat speed high alarm, in KTS, K/H or MPH
SPEED LOW	Boat speed low alarm, in KTS, K/H or MPH
HI SEA TEMP, in °C or °F	Sea temperature high alarm
LO SEA TEMP, in °C or °F	Sea temperature low alarm

You can use the ALARMS chapter pages to:

- Switch each alarm OFF, or on, or so that it operates with an external (Auxiliary) Alarm, connected to the DPU **AUX ALARM** terminals (see *Enabling alarms* below).
- Set a level for each alarm type (see *Setting alarm levels* below).

Enabling alarms

To enable or disable an alarm:

1. In the Alarms chapter, select the required alarm page.

   The alarm page shows either OFF to indicate the alarm is disabled, or an alarm level value to indicate the alarm is enabled.

2. Use the ⦿ button as necessary, to set the alarm either:
   - OFF

     or
   - So it shows a level value. With this setting, an activated alarm will sound at the ST290 system.

     or
   - So it shows a level value, and an A indicator. With this setting, an activated alarm will sound both at the ST290 system and at an Auxiliary Alarm, when connected to the DPU.

Setting alarm levels

To set an alarm level:

1. In the Alarms chapter, select the required alarm page.
2. Hold down the ⦿ button for 1 second, to enter Edit mode. The current level for this alarm flashes.
3. Use the ∧ or ∨ button, to set the alarm level as required.
4. Hold down the ⦿ button for 1 second, to leave the edit mode.

Environment chapter

The chapter menu title is ENVIRONMENT. The pages are summarized in *Table 2-10* .

Table 2-10: ENVIRONMENT chapter pages

Page content	Description
SEA TEMP	Sea temperature, in °C or °F
TIDE SET	Tide set (calculated), in degrees
TIDE RATE	Tide rate (calculated), in KTS, K/H or MPH
SUNRISE	Sunrise time
TWILIGHT AM	Morning twilight time

Table 2-10: ENVIRONMENT chapter pages

Page content	Description
SUNSET	Sunset time
TWILIGHT PM	Evening twilight time

There are no adjustable values in the Environment chapter.

Sunrise, sunset & twilight at extreme latitudes

The displayed sunrise, sunset and twilight times are valid in most cases. However, at extreme latitudes during periods of extended day or night, these times may not be accurate.

Vessel chapter

The chapter menu title is VESSEL. The pages are summarized in *Table 2-11* .

Table 2-11: VESSEL chapter pages

Page content	Description
POSITION LOG TIME DATE LATITUDE LONGITUDE CMG DMG WIND SPEED WIND DIR	Position log Local time Local date Latitude Longitude Course made good Distance made good Wind speed Wind direction
RUDDER ANGLE	Rudder angle
BATTERY V	Battery voltage

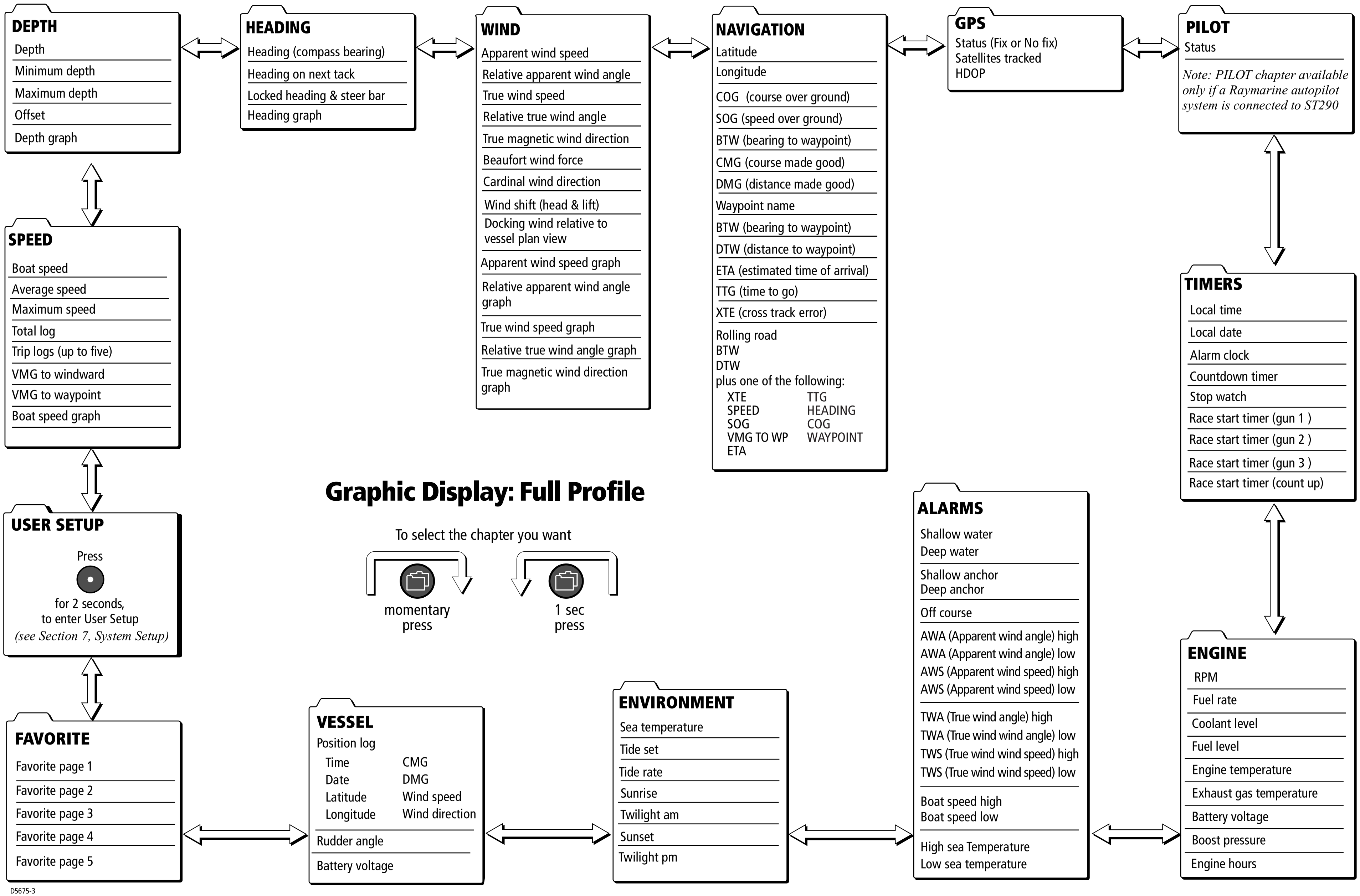
There are no adjustable values in the Vessel chapter.

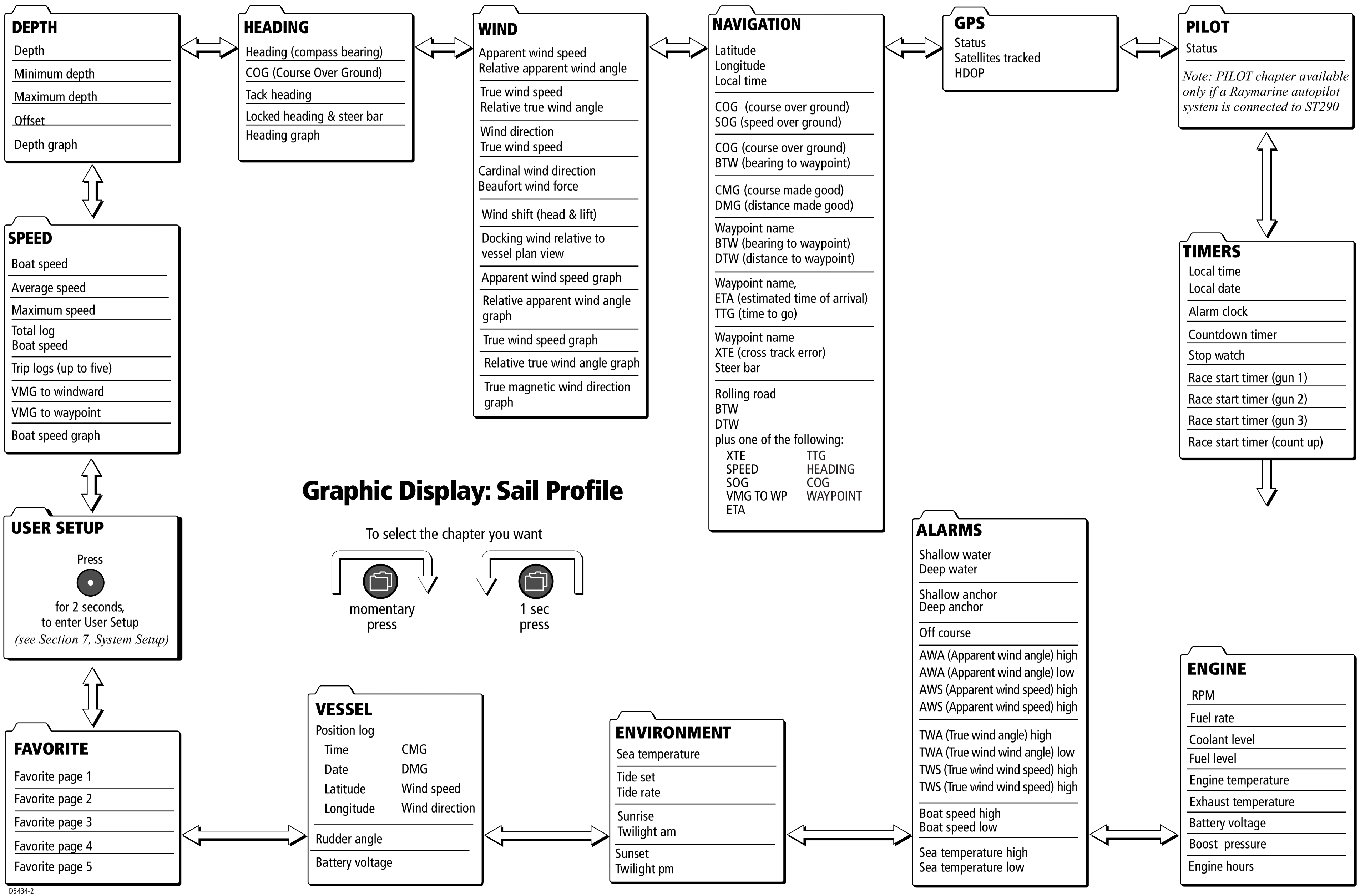
Favorite chapter

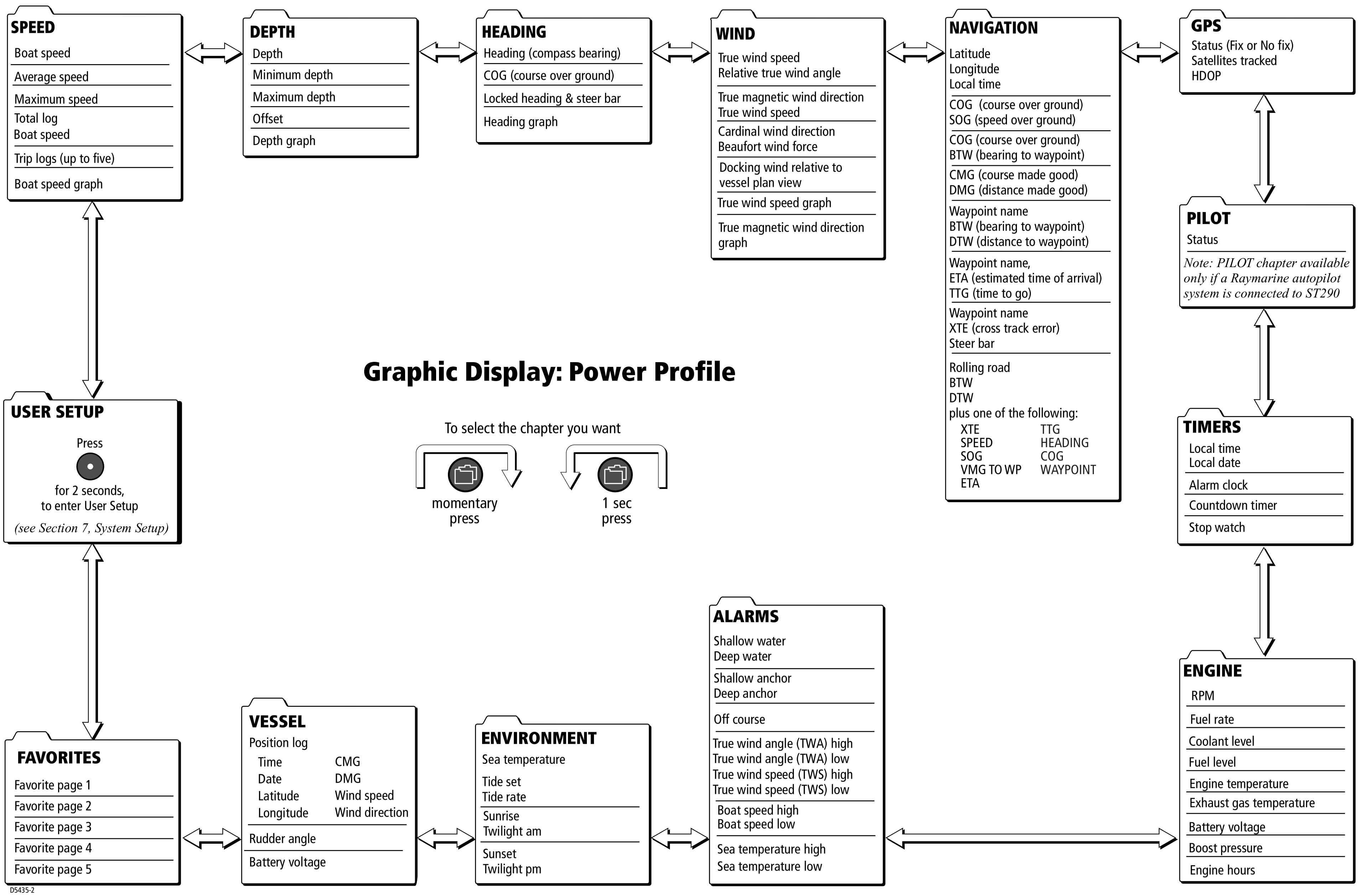
See *Using Favorite pages*, earlier in this chapter.

User Setup chapter

See *Section 7, System Setup*


DEPTH
Depth
Minimum depth
Maximum depth
Offset
Depth graph
HEADING
Heading (compass bearing)
Heading on next tack
Locked heading & steer bar
Heading graph
WIND
Apparent wind speed
Relative apparent wind angle
True wind speed
Relative true wind angle
True magnetic wind direction
Beaufort wind force
Cardinal wind direction
Wind shift (head & lift)
Docking wind relative to vessel plan view
Apparent wind speed graph
Relative apparent wind angle graph
True wind speed graph
Relative true wind angle graph
True magnetic wind direction graph
NAVIGATION
Latitude
Longitude
COG (course over ground)
SOG (speed over ground)
BTW (bearing to waypoint)
CMG (course made good)
DMG (distance made good)
Waypoint name
BTW (bearing to waypoint)
DTW (distance to waypoint)
ETA (estimated time of arrival)
TTG (time to go)
XTE (cross track error)
Rolling road
BTW
DTW
plus one of the following:
XTE TTG
SPEED HEADING
SOG COG
VMG TO WP WAYPOINT
ETA
GPS
Status (Fix or No fix)
Satellites tracked
HDOP
PILOT
Status
Note: PILOT chapter available only if a Raymarine autopilot system is connected to ST290
SPEED
Boat speed
Average speed
Maximum speed
Total log
Trip logs (up to five)
VMG to windward
VMG to waypoint
Boat speed graph
Graphic Display: Full Profile
To select the chapter you want
momentary press
1 sec press
TIMERS
Local time
Local date
Alarm clock
Countdown timer
Stop watch
Race start timer (gun 1)
Race start timer (gun 2)
Race start timer (gun 3)
Race start timer (count up)
USER SETUP
Press
for 2 seconds,
to enter User Setup
(see Section 7, System Setup)
ALARMS
Shallow water
Deep water
Shallow anchor
Deep anchor
Off course
AWA (Apparent wind angle) high
AWA (Apparent wind angle) low
AWS (Apparent wind speed) high
AWS (Apparent wind speed) low
TWA (True wind angle) high
TWA (True wind wind angle) low
TWS (True wind wind speed) high
TWS (True wind wind speed) low
Boat speed high
Boat speed low
High sea Temperature
Low sea temperature
ENGINE
RPM
Fuel rate
Coolant level
Fuel level
Engine temperature
Exhaust gas temperature
Battery voltage
Boost pressure
Engine hours
FAVORITE
Favorite page 1
Favorite page 2
Favorite page 3
Favorite page 4
Favorite page 5
VESSEL
Position log
Time CMG
Date DMG
Latitude Wind speed
Longitude Wind direction
Rudder angle
Battery voltage
ENVIRONMENT
Sea temperature
Tide set
Tide rate
Sunrise
Twilight am
Sunset
Twilight pm
D5675-3


Graphic Display: Sail Profile
To select the chapter you want
momentary press
1 sec press
DEPTH
Depth
Minimum depth
Maximum depth
Offset
Depth graph
HEADING
Heading (compass bearing)
COG (Course Over Ground)
Tack heading
Locked heading & steer bar
Heading graph
WIND
Apparent wind speed
Relative apparent wind angle
True wind speed
Relative true wind angle
Wind direction
True wind speed
Cardinal wind direction
Beaufort wind force
Wind shift (head & lift)
Docking wind relative to vessel plan view
Apparent wind speed graph
Relative apparent wind angle graph
True wind speed graph
Relative true wind angle graph
True magnetic wind direction graph
NAVIGATION
Latitude
Longitude
Local time
COG (course over ground)
SOG (speed over ground)
COG (course over ground)
BTW (bearing to waypoint)
CMG (course made good)
DMG (distance made good)
Waypoint name
BTW (bearing to waypoint)
DTW (distance to waypoint)
Waypoint name,
ETA (estimated time of arrival)
TTG (time to go)
Waypoint name
XTE (cross track error)
Steer bar
Rolling road
BTW
DTW
plus one of the following:
XTE TTG
SPEED HEADING
SOG COG
VMG TO WP WAYPOINT
ETA
GPS
Status
Satellites tracked
HDOP
PILOT
Status
Note: PILOT chapter available only if a Raymarine autopilot system is connected to ST290
TIMERS
Local time
Local date
Alarm clock
Countdown timer
Stop watch
Race start timer (gun 1)
Race start timer (gun 2)
Race start timer (gun 3)
Race start timer (count up)
SPEED
Boat speed
Average speed
Maximum speed
Total log
Boat speed
Trip logs (up to five)
VMG to windward
VMG to waypoint
Boat speed graph
USER SETUP
Press
for 2 seconds,
to enter User Setup
(see Section 7, System Setup)
FAVORITE
Favorite page 1
Favorite page 2
Favorite page 3
Favorite page 4
Favorite page 5
VESSEL
Position log
Time CMG
Date DMG
Latitude Wind speed
Longitude Wind direction
Rudder angle
Battery voltage
ENVIRONMENT
Sea temperature
Tide set
Tide rate
Sunrise
Twilight am
Sunset
Twilight pm
ALARMS
Shallow water
Deep water
Shallow anchor
Deep anchor
Off course
AWA (Apparent wind angle) high
AWA (Apparent wind angle) low
AWS (Apparent wind speed) high
AWS (Apparent wind speed) high
TWA (True wind angle) high
TWA (True wind wind angle) low
TWS (True wind wind speed) high
TWS (True wind wind speed) high
Boat speed high
Boat speed low
Sea temperature high
Sea temperature low
ENGINE
RPM
Fuel rate
Coolant level
Fuel level
Engine temperature
Exhaust temperature
Battery voltage
Boost pressure
Engine hours
D5434-2


SPEED
Boat speed
Average speed
Maximum speed
Total log
Boat speed
Trip logs (up to five)
Boat speed graph
DEPTH
Depth
Minimum depth
Maximum depth
Offset
Depth graph
HEADING
Heading (compass bearing)
COG (course over ground)
Locked heading & steer bar
Heading graph
WIND
True wind speed
Relative true wind angle
True magnetic wind direction
True wind speed
Cardinal wind direction
Beaufort wind force
Docking wind relative to vessel plan view
True wind speed graph
True magnetic wind direction graph
NAVIGATION
Latitude
Longitude
Local time
COG (course over ground)
SOG (speed over ground)
COG (course over ground)
BTW (bearing to waypoint)
CMG (course made good)
DMG (distance made good)
Waypoint name
BTW (bearing to waypoint)
DTW (distance to waypoint)
Waypoint name,
ETA (estimated time of arrival)
TTG (time to go)
Waypoint name
XTE (cross track error)
Steer bar
Rolling road
BTW
DTW
plus one of the following:
XTE
SPEED
SOG
VMG TO WP
ETA
TTG
HEADING
COG
WAYPOINT
GPS
Status (Fix or No fix)
Satellites tracked
HDOP
PILOT
Status
Note: PILOT chapter available only if a Raymarine autopilot system is connected to ST290
TIMERS
Local time
Local date
Alarm clock
Countdown timer
Stop watch
USER SETUP
Press
for 2 seconds, to enter User Setup
(see Section 7, System Setup)
Graphic Display: Power Profile
To select the chapter you want
momentary press
1 sec press
ALARMS
Shallow water
Deep water
Shallow anchor
Deep anchor
Off course
True wind angle (TWA) high
True wind angle (TWA) low
True wind speed (TWS) high
True wind speed (TWS) low
Boat speed high
Boat speed low
Sea temperature high
Sea temperature low
ENGINE
RPM
Fuel rate
Coolant level
Fuel level
Engine temperature
Exhaust gas temperature
Battery voltage
Boost pressure
Engine hours
FAVORITES
Favorite page 1
Favorite page 2
Favorite page 3
Favorite page 4
Favorite page 5
VESSEL
Position log
Time
Date
Latitude
Longitude
CMG
DMG
Wind speed
Wind direction
Rudder angle
Battery voltage
ENVIRONMENT
Sea temperature
Tide set
Tide rate
Sunrise
Twilight am
Sunset
Twilight pm
D5435-2

Chapter 3: ST290 Data Display

3.1 Introduction

The ST290 Data Display has separate upper and lower display areas, each of which operates independently of the other, to show information from any enabled chapter.

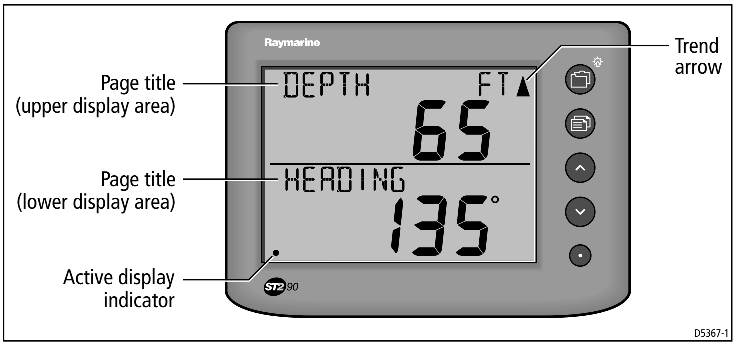


Figure 3-1: Data Display, basic features

Chapter and page titles

During Normal operation, the page title is shown at the top of each display area.

Chapter titles can be turned on or off during User Setup (see *Section 7*), but it is recommended you do not turn them off unless you are very familiar with the chapter and page structures.

In Chapter Select mode, when the chapter titles are turned on, the chapter title is displayed at the top of the relevant display area and centered horizontally.

Available information

The information you can see on your instrument depends on which profile is selected and on which transducers are fitted to your boat.

The chapter and page structures of the Full, Sail and Power operating profiles for the Data Displays are shown in diagrams at the end of this chapter. These diagrams assume that a full range of data is available (i.e. that all necessary transducers are fitted).

If you want to use a different operating profile, or edit a custom profile, refer to *Section 7, Chapter 3, Setting Up Data Displays*.

3.2 Operation

Getting started

At power up, each digital instrument is in Normal mode, using the operating profile that was in use when the instrument was last switched off.

Note: *When an instrument is switched on for the first time after installation, an operating profile must first be selected. See Section 2, Chapter 1 for details.*

Selecting active display area

In Normal mode, the upper and lower displays update continuously to show the current data in their respective chapters.

In order to make any changes to either display area (for example, to select another page or chapter), you must first select that area as the active display area. To do this, use the ∧ or ∨ button, to move the active display indicator to the required display area (see *Figure 3-2*).

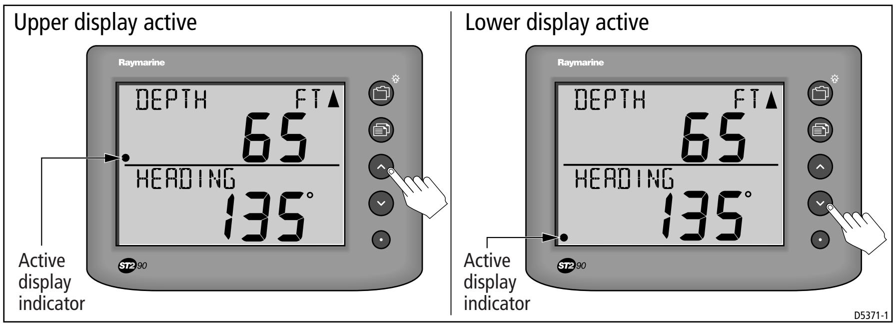


Figure 3-2: Selecting the adjustable display area

Selecting chapters & pages

Chapters

To select a different chapter in either display area (upper or lower):

1. Use the ∧ or ∨ button to select the required active display area (see *Figure 3-2*). The active display indicator moves to the selected area.

2. Press the button, to enter Chapter Select mode. In Chapter Select mode, the title of the currently-selected chapter is displayed, centered horizontally.

Note: *The Chapter Select mode times out to Normal mode if there are no button presses for 5 seconds.*

3. **While in Chapter Select mode**, press the button to cycle through the chapters names, until the name of the chapter you want is displayed:
   - Press the button, to move in one direction through the chapters or
   - Hold down the button for 1 second or more, to move in the opposite direction through the chapters.
4. Either wait for the 5 second time out, or press the button, to return to Normal mode. The page first displayed in your newly-selected chapter depends on which First Page option is set up. It is either:
   - The page that was last displayed when the chapter was last used. or
   - The top page in the chapter (as shown in the profile diagrams).

To set the required First Page option, refer to *Section 7, System Setup.*

Pages

In Normal mode, use the button to change pages, in the selected chapter. Press it, to move in one direction through the pages, or hold it down for 1 second or more, to move in the opposite direction.

Using Favorite pages

The Favorite chapter enables you to group together in one chapter, information you use most often. You can include information from any other chapter, to form a Favorite chapter of up to five pages. The Favorite chapter title is FAVORITE U for the upper display area and FAVORITE L for the lower

To see the Favorite pages, use the button to select the Favorite chapter and the button to select the required Favorite pages.

Note: *If the Favorite chapter is set to operate with an automatic rollover, the button has no effect.*

To define which information you want in the Favorite chapter, refer to *Section 7, System Setup*.

Setting Favorite operating method

During Normal operation, you can choose how the Favorite chapter operates. This is either:

- **Manually**. The Favorite chapter operates like any other chapter, i.e. each Favorite page is selected using the button,
  or
- **With an automatic rollover**. Each page is displayed for a period of time you set up, then the next page is automatically displayed.

To set the method of Favorite page display:

1. Select the Favorite chapter.
2. Hold down the button for 1 second, to display the Favorite roll-over setup page (*Figure 3-3*).

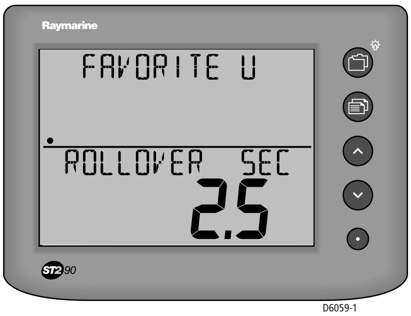


Figure 3-3: Set Favorite rollover page

3. Use the ∧ or ∨ button to set the mode you want:
   - If you want to use the button to select the Favorite pages manually during Normal operation (i.e. without a roll around), choose 0.0
   - If you want the Favorite pages to rollover automatically, set the time you want each page to be displayed (between 0.5 and 20 seconds).
4. Hold down the button for 1 second, to save and return to Normal operation.

3.3 Chapter & page details

The salient points of the Data Display chapters and pages are summarized here. Use the **Glossary** in *Section 9* of this handbook as necessary, for descriptions of abbreviations.

Speed chapter

The on-screen chapter title is SPEED and the pages are summarized in *Table 3-1* .

Table 3-1: SPEED chapter pages

Page content	Description
SPEED	Boat speed, in knots (KTS), miles per hour (MPH) or kilometers per hour (K/H)
AV SPEED	Average speed since last reset, in KTS, MPH or K/H
MAX SPEED	Maximum speed since last reset, in KTS, MPH or K/H
TOTAL LOG	Total log, in statute miles (SM), kilometers (KM) or nautical miles (NM)
TRIP LOG	Trip log, in SM, KM or NM
VMG WIND in	Velocity made good to windward, in KTS, MPH or K/H
VMG TO WP	Velocity made good to waypoint, in KTS, MPH or K/H

Resetting speed values

To reset the average speed, maximum speed or trip log value:

1. In the Speed chapter, select the appropriate page (AV SPEED, MAX SPEED or TRIP LOG, as appropriate).
2. Hold down the ⦿ button for 2 seconds. After 1 second the displayed value flashes and after 2 seconds, it resets. AV SPEED and MAX SPEED reset to the current speed. TRIP LOG resets to 0.

Depth chapter

The on-screen chapter title is DEPTH. The pages are summarized in *Table 3-2* .

Table 3-2: DEPTH chapter pages

Page content	Description
DEPTH	Current depth, in meters (MTR), feet (FT) or fathoms (FTM)
MIN DEPTH	Minimum depth since last reset,in MTR, FT or FTM
MAX DEPTH	Maximum depth since last reset,in MTR, FT or FTM
DP OFFSET	Depth transducer offset,in MTR, FT or FTM

Resetting depth values

To reset the minimum depth or maximum depth value:

1. In the Depth chapter, select the appropriate page (MIN DEPTH or MAX DEPTH, as appropriate).
2. Hold down the ⦿ button for 2 seconds. After 1 second the displayed value flashes and after 2 seconds, it resets to the current depth reading.

Depth transducer offset

Depths are measured from the Depth transducer to the seabed. During setup, a depth transducer offset can be applied to the actual distance measured, so that the displayed depth reading represents the depth either from the waterline (positive offset) or from the bottom of the keel (negative offset).

This is the value displayed on the DP OFFSETpage.

WARNING:
The use of incorrect offset values could result in misleading depth information being displayed with a consequent risk of running aground.

Before using your ST290 system, ensure the correct depth transducer offset has been set, as detailed in *Section 7, System Setup*.

Heading chapter

The on-screen chapter title is HEADING. The pages are summarized in *Table 3-3* .

Table 3-3: HEADING chapter pages

Page content	Description
HEADING	Compass heading, in degrees
COG	Course over ground, in degrees
TACK HEADING	Heading on next tack, in degrees
LOCKED HDG	Locked heading, in degrees

There are no adjustable values in the Heading chapter.

Wind chapter

The on-screen chapter title is WIND. The pages are summarized in *Table 3-4* .

Table 3-4: WIND chapter pages

Page content	Description
APP - WIND STBD or APP - WIND PORT	Apparent wind angle, in degrees, relative to vessel
AP - WIND	Apparent wind speed, in KTS or MS
TR - WIND PORT or TR-WIND STBD	True wind angle, in degrees, relative to vessel
TR - WIND	True wind speed, in KTS or MS
WND DIRECTION	Wind direction, as a bearing
HEAD/LIFTPORT or HEAD/LIFTSTBD	Head/Lift, in degrees
BEAUFORT WIND	Beaufort wind strength & cardinal direction

There are no adjustable values in the Wind chapter.

Navigate chapter

The on-screen chapter title is NAVIGATE. The pages are summarized in *Table 3-5* .

Table 3-5: NAVIGATE chapter pages

Page content	Description
50° 2.310N (example)	Latitude
134° 2.320W (example)	Longitude
COG	Course over ground, in degrees
SOG	Speed over ground, in KTS, MPH or K/H
CMG	Course made good, in degrees
DMG	Distance made good, in SM, KM or NM
WP followed by first 13 characters of WP name	Waypoint name
BTW	Bearing to waypoint, in degrees
DTW	Distance to waypoint, in either SM, KM or NM
ETA	Estimated time of arrival (at waypoint)
TTG	Time to go (to waypoint)
XTE plus steer bar	Cross track error plus steer bar

There are no adjustable values in the Navigate chapter.

GPS chapter

The GPS chapter repeats the fix status, number of satellites and horizontal dilution of position (HDOP) information for your GPS system. The on-screen chapter title is GPS. The pages are summarized in *Table 3-6* .

Table 3-6: GPS chapter pages

Page content	Description
FIX	Fix status
SATELLITES	Number of satellites
HDOP	Horizontal dilution of position

There are no adjustable values in the GPS chapter.

Pilot chapter

The PILOT chapter shows the status of the autopilot.

If an autopilot is not connected to the ST290 system, the PILOT chapter is not available.

Timers chapter

The on-screen chapter title is TIMERS. The pages are summarized in *Table 3-7*

Table 3-7: TIMERS chapter pages

Page content	Description
Current time & date. For example: APR 12 2001 10:45	Local date & time
ALARM CLOCK	Alarm clock
COUNTDOWN	Countdown timer
STOPWATCH	Stop watch/lap timer
RACE TIME	Race start timer, gun 1
RACE TIME	Race start timer, gun 2
RACE TIME	Race start timer, gun 3

Alarm clock

Setting the alarm clock off/on

To turn the alarm clock off or on:

1. In the Timers chapter, select the ALARM CLOCK page.
2. Press the ⊙ button to display either OFF or an alarm time, as required. If an alarm time is displayed, the alarm clock is on.

Setting the alarm time

To set the alarm time:

1. In the Timers chapter, select the ALARM CLOCK page.
2. If necessary, press the ⦿ button momentarily to display an alarm time.
3. If you want to change the alarm time, hold down the ⦿ button for 1 second, to enter Edit mode. The minutes value flashes.
4. Use the ∧ or ∨ button to set the required minutes value in the alarm time.
5. Press the ⦿ button, so that the hours value flashes.
6. Use the ∧ or ∨ button to set the required hours value the alarm time.
7. Hold down the ⦿ button for 1 second, to leave the edit mode.

Countdown timer

Setting the countdown time

To set the countdown time:

1. In the Timers chapter, select the COUNTDOWN page.
2. Hold down the ⦿ button for 1 second, to enter Edit mode. The seconds value flashes.
3. Use the ∧ or ∨ button to set the required seconds value.
4. Press the ⦿ button, to edit the minutes. The minutes value flashes.
5. Use the ∧ or ∨ button to set the required minutes value.
6. Hold down the ⦿ button for 1 second, to leave the edit mode.

Starting & stopping the countdown timer

To start or stop the countdown timer:

1. In the Timers chapter, select the COUNTDOWN page.
2. Press the ⦿ button. If the countdown timer was running, it stops. If the countdown timer was stopped, it starts counting.

Stopwatch/lap timer

The following description of how to use the stopwatch/lap timer, assumes a typical operational sequence:

- Starting the stopwatch from a stopped condition.
- Obtaining lap times while the stopwatch is running.
- Stopping and resetting the stopwatch.

Starting the stopwatch

To start the stopwatch:

1. In the Timers chapter, select the STOPWATCH page.
2. Press the ⊙ button. The stopwatch starts counting up.

Obtaining lap times

To obtain a lap time:

1. In the Timers chapter, select the STOPWATCH page.
2. With the stopwatch counting up, press the ⊙ button. The lap time is displayed, and the stopwatch continues counting up in the background.
3. To return to the real time count, press the ⊙ button again.

Stopping & resetting the stopwatch timer

To stop the stopwatch:

1. In the Timers chapter, select the STOPWATCH page.
2. Hold down the ⊙ button for 1 second. The stopwatch stops counting and resets to zero.

Race timers

There are three race gun timers, and a race timer. Each race gun timer counts down from a value determined during set up (see *Section 7, System Setup*). The race timer counts up from the start of the race.

To start or stop a race gun timer:

1. In the Timers chapter, select the required GUN timer.
2. Press the ⊙ button. The timer then counts down from its preset value to zero.

Engine chapter

Note: *In order to display engine information, the appropriate manufacturer's interface must be installed.*

The on-screen chapter title is ENGINE. The pages are summarized in *Table 3-8* .

Table 3-8: ENGINE chapter pages

Page content	Description
ENGINE RPM	Number of revolutions per minute x1000
FUEL	Fuel rate, in liters per hour (L/H) or gallons per hour (G/H)
COOLANT	Coolant level, in liters (LTR) or gallons (GAL)
FUEL	Fuel level, in either LTR or GAL
ENGINE	Engine temperature, in °C or °F
EXHAUST	Exhaust gas temperature, in °C or °F
BATTERY V	Battery voltage
BOOST	Boost pressure, in pounds per square inch (PSI)
ENGINE HRS	Engine hours

There are no adjustable values in the Engine chapter.

Alarms chapter

The on-screen chapter title is ALARMS, and for each alarm page, a 🔔 icon is displayed. The alarm pages show the status (OFF or alarm level) of the system alarms. These are summarized in *Table 3-9* .

Table 3-9: ALARMS chapter pages

Page content	Description
SHALLOW	Shallow water alarm level, in MTR, FT or FTM
DEEP	Deep water alarm level, in MTR, FT or FTM
SHALLOW with ⚓	Shallow anchor alarm level, in MTR, FT or FTM
DEEP with ⚓	Deep anchor alarm level, in MTR, FT or FTM
OFF COURSE	Off course heading alarm value, in degrees
AWA HIGH	Apparent wind angle high alarm value, in degrees
AWA LOW	Apparent wind angle low alarm value, in degrees

Table 3-9: ALARMS chapter pages (continued)

Page content	Description
AWS HIGH	Apparent wind speed high alarm level, in KTS or M/S
AWS LOW	Apparent wind speed low alarm level, in KTS or M/S
TWA HIGH	True wind angle high alarm value, in degrees
TWA LOW	True wind angle low alarm value, in degrees
TWS HIGH	True wind speed high alarm level, in KTS or M/S
TWS LOW	True wind speed low alarm level, in KTS or M/S
BOAT SPD HKTS (or HK/H or HMPH)	Boat speed high alarm level, in KTS, K/H or MPH
BOAT SPD LKTS (or LK/H or LMPH)	Boat speed low alarm level, in KTS, K/H or MPH
SEA TEMP H	Sea temperature high alarm level, in °C or °F
SEA TEMP L	Sea temperature low alarm level, in °C or °F

You can use the ALARMS chapter pages to:

- Switch each alarm OFF, or on, or so that it operates with an external (Auxiliary) Alarm, connected to the DPU **AUX ALARM** terminals (see *Enabling alarms* below).
- Set a level for each alarm type (see *Setting alarm levels* below).

Enabling alarms

To enable or disable an alarm:

1. In the Alarms chapter, select the required alarm page.
   The alarm page shows either OFF to indicate the alarm is disabled, or an alarm level value to indicate the alarm is enabled.
2. Use the ⊙ button as necessary, to set the alarm either:
   - OFF
     or
   - So it shows a level value. With this setting, an activated alarm will sound at the ST290 system.
     or

- So it shows a level value, and an A indicator. With this setting, an activated alarm will sound both at the ST290 system and at an Auxiliary Alarm, when connected to the DPU.

Setting alarm levels

To set an alarm level:

1. In the Alarms chapter, select the required alarm page.
2. Hold down the ⦿ button for 1 second, to enter Edit mode. The current level for this alarm flashes.
3. Use the ∧ or ∨ button, to set the alarm level as required.
4. Hold down the ⦿ button for 1 second, to leave the edit mode.

Environment chapter

The on-screen chapter title is ENVIRONMENT. The pages are summarized in *Table 3-10* .

Table 3-10: ENVIRONMENT chapter pages

Page content	Description
SEA TEMP	Sea temperature, in °C or °F
TIDE SET	Tide set (calculated), in degrees
TIDE RATE	Tide rate (calculated), in KTS, K/H or MPH
SUNRISE	Sunrise time
SUNSET	Sunset time
TWILIGHT AM	Morning twilight time
TWILIGHT PM	Evening twilight time

There are no adjustable values in the Environment chapter.

Sunrise, sunset & twilight at extreme latitudes

The displayed sunrise, sunset and twilight times are valid in most cases. However, at extreme latitudes during periods of extended day or night, these times may not be accurate.

Vessel chapter

The on-screen chapter title is VESSEL. The pages are summarized in *Table 3-11* .

Table 3-11: VESSEL chapter pages

Page content	Description
RUDDER ANGLE	Rudder angle, in degrees
BATTERY V	Battery voltage

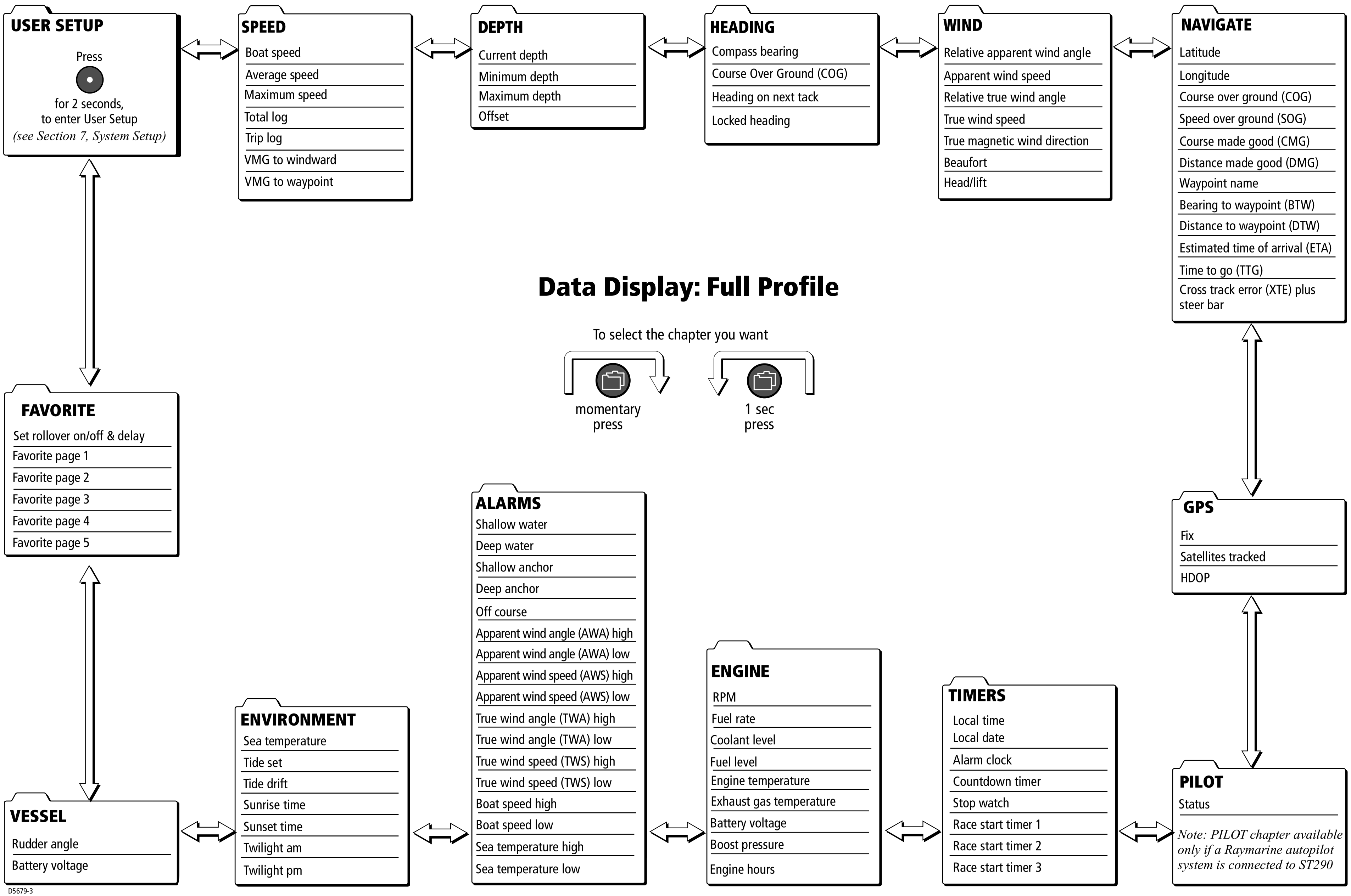
There are no adjustable values in the Vessel chapter.

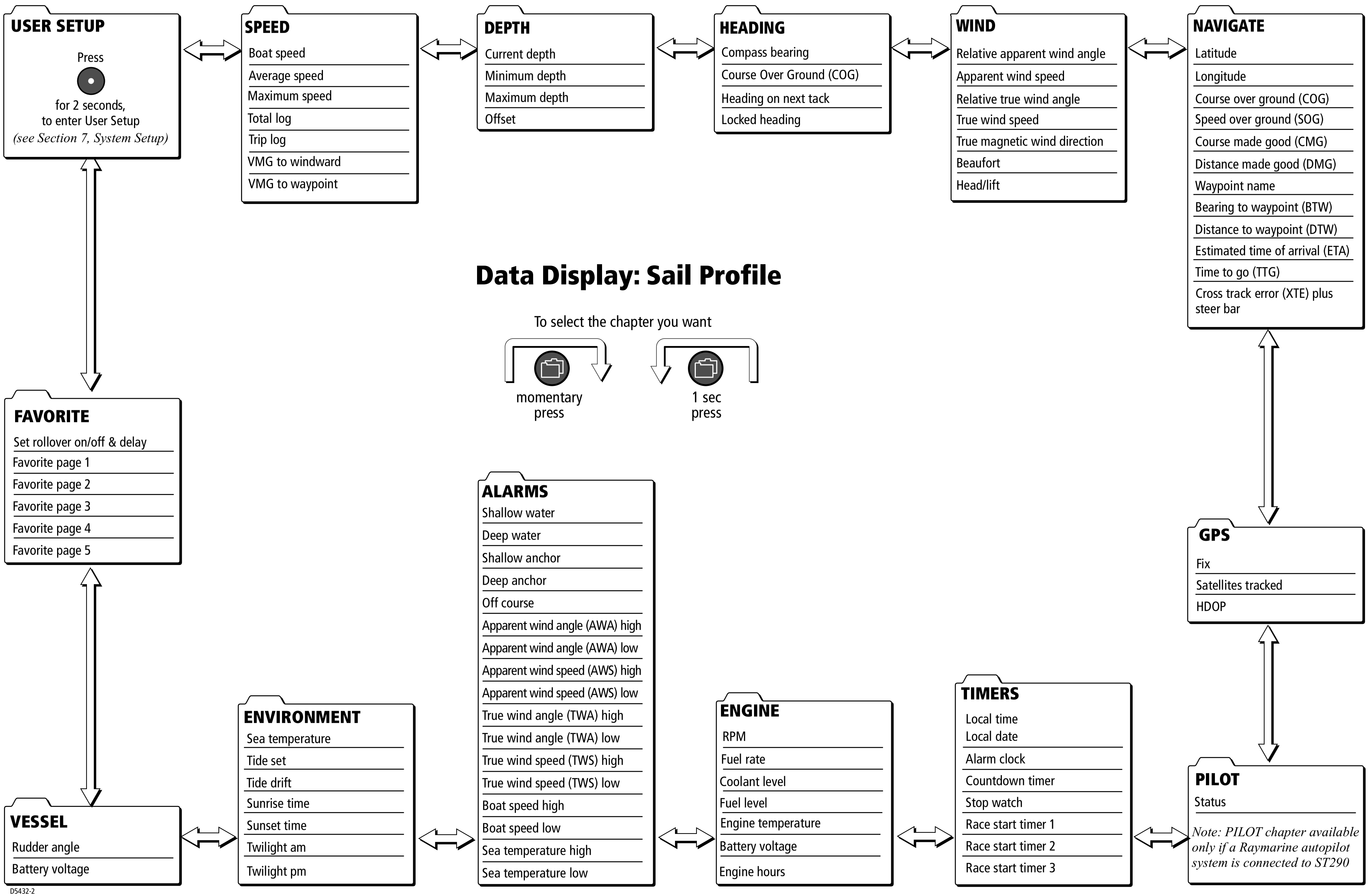
Favorite chapter

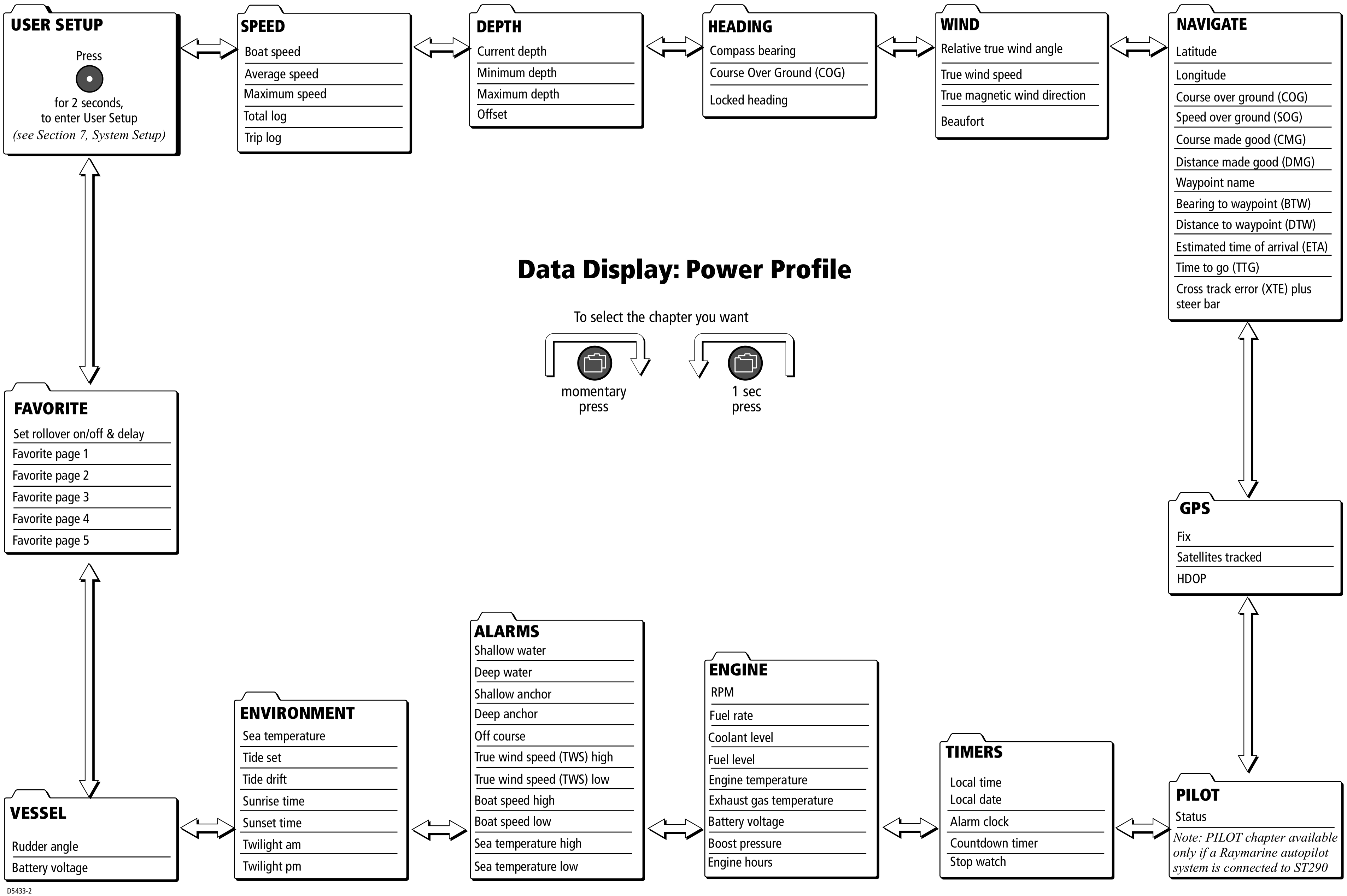
See *Using Favorite pages* on page 3 of this chapter and *Section 7, System Setup*.

User Setup chapter

See *Section 7, System Setup*.


Data Display: Full Profile
To select the chapter you want
momentary press
1 sec press
USER SETUP
Press
for 2 seconds,
to enter User Setup
(see Section 7, System Setup)
SPEED
Boat speed
Average speed
Maximum speed
Total log
Trip log
VMG to windward
VMG to waypoint
DEPTH
Current depth
Minimum depth
Maximum depth
Offset
HEADING
Compass bearing
Course Over Ground (COG)
Heading on next tack
Locked heading
WIND
Relative apparent wind angle
Apparent wind speed
Relative true wind angle
True wind speed
True magnetic wind direction
Beaufort
Head/lift
NAVIGATE
Latitude
Longitude
Course over ground (COG)
Speed over ground (SOG)
Course made good (CMG)
Distance made good (DMG)
Waypoint name
Bearing to waypoint (BTW)
Distance to waypoint (DTW)
Estimated time of arrival (ETA)
Time to go (TTG)
Cross track error (XTE) plus steer bar
FAVORITE
Set rollover on/off & delay
Favorite page 1
Favorite page 2
Favorite page 3
Favorite page 4
Favorite page 5
GPS
Fix
Satellites tracked
HDOP
ALARMS
Shallow water
Deep water
Shallow anchor
Deep anchor
Off course
Apparent wind angle (AWA) high
Apparent wind angle (AWA) low
Apparent wind speed (AWS) high
Apparent wind speed (AWS) low
True wind angle (TWA) high
True wind angle (TWA) low
True wind speed (TWS) high
True wind speed (TWS) low
Boat speed high
Boat speed low
Sea temperature high
Sea temperature low
ENGINE
RPM
Fuel rate
Coolant level
Fuel level
Engine temperature
Exhaust gas temperature
Battery voltage
Boost pressure
Engine hours
TIMERS
Local time
Local date
Alarm clock
Countdown timer
Stop watch
Race start timer 1
Race start timer 2
Race start timer 3
PILOT
Status
Note: PILOT chapter available only if a Raymarine autopilot system is connected to ST290
ENVIRONMENT
Sea temperature
Tide set
Tide drift
Sunrise time
Sunset time
Twilight am
Twilight pm
VESSEL
Rudder angle
Battery voltage
D5679-3


USER SETUP
Press
for 2 seconds,
to enter User Setup
(see Section 7, System Setup)
SPEED
Boat speed
Average speed
Maximum speed
Total log
Trip log
VMG to windward
VMG to waypoint
DEPTH
Current depth
Minimum depth
Maximum depth
Offset
HEADING
Compass bearing
Course Over Ground (COG)
Heading on next tack
Locked heading
WIND
Relative apparent wind angle
Apparent wind speed
Relative true wind angle
True wind speed
True magnetic wind direction
Beaufort
Head/lift
NAVIGATE
Latitude
Longitude
Course over ground (COG)
Speed over ground (SOG)
Course made good (CMG)
Distance made good (DMG)
Waypoint name
Bearing to waypoint (BTW)
Distance to waypoint (DTW)
Estimated time of arrival (ETA)
Time to go (TTG)
Cross track error (XTE) plus steer bar
Data Display: Sail Profile
To select the chapter you want
momentary press
1 sec press
FAVORITE
Set rollover on/off & delay
Favorite page 1
Favorite page 2
Favorite page 3
Favorite page 4
Favorite page 5
GPS
Fix
Satellites tracked
HDOP
ALARMS
Shallow water
Deep water
Shallow anchor
Deep anchor
Off course
Apparent wind angle (AWA) high
Apparent wind angle (AWA) low
Apparent wind speed (AWS) high
Apparent wind speed (AWS) low
True wind angle (TWA) high
True wind angle (TWA) low
True wind speed (TWS) high
True wind speed (TWS) low
Boat speed high
Boat speed low
Sea temperature high
Sea temperature low
VESSEL
Rudder angle
Battery voltage
ENVIRONMENT
Sea temperature
Tide set
Tide drift
Sunrise time
Sunset time
Twilight am
Twilight pm
ENGINE
RPM
Fuel rate
Coolant level
Fuel level
Engine temperature
Battery voltage
Engine hours
TIMERS
Local time
Local date
Alarm clock
Countdown timer
Stop watch
Race start timer 1
Race start timer 2
Race start timer 3
PILOT
Status
Note: PILOT chapter available only if a Raymarine autopilot system is connected to ST290
D5432-2


Data Display: Power Profile
To select the chapter you want
momentary press
1 sec press
USER SETUP
Press
for 2 seconds, to enter User Setup
(see Section 7, System Setup)
SPEED
Boat speed
Average speed
Maximum speed
Total log
Trip log
DEPTH
Current depth
Minimum depth
Maximum depth
Offset
HEADING
Compass bearing
Course Over Ground (COG)
Locked heading
WIND
Relative true wind angle
True wind speed
True magnetic wind direction
Beaufort
NAVIGATE
Latitude
Longitude
Course over ground (COG)
Speed over ground (SOG)
Course made good (CMG)
Distance made good (DMG)
Waypoint name
Bearing to waypoint (BTW)
Distance to waypoint (DTW)
Estimated time of arrival (ETA)
Time to go (TTG)
Cross track error (XTE) plus steer bar
GPS
Fix
Satellites tracked
HDOP
PILOT
Status
Note: PILOT chapter available only if a Raymarine autopilot system is connected to ST290
TIMERS
Local time
Local date
Alarm clock
Countdown timer
Stop watch
ENGINE
RPM
Fuel rate
Coolant level
Fuel level
Engine temperature
Exhaust gas temperature
Battery voltage
Boost pressure
Engine hours
ALARMS
Shallow water
Deep water
Shallow anchor
Deep anchor
Off course
True wind speed (TWS) high
True wind speed (TWS) low
Boat speed high
Boat speed low
Sea temperature high
Sea temperature low
ENVIRONMENT
Sea temperature
Tide set
Tide drift
Sunrise time
Sunset time
Twilight am
Twilight pm
VESSEL
Rudder angle
Battery voltage
FAVORITE
Set rollover on/off & delay
Favorite page 1
Favorite page 2
Favorite page 3
Favorite page 4
Favorite page 5
D5433-2

Section 3: Using Analog Instruments

Contents

Chapter 1: An Introduction to Analog Instruments

1.1 Overview

Various discrete data types can be displayed on dedicated analog instruments. Instruments are available to show:

- Wind speed and direction.
- Close hauled wind speed and direction.
- Compass bearing and locked heading information.
- Rudder angle information.

Each instrument has an analog dial, an inset digital display and four control buttons.

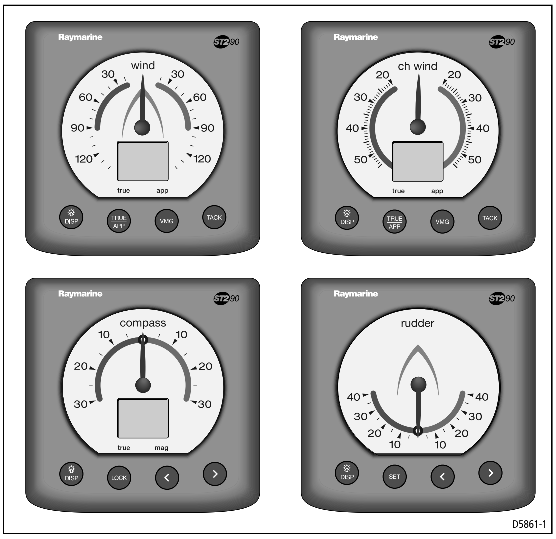


Figure 1-1: Analog instruments

1.2 General operating information

Instructions for using the individual instrument types are given as follows:

- Wind and Close Hauled Wind normal operation is described in *Section 3, Chapter 2*.

- Compass operation is described in *Section 3, Chapter 3*.
- Rudder Angle Indicator normal operation is described in *Section 3, Chapter 4*.
- Setup routines for all analog instrument types are described in *Section 7, Chapter 4*.

1.3 Display illumination

When an analog instrument is first powered up, the display illumination is set to its lowest (courtesy) level, to facilitate initial access to the buttons.

To adjust the level of display illumination:

1. Hold down the **/DISP** button for approximately 1 second, to enter the Backlighting Adjust mode.
2. There are three preset illumination levels and an off setting. Press the **/DISP** button to cycle through the these levels until you reach the level you want.
3. Press any other button to leave the Backlighting Adjust mode.

Note: *The digital display will return to normal operation 7 seconds after the last button press.*

Chapter 2: Wind instruments

2.1 Introduction

The ST290 Wind and Close Hauled Wind instruments each comprise an analogue dial and integral digital display. The instruments provide:

- True and Apparent wind direction and speed. Wind speed is displayed either in knots or meters per second.
- Velocity made good (VMG), when boat-speed information is available on the system.
- Maximum wind speed.
- Tack angle.

In addition to the units shown above, the Wind instrument can show wind force as Beaufort scale values.

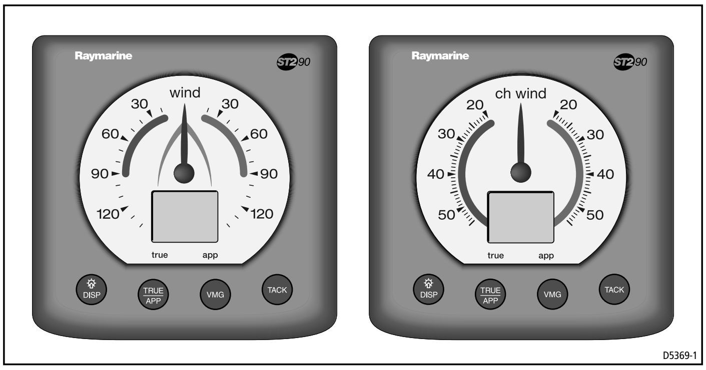


Figure 2-1: ST290 Wind and Close Hauled Wind instruments

Displayed information

The information on the Wind and Close Hauled Wind instruments can be either true or apparent, depending on which mode you select at the instrument.

Pointer

The pointer shows the true or apparent wind direction. The scale range given by the Wind instrument is a full 360°, whereas the Close Hauled Wind instrument gives an expanded indication from -60° to +60° about the bow or stern of the boat.

Digital display

You can select which information is displayed in the digital display. This can be:

- True/Apparent Wind Speed.
- Velocity Made Good (VMG).
- Tack Heading.
- Maximum Wind Speed.
- Wind Alarm Data.

2.2 Operation

IMPORTANT

Do not use your Wind or Close Hauled Wind instrument until the appropriate setup procedures in *Section 7, Chapter 4*, have been satisfactorily completed.

Procedures

Figure 2-2 shows the button functions. Use this information, in conjunction with the information in *Figure 2-3* , to operate your Wind and Close Hauled Wind instruments.

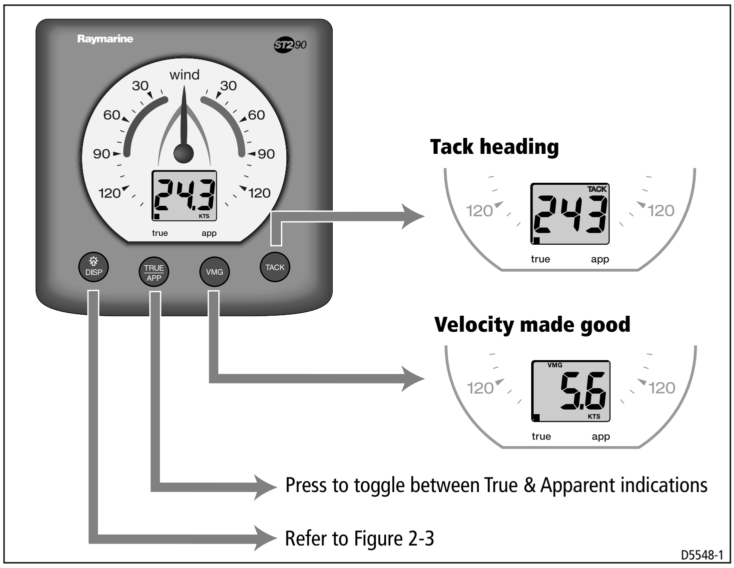


Figure 2-2: Basic operation

The flow charts show the sequence of button presses and displays for the various operating tasks.

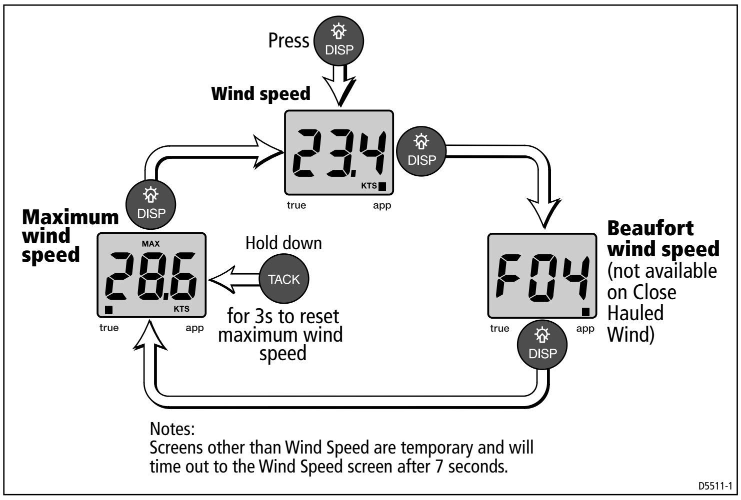


Figure 2-3: Using the ☼/**DISP** button

True or apparent data

Use the **TRUE/APP** button to select either true or apparent data, as required (toggle action). The type of data selected is indicated by a black square marker on the digital display, adjacent to either the **true** or **app** legend, as appropriate.

Tacking information

Press the **TACK** button to show tack heading information on the digital display. The analogue display continues to show the wind angle.

Alarms

An alarm condition is indicated by a flashing alarm icon (🔔) on the digital display and an audible alarm at the instrument.

- When an alarm is sounding the instrument will continue to display live wind speed and angle.
- A wind speed alarm will cause the current speed unit legend (KTS or M/S) to flash.
- A flashing MAX legend indicates a high wind speed alarm.

- A flashing HI legend indicates a high wind angle alarm.
- A LO legend indicates either:
  - A low wind speed alarm (LO plus speed units displayed).
  - A low wind angle alarm (LO displayed).

Silencing an alarm

Pressing any button will silence the alarm. Pressing the button repeatedly will silence any additional alarms.

Chapter 3: Compass Instrument

3.1 Getting started

The ST290 Compass instrument comprises an analogue dial and integral digital display, which provide:

- Compass heading indication.
- Steering indication
- Course over ground (COG) information, if GPS or similar positioning data is available on the system.

Figure 3-1: Compass instrument

3.2 Operation

IMPORTANT

Do not use your Compass instrument until the appropriate setup procedures in *Section 7, Chapter 4*, have been satisfactorily completed.

Operating modes

The ST290 Compass instrument operates in either Unlocked, Locked or Auto mode. A summary of these modes and the respective instrument indications is given in *Table 3-1* .

Table 3-1: Compass instrument indications

Mode	Pointer indication	Digital display
Unlocked	Zero.	Current course heading (true or magnetic.
Locked	Course error from locked heading, to a maximum ±30° deviation.	Locked heading.
Auto (see Note below)	Autopilot course error.	Autopilot locked heading.

Note: *If your ST290 system is connected to a Raymarine autopilot operating in Auto, Vane or Track mode, the ST290 Compass instrument is forced to operate in Auto mode. In this mode, all ST290 Compass instrument button functions, except illumination, are disabled.*

Switch on

When power is first switched on, the Compass instrument is in unlocked mode. The current heading (true or magnetic) is displayed on the digital display and the analogue pointer indicates zero.

Digital display

In addition to showing the course heading or the locked heading, (see *Table 3-1* , the digital display can also show:

- Course Over Ground (COG), or
- Average Heading.

Procedures

Figure 3-2 shows the button functions. Use this information, in conjunction with the information in*Figure 3-3* to operate your ST290 Compass instrument.

The displayed heading is either **true** or **mag**(netic) as indicated by a black square marker adjacent to the corresponding legend.

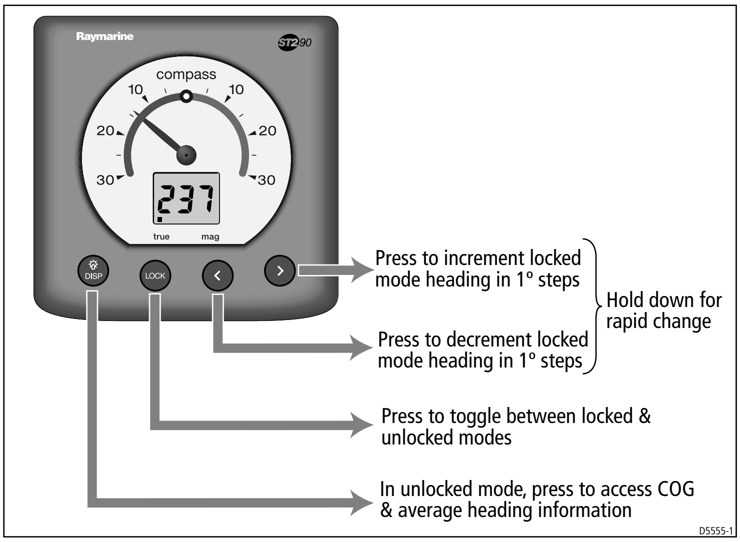


Figure 3-2: Basic operation

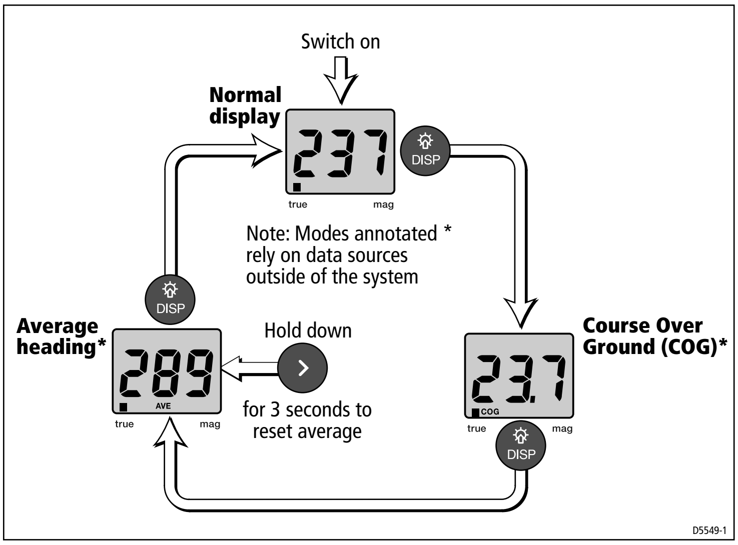


Figure 3-3: Selecting operating screen

COG

If you have GPS or similar positioning data on your ST290 system and you select the select COG screen, the digital display displays your course over the ground. If such data is not available the display shows "---".

Average heading

You can reset the average heading value to zero, by pressing the **>** button for 3 seconds when the Average heading screen is displayed.

Locked mode

Locked mode enables you to define a fixed (locked) heading then calculates any deviation from this locked heading. The digital display shows heading information and a LOCK indicator. The pointer shows the difference between the locked heading and the actual course being steered, i.e. heading error (see *Figure 3-4*).

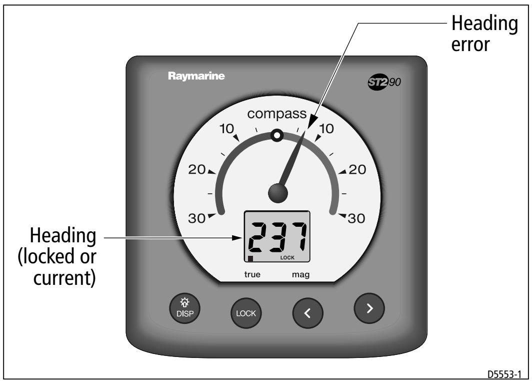


Figure 3-4: Locked mode indications

To enter Locked mode, press the **LOCK** button, then refer to *Figure 3-5* .

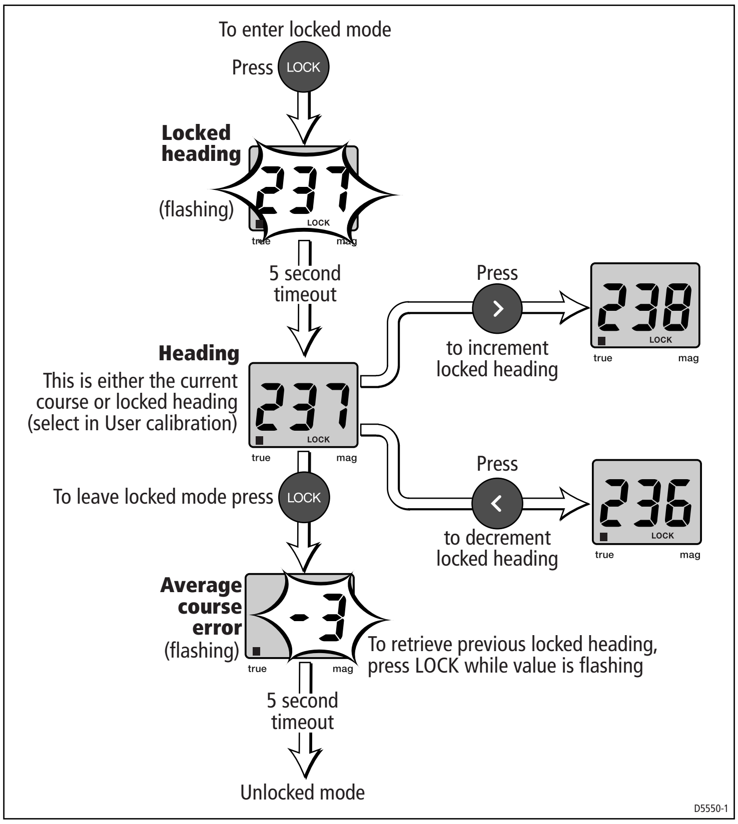


Figure 3-5: Locked mode operation

When you leave locked mode, the average error flashes on the digital display for 5 seconds. Negative values are given for errors to port and positive value for errors to starboard. If you press the **LOCK** button again within this 5 second period, you re-enter locked mode with the previously stored heading as the locked heading.

The average course error is reset to zero whenever the locked heading is changed.

Auto mode

The auto mode is activated automatically when the ST290 system is connected to a SeaTalk compatible autopilot.

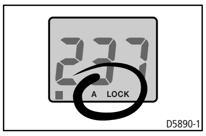


Figure 3-6: Auto lock indications

Whenever the autopilot is engaged, the heading set by the autopilot is displayed on the digital display and the analogue pointer displays the autopilot's course error.

Note: *In Auto mode, all* ST290 *Compass instrument button functions, except illumination, are disabled.*

Operating hints

Steering sense

When the analogue pointer indicates an off course error, steer the vessel in the direction you want the pointer to move.

Man overboard/reciprocal course

When the ST290 Compass instrument is in lock mode and the vessel is turned through 110° or more, the ST290 Compass instrument automatically locks to the reciprocal of the original course (180° from the original). The digital display shows the reciprocal course and the pointer shows the course error from the reciprocal course.

The reciprocal course function is reversible, so that a second similar turn would lock onto the original locked course.

Note: *The Man overboard/reciprocal course feature is not available when operating in Auto mode.*

Chapter 4: Rudder Angle Instrument

4.1 Getting started

The ST290 Rudder Angle Indicator Instrument provides a real-time indication of rudder position as determined by the associated Rudder Reference Transducer.

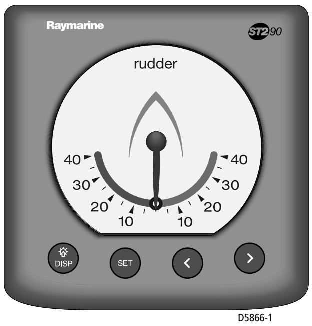


Figure 4-1: Rudder Angle instrument

Displayed information

The rudder position is indicated by a pointer. The instrument scale range gives an expanded indication from -40° to +40° about zero.

4.2 Normal use

As the ST290 Rudder Angle Indicator operates in real time, very little operator action is necessary during normal use except to observe the instrument as required to ascertain the rudder angle.

Note: *If rudder angle information is not available on the SeaTalk bus, the analogue pointer oscillates ±10° about the top of the dial.*

The /**DISP** button is used to set the backlighting. The **SET**, **<** and **>** buttons are not used.

Section 4: Using Keypads

Contents

Chapter 1: An Introduction to Keypads

1.1 Keypad types

The following ST290 keypad types are available:

- Remote Keypad.The Remote Keypad enables you to control standard ST290 digital instruments and MaxiView instruments. The operation of the Remote Keypad is described in *Section 4, Chapter 2*.
- Man Overboard (MOB) Keypad. Enables you to swiftly initiate a MOB routine when necessary. The operation of the MOB Keypad is described in *Section 4, Chapter 3*.
- Pilot Keypad. Provides comprehensive control of Raymarine autopilots. The operation and calibration of the Pilot Keypad are described in *Section 8, Autopilots*.

Chapter 2: Remote Keypad

2.1 Introduction

The ST290 Remote Keypad enables you to operate your ST290 digital and MaxiView instruments, without actually being present at the instruments.

Figure 2-1: Remote Keypad

Remote control organization

For the purposes of remote control, instruments are organized into groups. You can have up to eight groups of standard ST290 instruments and eight groups of MaxiView instruments, within your ST290 system:

- Each group can comprise up to eight instruments.
- Each group must have at least one Remote Keypad associated with it.
- Each keypad can control one standard instrument group and one group of MaxiView instruments.
- Within each group, instruments are identified by number, from 1 to 8.
- Each group is identified alphabetically:
  - Standard ST290 instrument groups are assigned letters A to H.
  - MaxiView instruments are assigned group letters J to Q.
- Each instrument in a group has a unique alphanumeric identity (e.g. A1, where A defines the group and 1 the instrument sequence number within the group). Ungrouped instruments have a dash (-) in place of a group letter.

The method of setting up the instrument groupings is described in *Section 7, System Setup*.

2.2 Remote operation

General principles

Each keypad can control all the instruments in the associated groups of instruments. Within each group, you select the instrument you want by means of a ⇄ button:

- An **INSTRUMENT** ⇄ button, enables you to select the required standard ST290 instrument.
- A **MAXIVIEW** ⇄ button, enables you to select the required MaxiView instrument.

Each time one of these buttons is pressed, a different instrument in the associated group is selected to be controlled.

For example, in remote control group B, successive presses of the **INSTRUMENT** ⇄ button on the associated keypad would select instruments B1, B2, B3 etc in turn. As each instrument is selected, it either displays a remote indicator or presents inverse video, to show you can control it from the Remote Keypad.

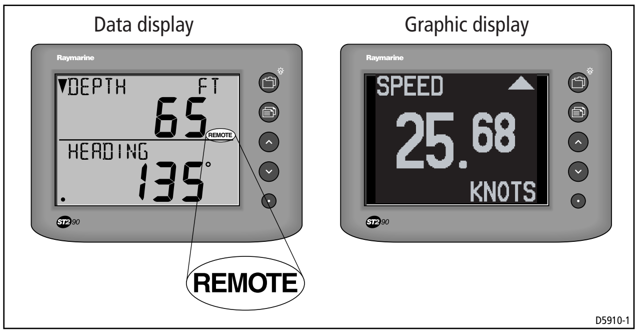


Figure 2-2: Typical remote control indicators

Button function

The the functions assigned to each keypad button are shown in *Figure 2-3* .

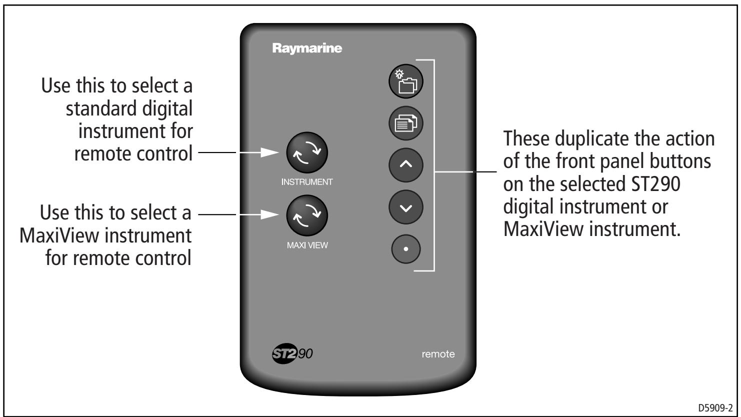


Figure 2-3: Remote controls

Procedure

To remotely operate an instrument:

1. Observing the instruments in the relevant instrument group, press the appropriate ⇄ button (**INSTRUMENT** or **MAXIVIEW**) the necessary number of times, to select the instrument you want to control remotely.

Note: *Once selected, an instrument returns to local control if there is no Remote Keypad activity for 5 seconds.*

2. Use the appropriate Remote Keypad buttons to operate the selected instrument (see *Figure 2-3*), in the same way that you would use the respective buttons at the instrument.

Chapter 3: MOB Keypad

3.1 Introduction

The Man-Overboard (MOB) Keypad is used if a man overboard situation occurs, to initiate an alarm and request MOB position information from the appropriate system components.

Any number of MOB Keypads can be installed, and any one can be used to initiate a MOB alarm. When a MOB alarm is initiated and an appropriate Raymarine product is connected to the ST290 system, selected instruments will display information relating to the location of the man-over-board incident.

Figure 3-1: MOB Keypad general view

3.2 Operation

CAUTION:
The MOB keypad is intended only an aid to recovery. It must not be used as an alternative to traditional methods and skills.

If a man overboard situation occurs, press the button immediately. When the button is pressed, the keypad beeps and a MOB condition is initiated. When this occurs:

- An internal buzzer sounds every 30 seconds.
- The elapsed time since the button was pressed is sent to the system.
- If a Raymarine product that supports the MOB function is connected to ST290, the range and bearing to the MOB position are calculated and transmitted to the digital instruments.

Cancelling a MOB condition

A MOB condition can be cancelled from any MOB Keypad or from a compatible instrument. Clearing a MOB alarm resets the system to normal.

To cancel a MOB condition, hold down the button for 3 seconds.

Section 5: Maintenance & Troubleshooting

Contents

Maintenance & Troubleshooting

1.1 Maintenance

Servicing and safety

- Raymarine equipment should be serviced only by authorized Raymarine service technicians. They will ensure that service procedures and replacement parts used will not affect performance. There are no user-serviceable parts in any Raymarine product.
- Some products generate high voltages, so never handle the cables/connectors when power is being supplied to the equipment.
- When powered up, all electrical equipment produces electromagnetic fields. These can cause adjacent pieces of electrical equipment to interact with one another, with a consequent adverse affect on operation. In order to minimize these effects and enable you to get the best possible performance from your Raymarine equipment, guidelines are given in the installation instructions, to enable you to ensure minimum interaction between different items of equipment, i.e. ensure optimum Electromagnetic Compatibility (EMC).
- Always report any EMC-related problem to your nearest Raymarine dealer. We will use any such information to improve our quality standards.
- In some installations, it may not be possible to prevent the equipment from being affected by external influences. In general this will not damage the equipment but it can lead to spurious resetting action, or momentarily may result in faulty operation.
- Always switch off the power to Raymarine equipment before working on it.

Routine care

Periodically examine all ST290 system components, including cabling for signs of damage, and repair if necessary.

Instruments and Keypads

Certain atmospheric conditions may cause a small amount of condensation to form on instrument windows. This will not harm the instruments and will clear after they have been switched on for a short period.

Periodically clean each ST290 instrument and keypad with a soft, moist, lint-free cloth. Do NOT use chemical or abrasive materials.

When your instruments or keypads are not in use, always fit the suncovers supplied.

Wind transducer

If the windvane is removed from its mounting block for any reason (e.g. if the mast is unstepped), fit the blanking cover (supplied) to the windvane mounting block connector.

Speed & Depth transducers

Refer to the Installation and Maintenance instructions supplied with the relevant transducer.

Cabling

Periodically examine all cables for chafing or other damage, and for security of connection. Where necessary, replace and/or re-secure.

1.2 Troubleshooting

If you think you have a fault, always check that the perceived problem is genuine and not due to the way the system and/or instrument has been set up (see *Section 7, System Setup*).

For example, if a chapter title is not being displayed on an instrument, this could be due to a fault, but it is more likely to be caused by one or more of the following:

- The relevant transducer is not fitted to your boat.
- Chapter titles have been turned off during User Setup.
- All the pages in the relevant chapter have been turned off during User Setup.

Preliminary procedures

Changes in the electronic environment may adversely affect the operation of your ST290 system. Typical examples of such changes are:

- Electrical equipment has recently been installed or moved aboard your vessel.
- You are in the vicinity of another vessel or shore station emitting radio signals.

If you appear to have a problem, first ensure that the EMC requirements (see *Section 6, Installation*) are still being met before further investigating the problem.

Fixing faults

All Raymarine products are subjected to comprehensive test and quality assurance programmes prior to packing and shipping. However, if a fault occurs, the following table may help to identify and rectify the problem.

Fault	Possible cause	Action
All instrument displays blank. No backlighting.	No power supply	Check power supply. Check fuse/circuit breaker
Analog instruments not functioning correctly. Digital instruments OK.	SeaTalk	Check SeaTalk cabling
Digital instrument not functioning correctly. Analog instruments OK.	SeaTALK^2	Check SeaTALK^2 cabling
Digital instrument chapters and/or pages missing	Not included in current instrument profile	Check that the instrument profile supports these chapters/pages. If necessary, use the procedures in *Section 7* to apply the appropriate profile.
One type of data (e.g. speed) missing from all instruments.	Transducer information missing	Check transducer Check cable connections from transducer to Pod. Check Pod.
No chapter titles on digital instruments.	Chapter titles turned off during setup	Use the procedures for either Data Display or Graphic Display as appropriate, in *Section 7* to check the setup status.

Autopilot troubleshooting

Additional troubleshooting procedures for Raymarine autopilots, are given in *Section 8* of this handbook.

1.3 Technical support

Raymarine provides a comprehensive customer support service, on the world wide web and by telephone help line. Please use either of these facilities if you are unable to rectify a problem.

World wide web

Please visit the Customer Support area of our website at:

www.raymarine.com

As well as providing a comprehensive Frequently Asked Questions section and servicing information, it also gives e-mail access to the Raymarine Technical Support Department and a details of the locations of Raymarine agents, worldwide.

Telephone help line

If you do not have access to the world wide web, please call:

1-800-539-5539, extension 2444 or

(603) 881-5200 extension 2444

Help us to help you

When requesting service, please quote the following product information:

- Equipment type.
- Model number.
- Serial number.
- Software issue number.

To obtain serial numbers and software release issue numbers in your ST290 system, carry out the following procedure, at a Graphic Display:

1. In Normal operating mode, press the button to enter Chapter Select mode, then cycle to the USER SETUP chapter heading.
2. Press the button momentarily to display the SETUP ACCESS page.

Figure 1-1: SETUP ACCESS page

3. Hold down the ⊙ button for 10 seconds to display DEALER ENTRY screen.

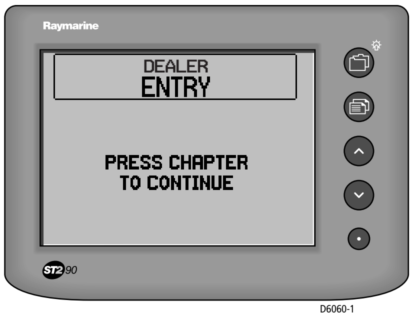


Figure 1-2: Confirm dealer setup screen

4. Within 5 seconds, press down the button to display the first DEALER screen.
5. Use the button to scroll to the DEALER VERSION NOS and DEALER SERIAL NOS screens, and make a note of the relevant version and serial numbers.
6. To leave the Dealer options and return to Normal operation:
   i. Use the button to move to the DEALER EXIT screen
   ii. Press the ⊙ button for 2 seconds, to return to Normal operation.

Note: *Serial numbers are also printed on the individual products.*

Section 6: Installation

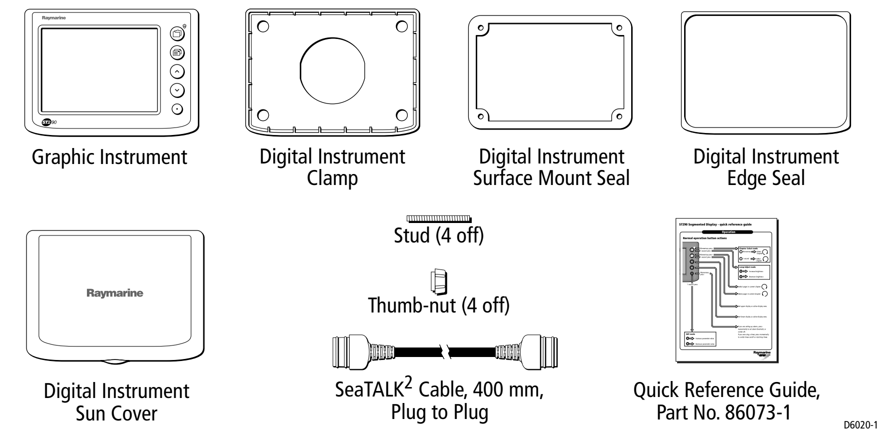
Contents

Chapter 1: Preparing for Installation

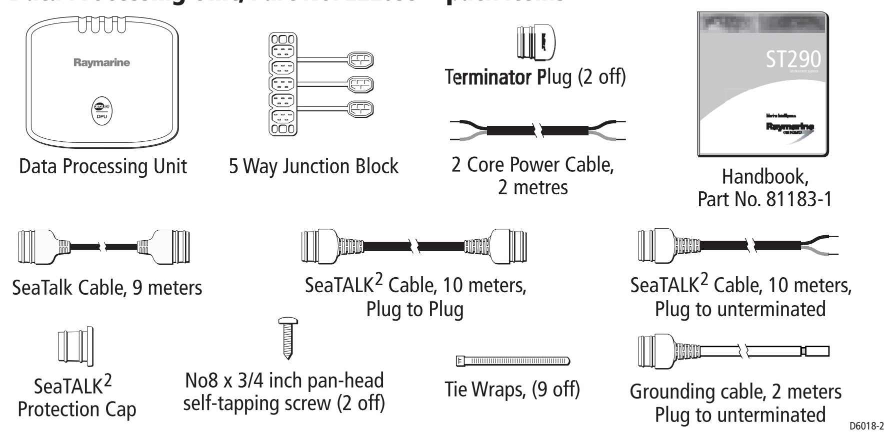
1.1 Introduction

This chapter provides information to assist in planning the installation of an ST290 system. As different ST290 systems will comprise different product combinations, the items packed with each product are shown in the following illustrations. A System Pack T22071 containing all the items provided in E22055, E22057, E22067 and E22069, is also available.

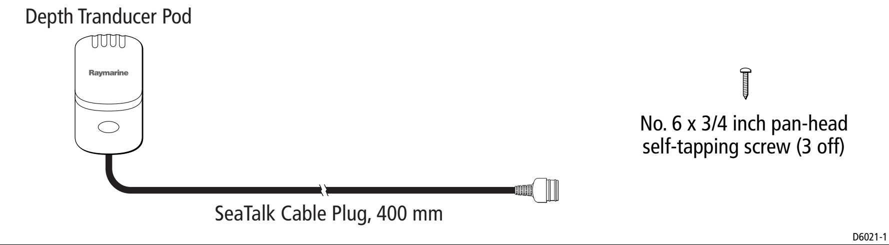
Graphic Instrument Part No. E22057 - pack items



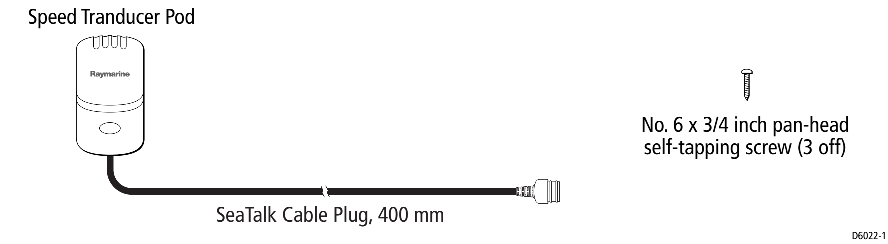
Data Processing Unit, Part No. E22055 - pack items



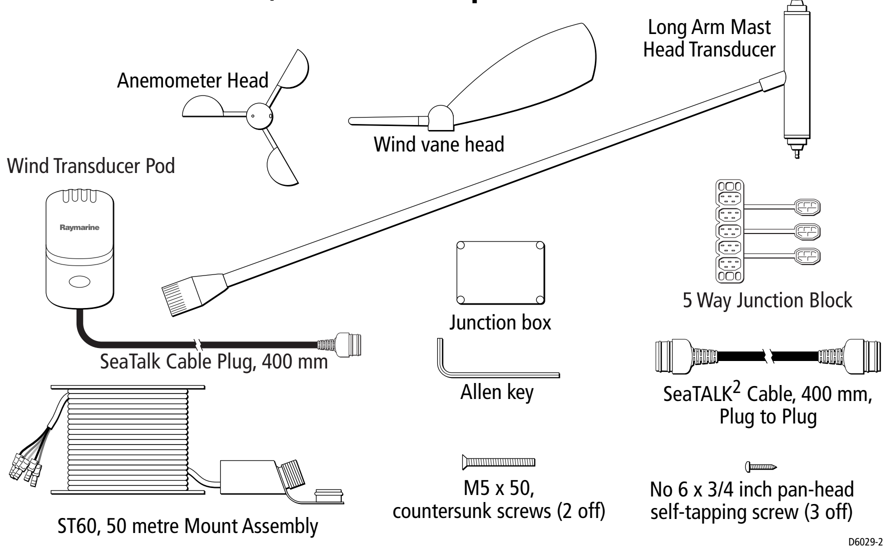
Depth Pod, Part No. E22067 - pack items



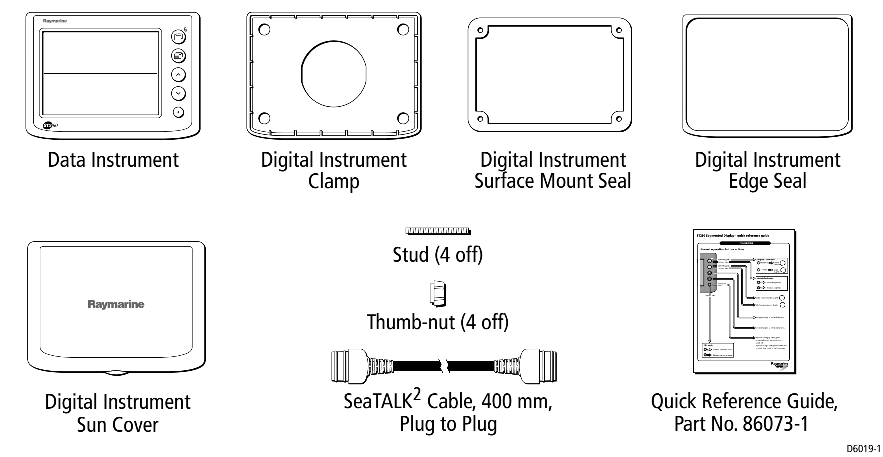
Speed Pod, Part No. E22069 - pack items



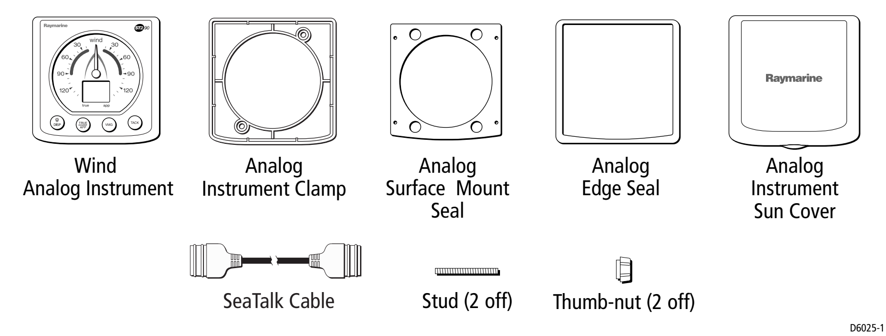
Wind Transducer & Pod, Part No. E22068 - pack items



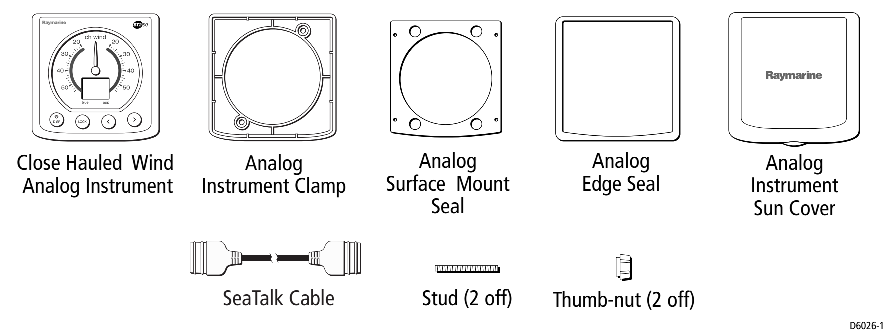
Data Instrument Part No. E22056 - pack items



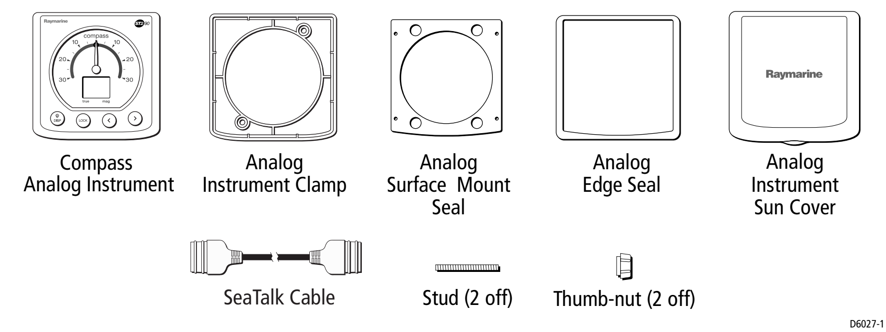
Analog Wind Instrument, Part No. E22059 - pack items



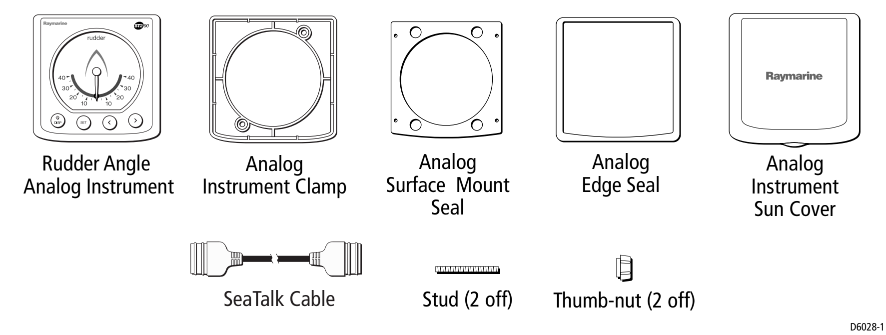
Analog Close Hauled Wind Instrument, Part No. E22061 - pack items



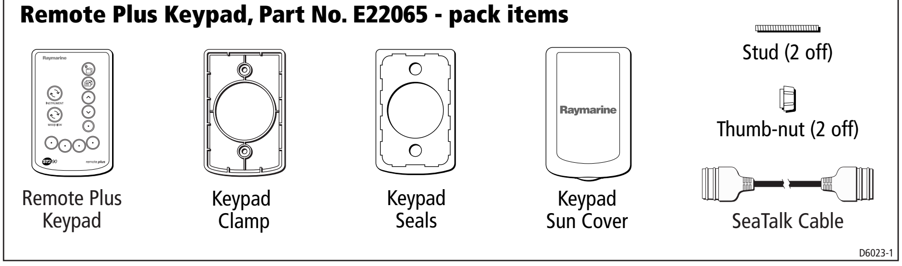
Analog Compass Instrument, Part No. E22060 - pack items



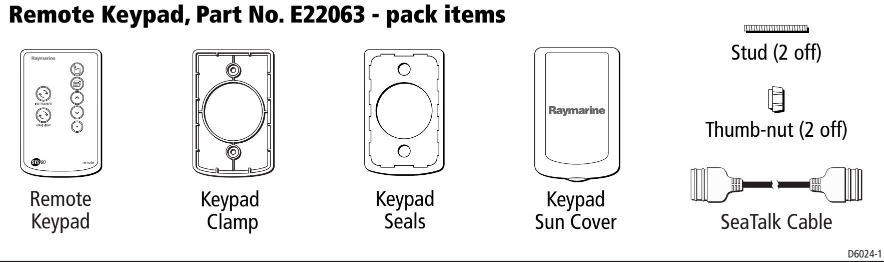
Analog Rudder Angle Indicator Instrument, Part No. E22062 - pack items



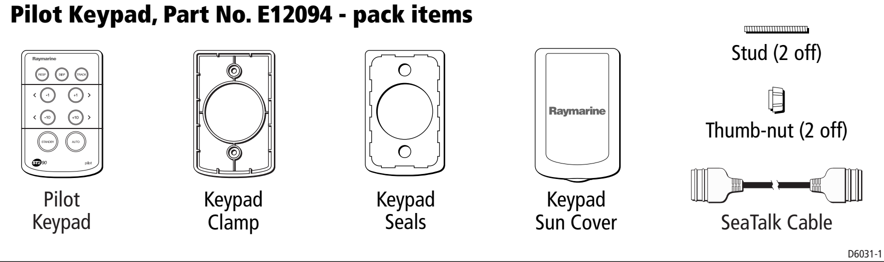
Remote Plus Keypad, Part No. E22065 - pack items



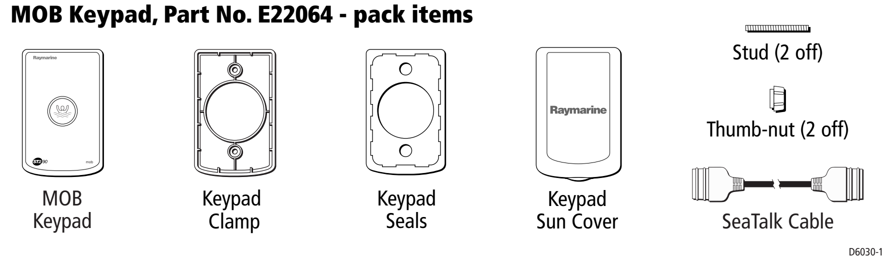
Remote Keypad, Part No. E22063 - pack items



Pilot Keypad, Part No. E12094 - pack items



MOB Keypad, Part No. E22064 - pack items



1.2 Planning the installation

EMC Installation Guidelines

All Raymarine equipment and accessories are designed to the best industry standards for use in the recreational marine environment.

Their design and manufacture conforms to the appropriate Electromagnetic Compatibility (EMC) standards, but correct installation is required to ensure that performance is not compromised. Although every effort has been taken to ensure that they will perform under all conditions, it is important to understand what factors could affect the operation of the product.

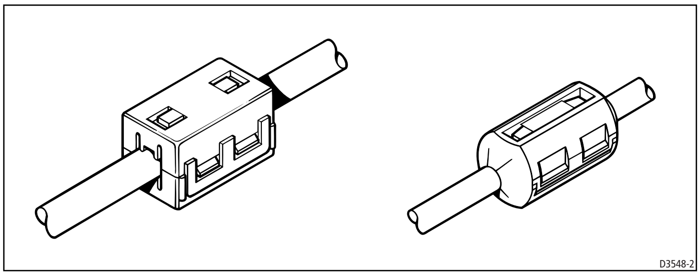
The guidelines given here describe the conditions for optimum EMC performance, but it is recognized that it may not be possible to meet all of these conditions in all situations. To ensure the best possible conditions for EMC performance within the constraints imposed by any location, always ensure the maximum separation possible between different items of electrical equipment.

For **optimum** EMC performance, it is recommended that **wherever possible**:

- Raymarine equipment and cables connected to it are:
  - At least 3 ft (1 m) from any equipment transmitting or cables carrying radio signals e.g. VHF radios, cables and antennas. In the case of SSB radios, the distance should be increased to 7 ft (2 m).
  - More than 7 ft (2 m) from the path of a radar beam. A radar beam can normally be assumed to spread 20 degrees above and below the radiating element.
- The equipment is supplied from a separate battery from that used for engine start. Voltage drops below 10 V, and starter motor transients, can cause the equipment to reset. This will not damage the equipment, but may cause the loss of some information and may change the operating mode.
- Raymarine specified cables are used. Cutting and rejoining these cables can compromise EMC performance and must be avoided unless doing so is detailed in the installation manual.
- If a suppression ferrite is attached to a cable, this ferrite should not be removed. If the ferrite needs to be removed during installation it must be reassembled in the same position.

Suppression Ferrites

The following illustration shows typical cable suppression ferrites used with Raymarine equipment. Always use the ferrites supplied by Raymarine.



Connections to Other Equipment

If your Raymarine equipment is to be connected to other equipment using a cable not supplied by Raymarine, a suppression ferrite MUST always be attached to the cable near to the Raymarine unit.

Data Processing Unit

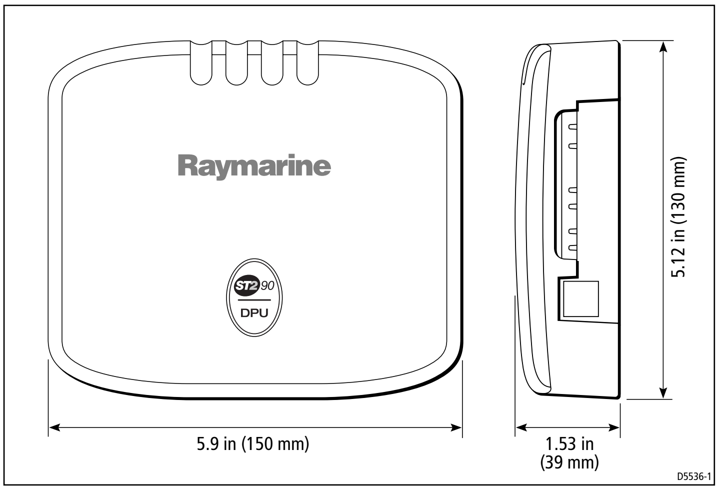


Figure 1-1: DPU dimensions

CAUTION:
The DPU is not waterproof and so must be installed in a dry location.

The DPU must be positioned below decks in a dry location where:

- It is protected against physical damage.
- It is at least 9 in (230 mm) from a compass.
- It is at least 20 in (500 mm) from radio receiving equipment.
- There is reasonable access for installation and servicing.

Transducer Pods

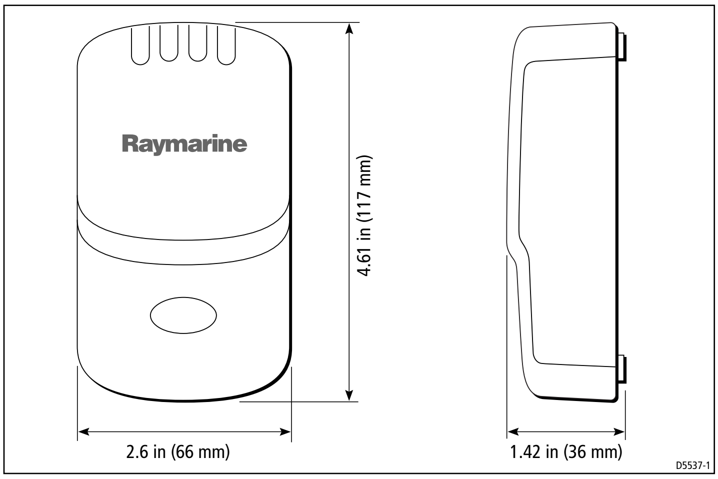


Figure 1-2: Transducer Pod dimensions

CAUTION:
The transducer Pods are not waterproof and so must be installed in a dry location.

Each transducer Pod must be positioned below decks in a dry location where:

- It is protected against physical damage.
- It is at least 9 in (230 mm) from a compass.
- It is at least 20 in (500 mm) from radio receiving equipment.
- There is reasonable access for installation and servicing.

Instruments & keypads

Templates to facilitate instrument and keypad installation are provided in Section 11 of this handbook.

The necessary mounting surface thickness for the different instrument and keypad types, are summarized in *Table 1-1* .

Table 1-1: Mounting surface thickness

Product	Mounting surface Minimum thickness	Mounting surface Maximum thickness
Digital instruments	$^{1}/_{8}$ inch (3 mm)	1 inch (25 mm)
Analog instruments	$^{1}/_{8}$ inch (3 mm)	$^{3}/_{4}$ inch (20 mm)
Keypads	$^{1}/_{8}$ inch (3 mm)	$^{3}/_{4}$ inch (20 mm)

The maximum thicknesses given in *Table 1-1* apply when using the standard fixing studs supplied with your ST290 product. If you want to install an ST290 product in a mounting surface thicker than the maximum quoted thickness, use an M4 stud x 0.7 mm pitch, of the appropriate length.

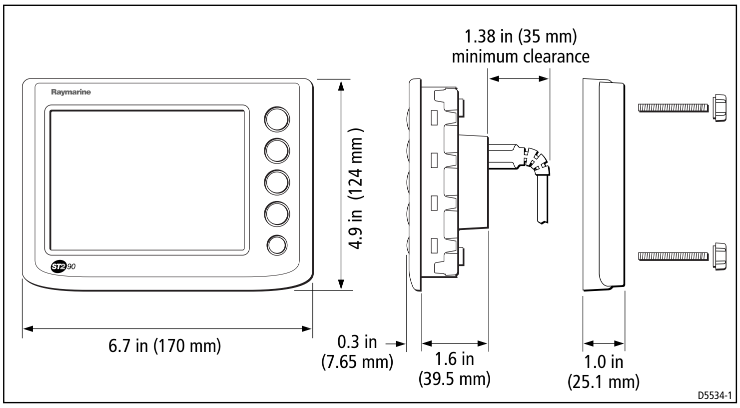


Figure 1-3: Digital instrument dimensions

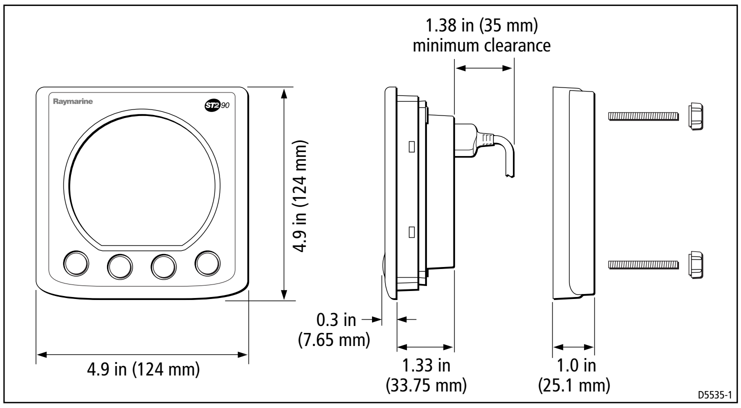


Figure 1-4: Analog instrument dimensions

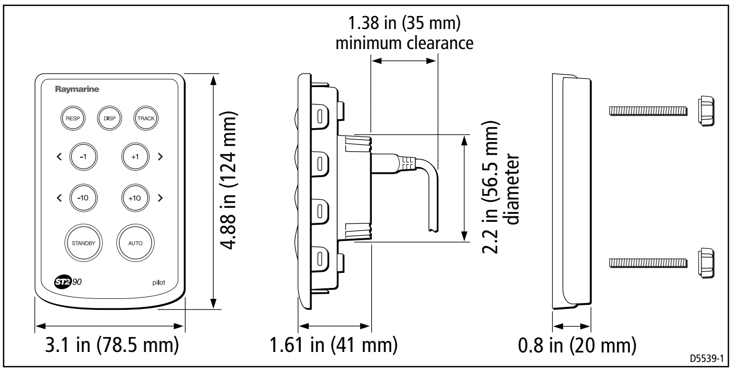


Figure 1-5: Keypad dimensions

CAUTION:
The presence of moisture at the rear of an instrument or keypad could cause damage either by entering the instrument through the breathing hole or by coming into contact with the electrical connectors.

Each ST290 instrument and keypad can be fitted either above or below deck, provided:

- The rear of each product is protected from water.
- Instruments are easily read by the helmsman.
- Keypads are easily operable.
- Each product is protected against physical damage.
- Each product is at least 9 in (230 mm) from a compass.

- Each product is at least 20 in (500 mm) from radio receiving equipment.
- There is reasonable rear access for installation and servicing.

Wind, Speed & Depth transducers

Cable lengths

The Wind, Speed and Depth transducer types connect to SeaTALK^2 via an associated Pod. The transducers are supplied with fitted cables, as follows:

- Wind: 164 ft (50 m)
- Depth/Speed: 45 ft (13.7 m)

Wind

The Wind transducer is supplied with a junction box and a set of spade terminals. The intended location for the wind transducer must:

- Be as high as possible and away from any equipment which may shield the transducer or otherwise disturb the air flow.
- Allow reasonable access for installation and servicing.
- Provide a horizontal mounting surface. If a surface (e.g. mast top) is otherwise suitable but not horizontal, make up a suitable wedged packing piece to provide the necessary horizontal surface.

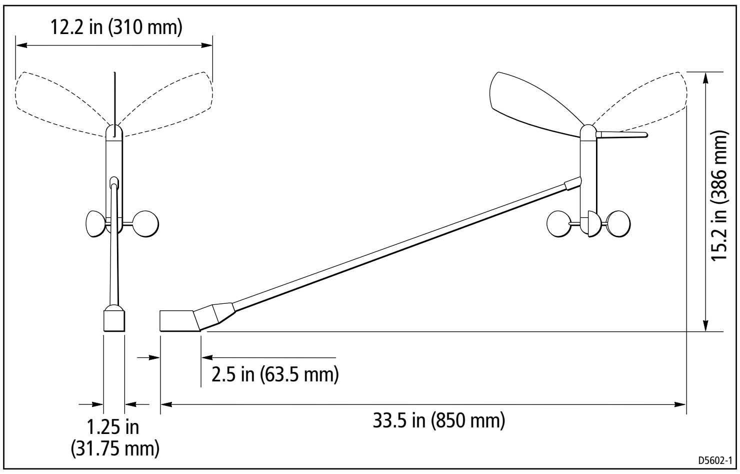


Figure 1-6: Wind Transducer dimensions

Speed and Depth

A wide range of through-hull Speed and Depth transducers are available, suitable for GRP, steel and aluminum hulled vessels (see *Table 1-2*). Please consult your Raymarine dealer for advice on the most appropriate transducer type for your vessel.

Table 1-2: Summary of transducer types

Hull material	Speed transducer	Depth transducer
GRP	M78712 Through hull plastic	M78713 Through hull plastic or M78718 Retractable through hull.
Steel	M78712 Through hull plastic	M78713 Through hull plastic or M78718 Retractable through hull.
Aluminium	M78712 Through hull plastic	M78713 Through hull plastic or M78718 Retractable through hull.
Wood	M78716 Through hull bronze	M78714 Through hull bronze

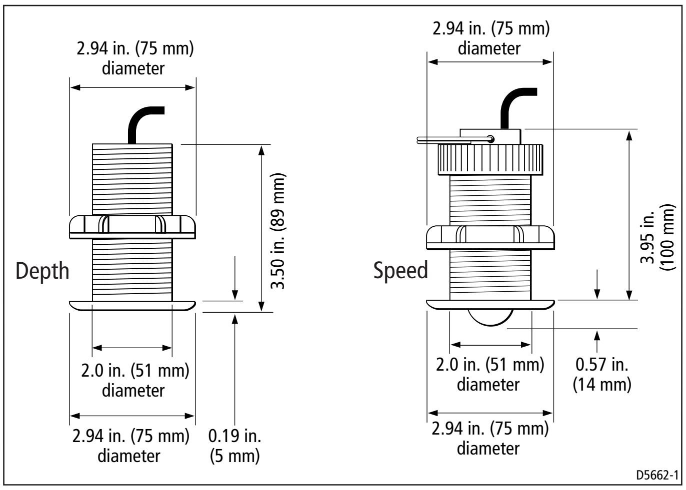


Figure 1-7: Typical plastic through hull transducer dimensions

Siting

Speed and Depth transducers should be sited within the clear water flow areas indicated by the shaded areas in *Figure 1-8* .

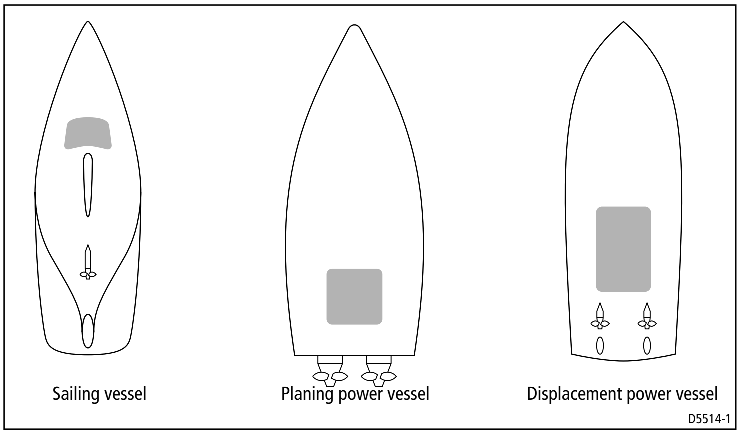


Figure 1-8: Speed & Depth Transducer siting

Each transducer should also:

- Be ahead of the propellers by at least 10% of the water line length.
- Be at least 6 in (150 mm) away from the keel (ideally ahead of the keel if a sailing yacht).
- Be as near as possible to the centre line of the vessel.
- Be clear of other through-hull fittings or projections.
- Have sufficient clearance inside the hull to enable the nut to be fitted.
- Have 4 in (100 mm) of space above it, to allow for withdrawal.

In addition to the above requirements, the depth transducer must be mounted within 10° of the vertical, forward, aft and athwart ships.

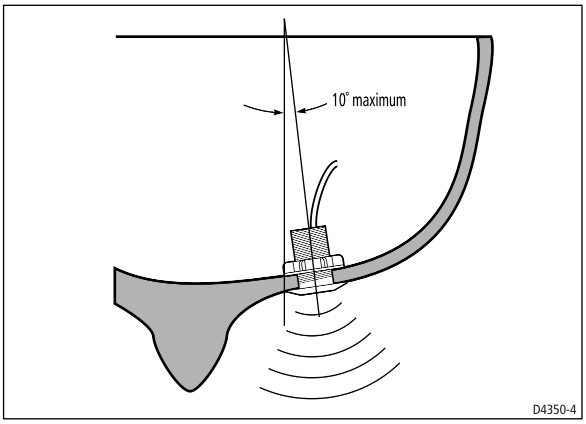


Figure 1-9: Depth Transducer maximum angle

Further information

For advice or further information regarding the installation of any ST290 product, please contact the Raymarine Product Support Department or your local Raymarine dealer. *Technical Support* information in given in *Section 5* of this handbook.

1.3 SeaTALK^2 requirements

Each SeaTALK^2 product is labelled with a Load Equivalency Number (LEN), to indicate how much power it consumes (see *Table 1-3*).

Table 1-3: Load Equivalence Numbers

Product	LEN
Digital instrument	6
DPU	5
Transducer Pods	1

In order to achieve optimum performance, always observe the following guidelines when installing SeaTALK^2 cables:

- A terminator plug is required AT EACH END of the main SeaTALK^2 cable run (see *Figure 1-10*).

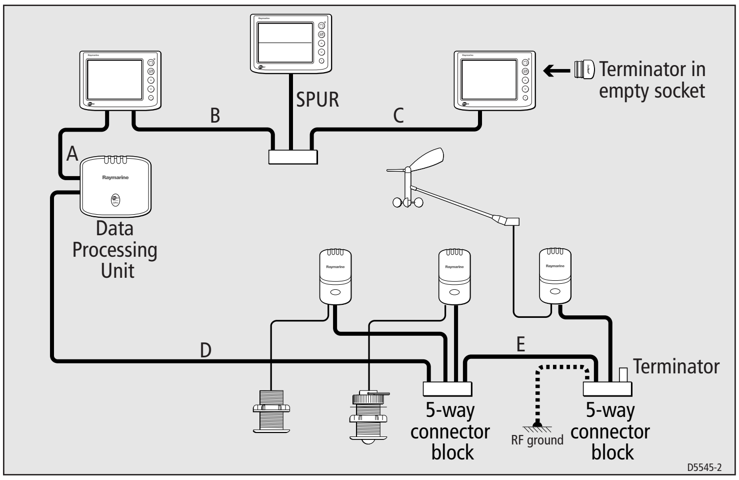


Figure 1-10: SeaTALK^2 dimensions

- The total length of the SeaTALK^2 main cable run must be no more than 655 ft (200 m). The main cable run is defined as the total length of cable between the two terminators. For example, in *Figure 1-10* , the length of the main cable run is the sum of distances A+B+C+D+E.
- Where it is impractical to connect a product in a daisy-chained manner, a connector block and spur cable can be used. Where this method is used, the length of the spur cable must not exceed 3 ft (1 m).
- The sum of the LENs of all individual products in a SeaTALK^2 system must not exceed 100. If this value exceeds 100 in the system you are planning, contact the Raymarine Technical Support Department or your local Raymarine Dealer for advice.

1.4 System structures

Preliminary information

Before running cables, refer to *Table 1-4* , to determine which bus type (SeaTalk or SeaTALK^2) is required for each product you intend installing. A summary of the various ST290 components and their associated bus connections is shown in *Table 1-4* .

Table 1-4: Bus allocations

Component	Bus connections
DPU	SeaTALK^2 and SeaTalk. NMEA 2000, NMEA 0183 and USB ports are also available.
Digital instruments (Graphic & Data)	SeaTALK^2
Transducer Pods (all types)	SeaTALK^2
Analog instruments (all types)	SeaTalk
Keypads (all types)	SeaTalk

Spend some time determining the best positions for the instruments and transducers, such that the conditions described under *Planning the installation* are satisfied. If you are planning to utilize the NMEA0183, NMEA2000 or USB interfaces, for other products (e.g. GPS), you must also take this into account when positioning your ST290 products.

In an ST290 system the Data Processing Unit (DPU) controls the operation of the system, and connects to the other system components via SeaTalk and SeaTALK^2 buses. The Digital instruments and the transducer Pods connect to SeaTALK[2], whereas the analog instruments and keypads connect to SeaTalk.

A very basic system could comprise the DPU, one instrument, one transducer and one Pod, but in practical terms, a typical ST290 system will comprise a number of digital and analog instruments, several transducers, Pods and keypads.

Cables

Cables for both SeaTalk buses are available both in made-up form with fitted connectors, and unterminated on a drum. Spade connectors and junction boxes are provided to terminate cables as necessary.

Power supply

The power supply installation information in this handbook is valid for a typical ST290 system with a total LEN of up to 100 (see *SeaTalk[2] requirements* on page 6-1-14). Larger systems need additional power supplies. If the system you are intending to install will have a total LEN of more than 100, please contact the Raymarine Technical Support Department, or your local Raymarine Dealer, for advice on power supply connection.

An ST290 system requires a 12 V dc supply, connected in one of the following ways:

- With the supply (normally a battery) connected to the DPU.
- From a Raymarine Course Computer, via SeaTalk.

Note: *If a battery is used as a power source, it is recommended that in order to avoid sudden voltage drops, the battery used for engine starting is NOT used to power ST290.*

Refer to *Section 6, Chapter 2* for power connection details.

Protection

The power supply must be protected with a 5 A fuse or circuit breaker.

1.5 Typical systems

The exact manner in which ST290 is installed will be different from boat to boat, but suggested layouts for a sail boat and a power boat are shown in *Figure 1-11* .

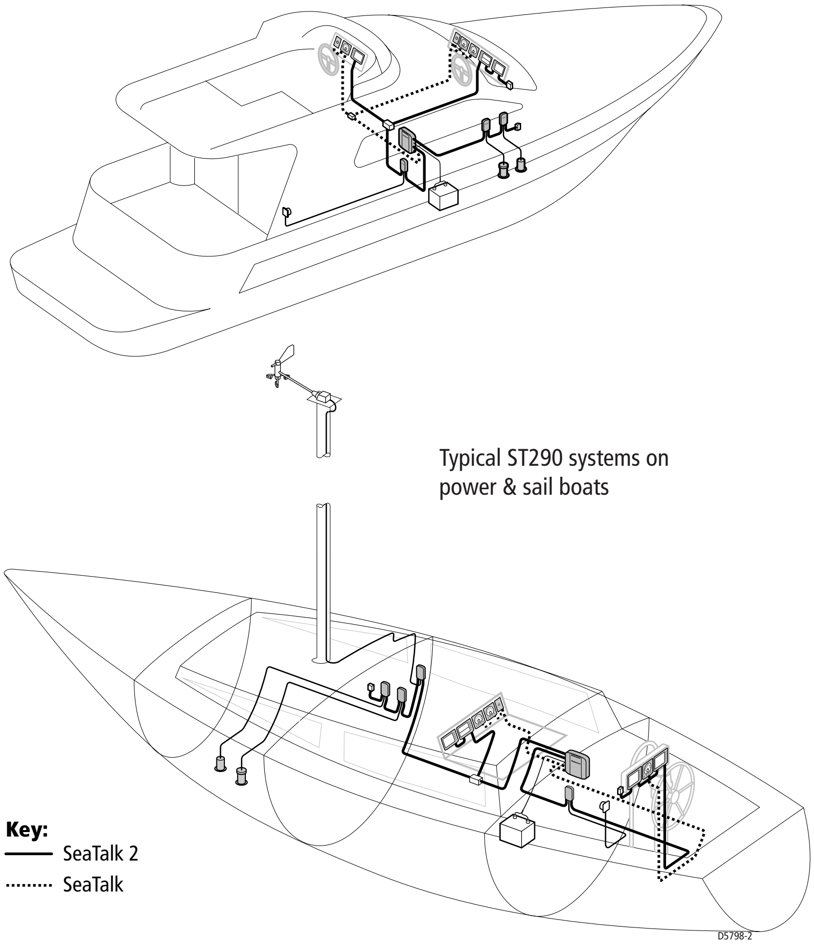


Figure 1-11: Typical system layouts

Suggested connection schemes for two different ST290 systems are shown in *Figure 1-12* and *Figure 1-13*

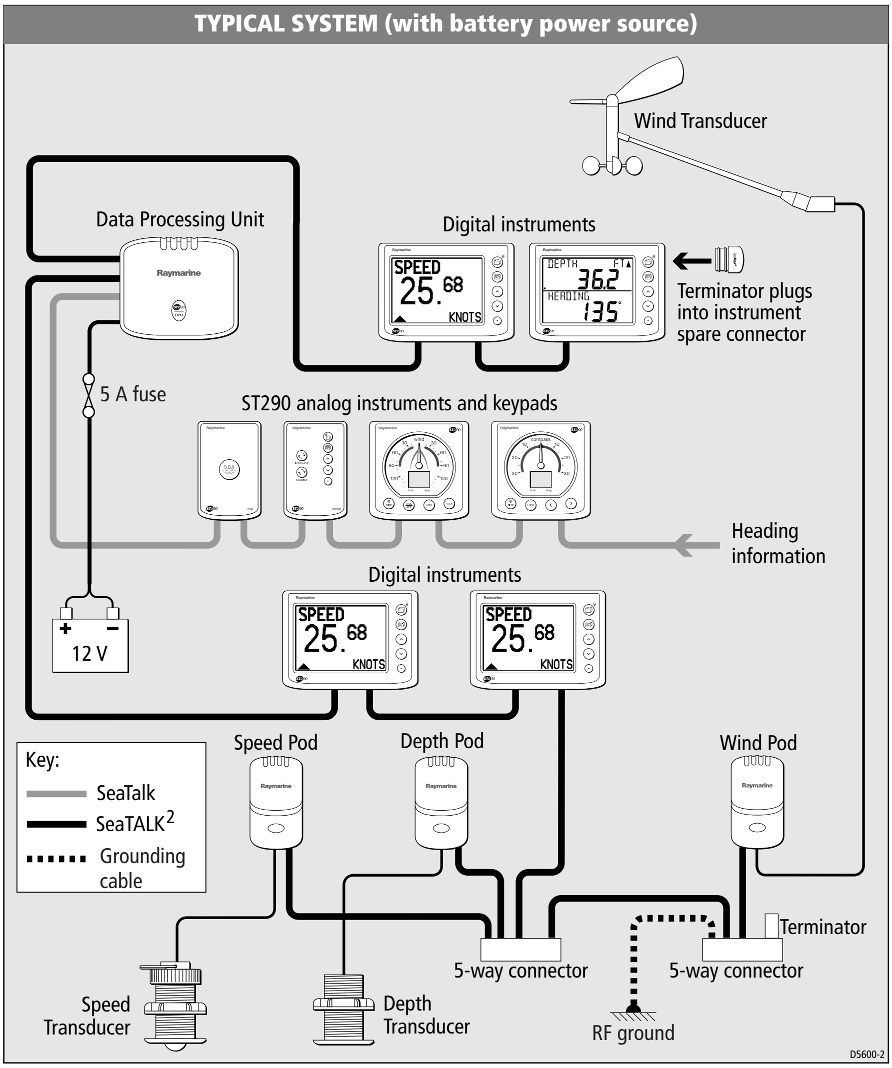


Figure 1-12: Typical system using both SeaTalk and SeaTALK^2 products with power supplied from battery

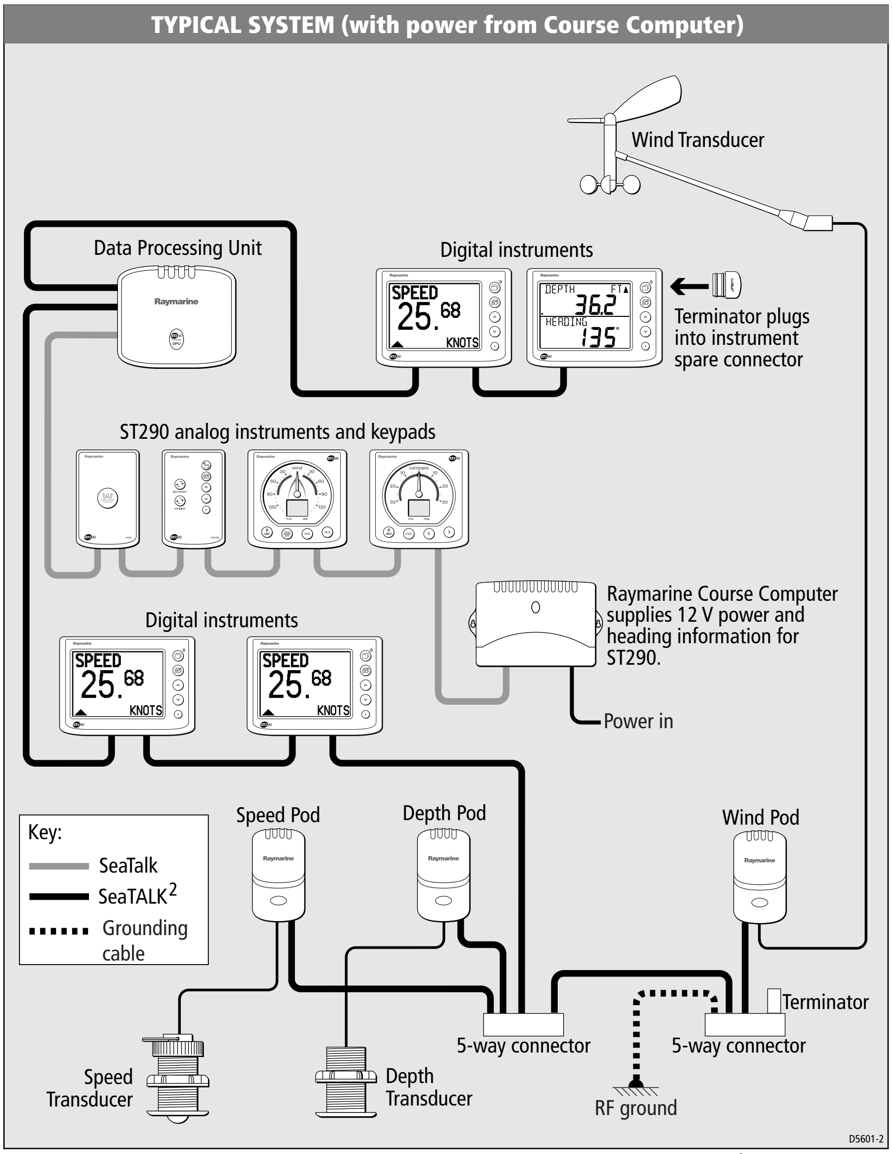


Figure 1-13: Typical system using both SeaTalk and SeaTALK^2 products with power supplied from a Raymarine Course Computer

Chapter 2: Installation Procedures

2.1 Introduction

Important

WARNING:
Make sure you have switched off the power supply before you start installing this product.

CAUTION:
Where it is necessary to drill or cut holes (e.g. for cable routing and instrument mounting):

- **Ensure that these will not cause a hazard by weakening critical parts of the vessel's structure. If in doubt, seek advice from a reputable boat builder.**
- **Ensure that you do not damage items behind the surfaces you cut.**

Before commencing any installation procedure, ensure that you have read and understood *Section 6,Chapter 1*, and that you are able to meet the requirements described there. Provided you adhere to those conditions, you can position the ST290 system components as required.

Sequence of operations

Typical installation procedures are described in the following sequence:

- Running SeaTalk & SeaTALK^2 cables.
- Fitting Data Processing Unit.
- Fitting Speed, Depth and Wind transducers.
- Fitting transducer Pods.
- Fitting instruments and keypads.
- Making power connections.
- Preparation for use.

If necessary, adapt this sequence to best suit your situation.

2.2 Running SeaTalk & SeaTALK² cables

Cable routing practices

When running cable, always observe the following guidelines:

- If a cable has to be fed through the deck, always use a good quality deck gland.
- Where cables are fed through holes, always use grommets to prevent chafing.
- Secure long cable runs so they do not present a hazard.
- Wherever possible, route cables away from fluorescent lights, engines and radio transmitting equipment, as these may cause interference.
- Always observe the *SeaTALK² requirements*, detailed in *Section 6, Chapter 1*.

Identifying cables

SeaTalk and SeaTALK² buses are used in the ST290 system. SeaTalk uses a 3-core cable and SeaTALK² uses a 5-core, screened cable. Each cable type is available in both made-up form with pre-fitted connectors (see *Figure 2-1*), and in unterminated form on a drum.

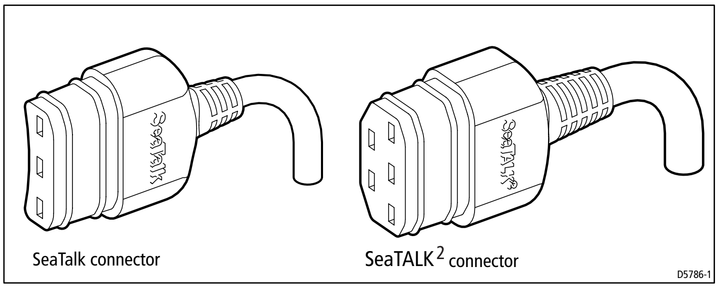


Figure 2-1: Bus connectors

If you are working with unterminated cable, use the details in *Table 2-1* (SeaTalk) and*Table 2-2* (SeaTALK²) to ascertain the correct connections. Cable boots are available to cover the spade terminals used to connect unterminated SeaTALK² cables. Further details are given under *Unterminated SeaTalk2 cable* on on page 6-2-25.

Table 2-1: SeaTalk connections

Wire	Function
Red	12 V +
Uninsulated	12 V -
Yellow	Data

Table 2-2: SeaTALK^2 connections

Wire	Function
Shield	Screen
Red	12 V +
Black	12 V -
White	Signal line high
Blue	Signal line low

Procedure

Using *Figure 2-2* as a guide, run the SeaTalk and SeaTALK^2 cables from the intended location of the DPU to the intended location of the nearest instrument or keypad on each bus. If necessary, SeaTALK^2 can comprise two sections (as shown in *Figure 2-2*). **Remember that the total of the Load Equivalency Numbers (LEN) of the products connected to SeaTALK^2 must not exceed 100** (see *Section 6, Chapter 1* for details).

Run SeaTalk and SeaTALK^2 cables as appropriate, between the intended locations of the remaining products, so you can to daisy-chain the products together (as in *Figure 2-2*).

At the intended location for each ST290 product, take the following action:

- If you are using pre-made cables, coil up the cable to await connection.
- If you are using unterminated cable, leave two cable 'tails' each approximately 2 ft (600 mm) long, to facilitate future connection.

Connector blocks can be used to connect to spurs where appropriate.

Always fit a SeaTALK^2 terminator at each end of the SeaTALK2 bus.

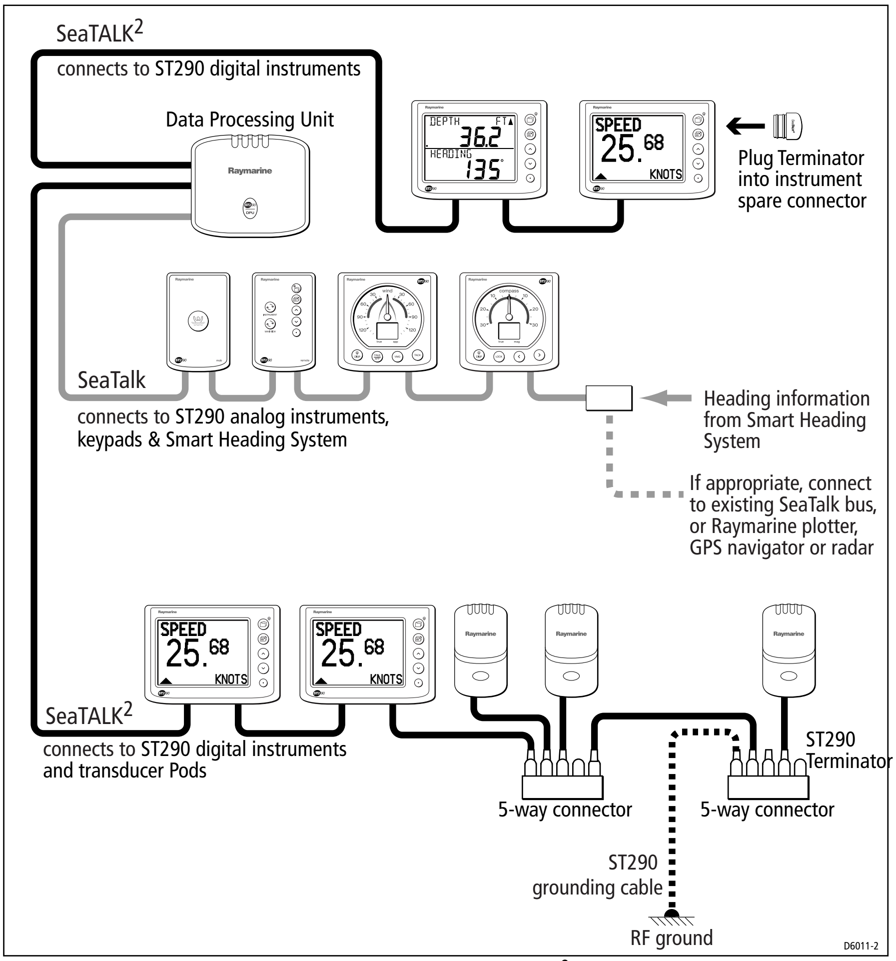


Figure 2-2: Running SeaTalk and SeaTALK^2 cables

Pods

Each transducer Pod is supplied with a fitted SeaTALK^2 cable and integral plug. The recommended method for installing the Pods is to fit them in close proximity to one another and plug the cable from each Pod to a 5-way SeaTALK^2 connector block (as in *Figure 2-2*).The connector block is connected to SeaTALK^2 and also provides a convenient point to insert a SeaTALK^2 terminator.

System power

DO NOT CONNECT POWER to an ST290 system other than by the methods described under *Making power connections* on page *6-2-27*.

If a SeaTalk bus is already installed on the vessel, use SeaTalk cable to extend the bus to the existing products from the intended locations of the ST290 analog products. In such a case, the power source for the existing SeaTalk bus will also supply power for the entire ST290 system.

2.3 Cable preparation

In an ST290 system, cables not already fitted with molded connectors must be correctly prepared for connection. To do this, use either the *General connections* procedure (for connection to spade connectors or junction box) or the *Connections to spring retention connectors* procedure below, as appropriate.

General connections

The method of preparing a cable for connection to spade connectors or to the connector block in the Wind transducer junction box, is shown in *Figure 2-3* .

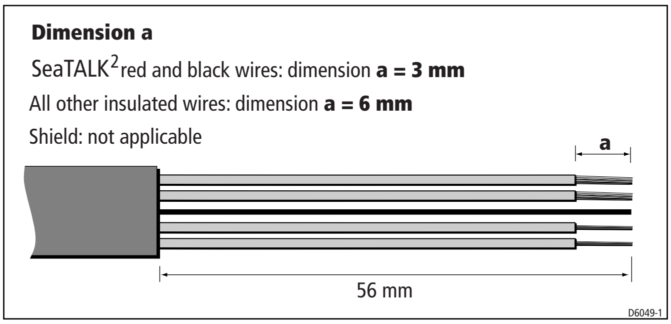


Figure 2-3: Preparing cable for spade connectors or junction box

Prepare the cable as described in *Figure 2-3* then, ensuring wire strands do not extend beyond the rear of the connector insulation, insert each wire into the connector. An example showing a spade connector is shown in *Figure 2-4* . Secure the wires as follows:

- Crimp spade connectors.
- Tighten connector block screws.

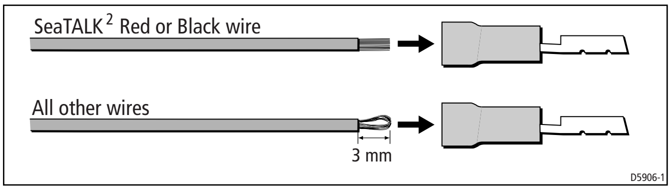


Figure 2-4: Inserting wires in spade connectors

Connections to spring retention connectors

The DPU and transducer Pods use color-coded, spring retention connectors for SeaTALK^2 connections. To make a secure connection to a spring retention connector, prepare the cable for connection as shown in, *Figure 2-5* , then use the method illustrated in *Figure 2-6* to connect each wire.

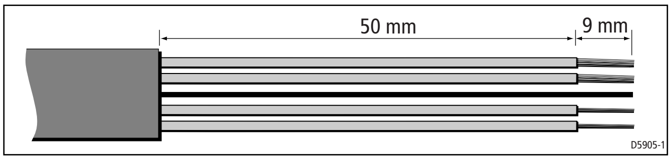


Figure 2-5: Preparing cable for spring retention connectors

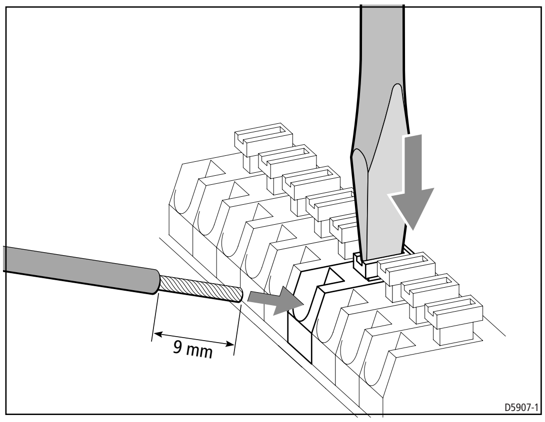


Figure 2-6: Connecting to spring retention connector

81183_2 S6.book Page 7 Wednesday, May 7, 2003 11:27 AM

2.4 Fitting Data Processing Unit

Fit the Data Processing Unit to a vertical surface, as follows:

1. Remove the outer cover.

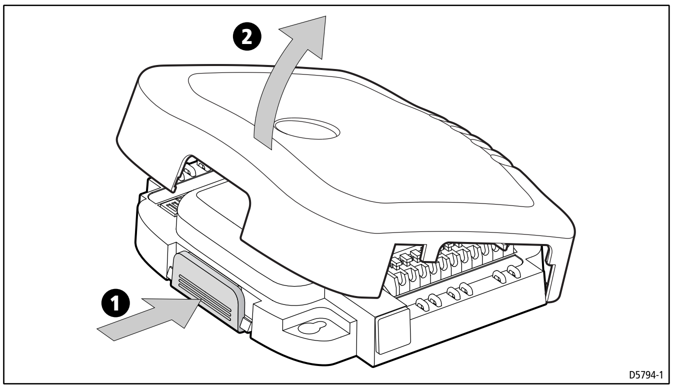


Figure 2-7: Removing DPU cover

2. Place the DPU in the required position and mark the position of the fixing holes.
3. Using a $^1/_8$ in (3.5 mm) drill, drill a pilot hole for each of the two fixing screws.
4. Screw one of the self-tapping screws provided (No 8 x 1 in) into each hole, so each screw-head is at least 15 mm from the surface.

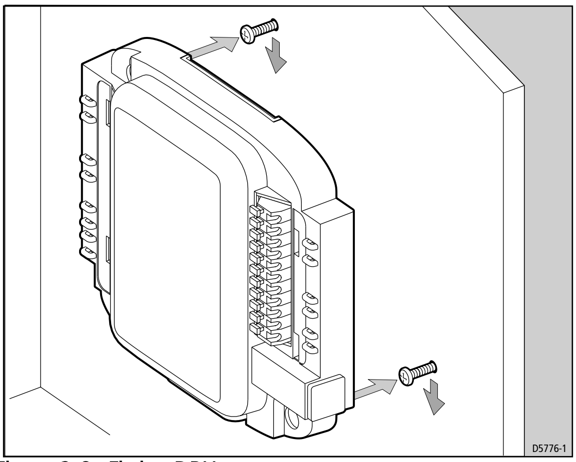


Figure 2-8: Fitting DPU

5. Place the fixing holes over the screw heads, then move the DPU down so the screw heads are at the top of the keyhole slots.
6. Tighten the self-tapping screws to secure the DPU in position.

Connections to DPU

SeaTalk & SeaTALK^2

Connect SeaTalk and SeaTALK^2 cables to the DPU as shown in *Figure 2-9, DPU SeaTalk & SeaTALK2 connections*.

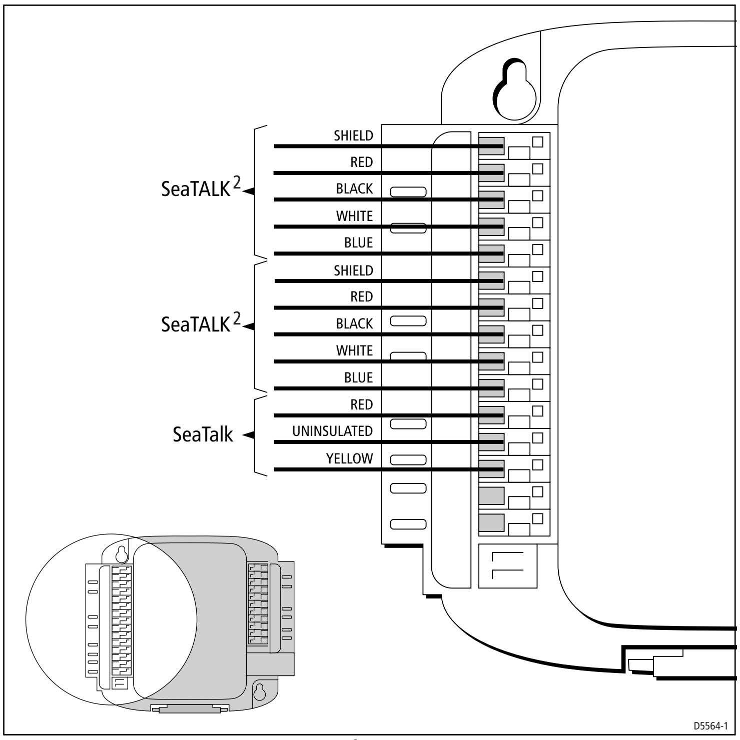


Figure 2-9: DPU SeaTalk & SeaTALK^2 connections

Miscellaneous

The DPU also provides the following connections (see *Figure 2-10, Miscellaneous DPU connectors*):

- NMEA0183
- NMEA2000
- Universal Serial Bus (USB) connector to enable ST290 to be connected to a computer system for operation with navigational systems such as Raytech, and for diagnostic purposes.
- Auxiliary Alarm.

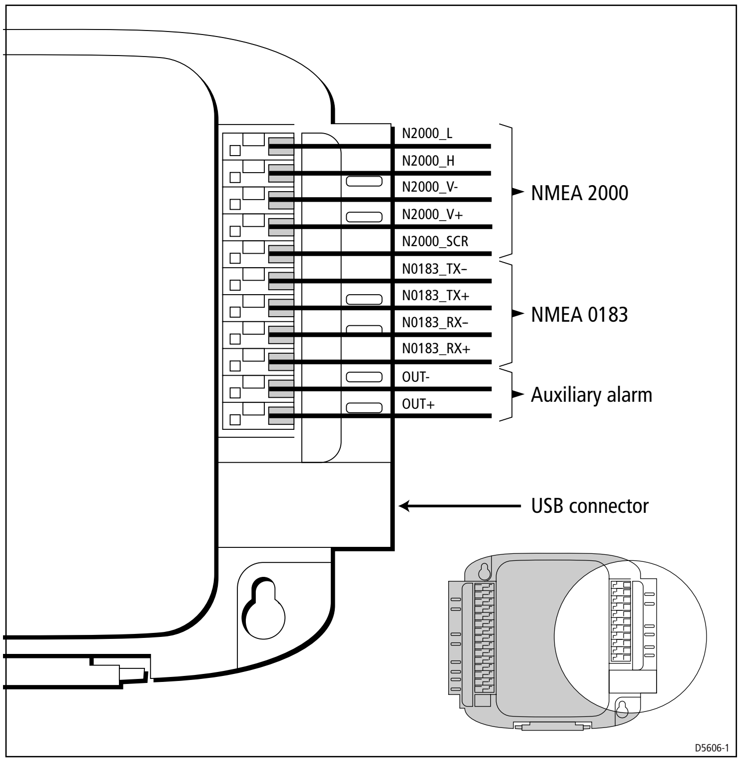


Figure 2-10: Miscellaneous DPU connectors

NMEA data

NMEA0183

Supported NMEA 0183 data is detailed in *Table 2-3* and *Table 2-4* .

Table 2-3: NMEA0183 transmitted data

Header	Data
DBT	Depth
HDG	Heading, deviation and variation
HDM	Magnetic heading
MTW	Water temperature
VHW	Water speed and heading
MWV	Wind speed and angle

Table 2-4: NMEA0183 Received data

Header	Data
BWC	Bearing and distance to waypoint
VTG	COG and SOG
XTE	Cross track error
GLL	Latitude, longitude and time
RMB	Cross Track Error Origin and destination waypoint identity Destination waypoint latitude and longitude Range and bearing to waypoint Waypoint arrival status
RMC	Time, date, latitude, longitude, COG and SOG Variation
GGA	Time Latitude and longitude Satellites Tracked HDOP
APB	Cross track error Waypoint identifier Waypoint Bearing Waypoint Distance

NMEA2000

Table 2-5: NMEA2000 Transmitted data

Parameter Group Number	Data
128259	SOG and water speed
127250	Magnetic heading, deviation and variation
128267	Water depth
130306	Wind speed and direction
130310	Water temperature

Securing cables and replacing cover

When the DPU cables have all been connected, secure each cable to the loops on the DPU, using the cable ties provided.

When all cables are secure, replace the DPU cover.

Do not use the DPU with the cover removed, as this could degrade the EMC performance.

2.5 Fitting Speed, Depth & Wind transducers

Each transducer connects to SeaTALK^2 via a dedicated Pod, supplied with the transducer. These instructions describe how to fit the transducers and run the transducer cables to the intended locations for the Pods. At each Pod location, leave at least 2 ft (600 mm) of transducer cable, to facilitate future connection.

Speed & Depth

Instructions for installing and maintaining the Speed and Depth transducers are packed with the transducers. Install these transducer types in accordance with these enclosed instructions.

Running transducer cable

Speed and Depth transducers each have a 45 ft (13.7 m) cable, which connects to the relevant Pod. Observing the guidelines given under *Cable routing guidelines* near the start of this chapter, run the cable to the intended location for the Pod.

Important point: Do NOT shorten the cable from the Depth transducer as this will seriously degrade transducer performance. If the Depth transducer cable is too long, coil the spare cable in an appropriate, safe position.

Wind transducer

The Wind transducer is fitted with a 164 ft (50 m) cable, terminated with spade connectors for connection to the Wind transducer Pod. The manner in which the cable is fitted will depend on the locations of the transducer and Pod. The following guidelines are provided:

- If the transducer is mounted on a masthead or other structure likely to be removed for maintenance or storage purposes, always incorporate a disconnection point as near as possible to the cable entry point into the vessel. This can be achieved either by positioning the Wind Pod at an appropriate point, or if this is not possible, by connecting the junction box supplied, between the Wind transducer and Pod, near the cable entry point.
- It may be necessary to remove the spade connectors to facilitate installation, e.g. if you want incorporate the junction box in the cable run or if the cable has to be routed through narrow apertures.

Assembling Wind Vane

Referring to *Figure 2-11* , assemble the wind vane, transducer body and anemometer as follows:

1. Insert the upper spindle of the transducer body into the vane and secure with the grub screw.
2. Insert the lower spindle of the transducer body into the anemometer and secure with the grub screw.

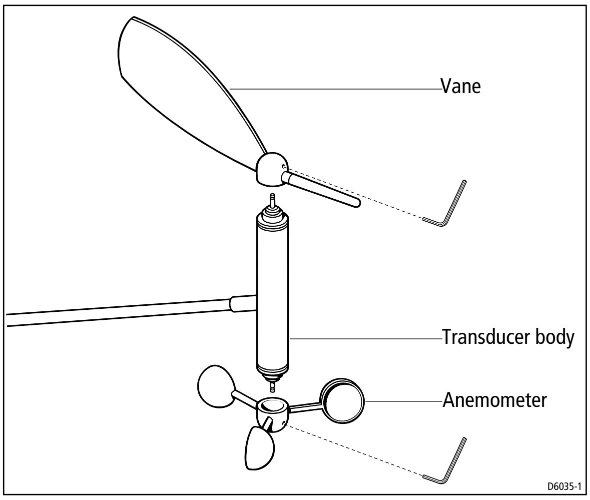


Figure 2-11: Assembling vane, transducer & anemometer

Fitting transducer

The Wind transducer is typically mounted on a mast top (see *Figure 2-12*), as follows:

1. With the threaded end of the Wind transducer mounting block facing forwards, mark the position of the two self-tapping screws.
2. Drill two holes using a $^5/_{32}$ in (4 mm) drill bit.
3. Apply sealing compound to the bottom of the mounting block.

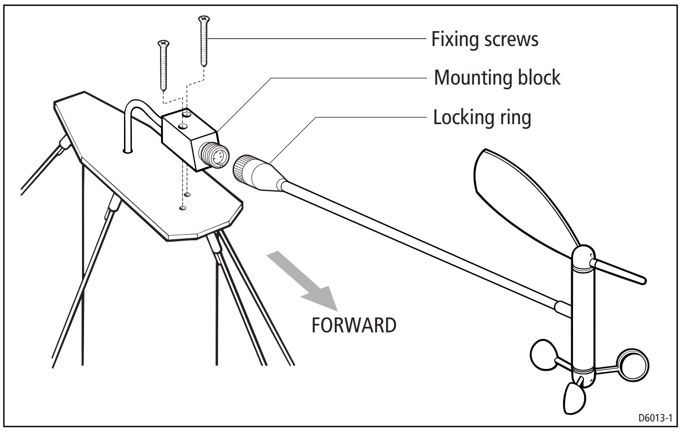


Figure 2-12: Fitting Wind transducer

4. Secure the mounting block to the mast top using the two fixing screws.
5. Taking care to locate the key on the transducer arm connector with the corresponding keyway on the mounting block connector, insert the transducer arm connector into the mounting block connector and tighten the locking ring securely by hand.

Running transducer cable

If the Wind transducer is fitted on a masthead, remove the spade connectors from the free end of the cable, then feed the free end of the cable down inside the mast.

- If the mast is a through-deck mast, feed the cable out through a suitable below-decks aperture.
- If the mast is deck stepped, feed the cable through the deck, using a proprietary deck gland.

If the Wind Pod is situated near to the cable entry point, crimp new spade connectors onto the wires, as described under *Cable preparation* on page 6-2-5, then connect the cable to the Wind Pod, as described under *Fitting transducer Pods*. If the Wind Pod is not situated near to the cable entry point, fit the junction box (see *Figure 2-13*) inside the vessel, close to the cable entry point, then:

1. Run the cable to the junction box, then allowing sufficient cable to connect inside the junction box, cut the cable and connect each wire at the free end of the cable from the transducer, to a separate connector inside the junction box.
2. Connect each wire at one end of the remaining cable to the same-colored wire inside the junction box.
3. Run the cable from the junction box to the intended location for the Wind Pod.
4. Crimp new spade connectors onto the wires at the Wind Pod end of the cable, as described above, and connect the cable to the Wind Pod, as described under *Fitting transducer Pods*.

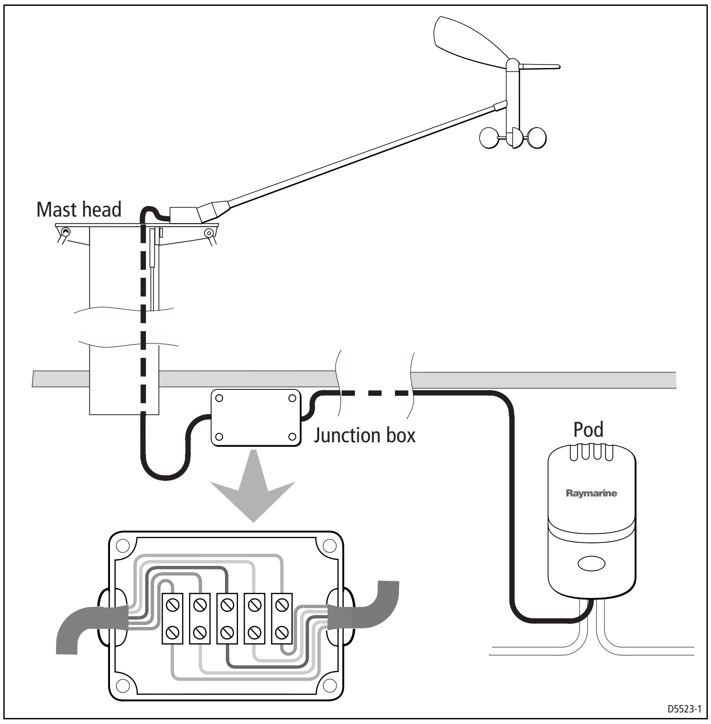


Figure 2-13: Using the Wind transducer junction box

Connect the cable to the Wind Pod, as described under *Fitting transducer Pods.*

2.6 Fitting transducer Pods

The installation procedure given here is common to all Pod types and assumes that SeaTALK^2 and transducer cables have been routed to the Pod location, as described under *Running SeaTalk & SeaTALK^2 cables* on page 6-2-2.

Install each Pod as follows:

1. Remove the Pod cover as shown in *Figure 2-14* .

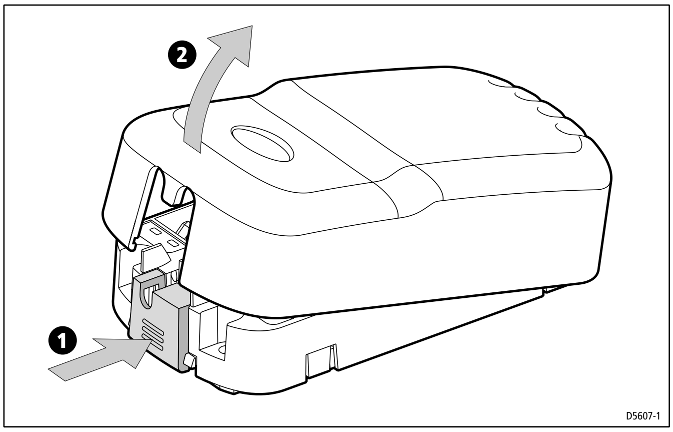


Figure 2-14: Removing Pod cover

2. Place the Pod, with the SeaTALK^2 connector block uppermost on the mounting surface and mark the centres of the fixing holes.
3. Drill three pilot holes for the Pod mounting screws, then secure the Pod to the mounting surface with the screws provided, as in *Figure 2-15* .

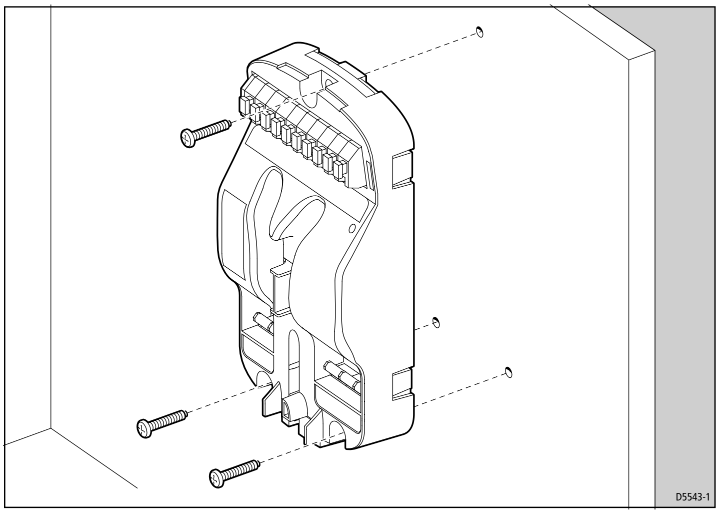


Figure 2-15: Securing Pod

Connecting Pods

CAUTION:

Using the wrong type of Pod could cause damage to your equipment. Before connecting a transducer to a Pod, ensure that you are using the correct type of Pod, i.e. Speed Pod for a Speed Transducer, Depth Pod for a Depth Transducer etc.

A summary of the connections for the various transducer Pod types, is given in *Figure 2-16* .

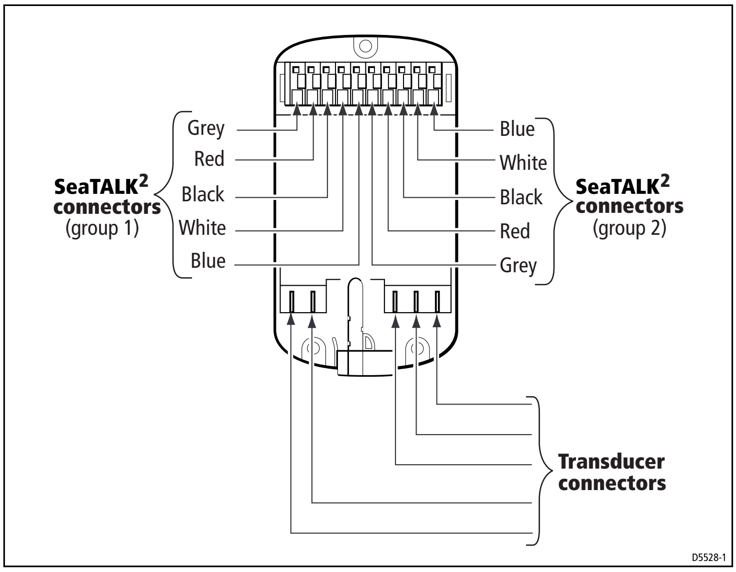


Figure 2-16: Pod connections

Note that each Pod has two groups of SeaTALK^2 connectors. Each pod is supplied with a SeaTALK^2 cable connected to one group. If necessary, you can use the second group to daisy-chain Pods into the system (see *Figure 2-17*).

Use *Figure 2-17* , to determine the optimum connection sequence and the correct arrangement of cables in the Pod.

Identifying connections

The Pod connectors are color-coded, so ensure that each wire is connected to the correspondingly-colored connector.

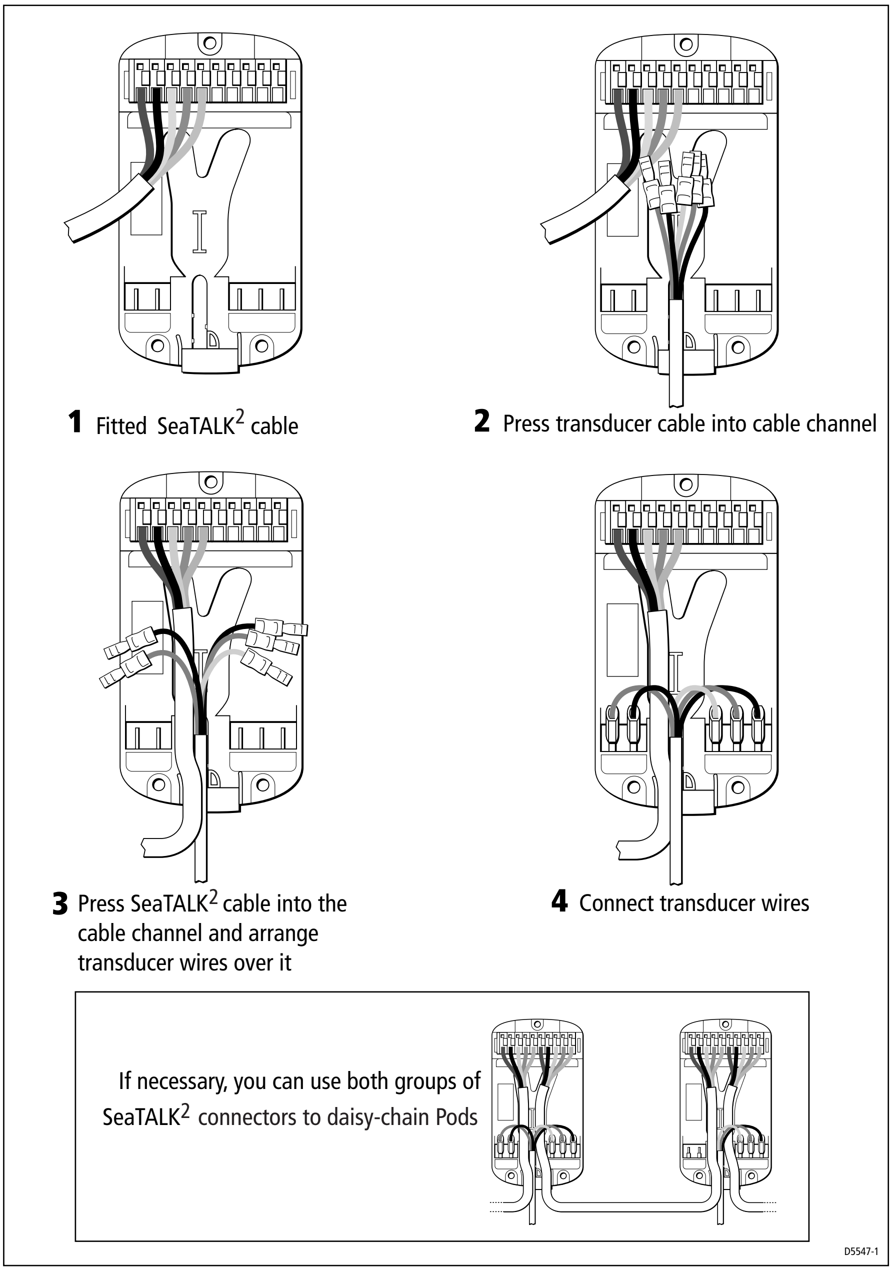


Figure 2-17: Wiring a Pod

Replacing Pod cover

Do not use the Pod with the cover removed, as this could degrade the EMC performance.

When all connections have been made to the Pod, replace the Pod cover

2.7 Fitting instruments & keypads

General requirements

All ST290 instrument and keypad types are installed in a similar manner, so generic procedures are given. Adapt these as necessary for the product you are installing.

Use the appropriate template, included at Section 11 of this handbook, to facilitate installation.

Pilot Keypad

If you intend installing an ST290 Pilot Keypad, it is strongly recommended that you install it in close vicinity to the helm.

Mounting options

ST290 instruments and keypads can be flush mounted or surface mounted (see *Figure 2-18*).

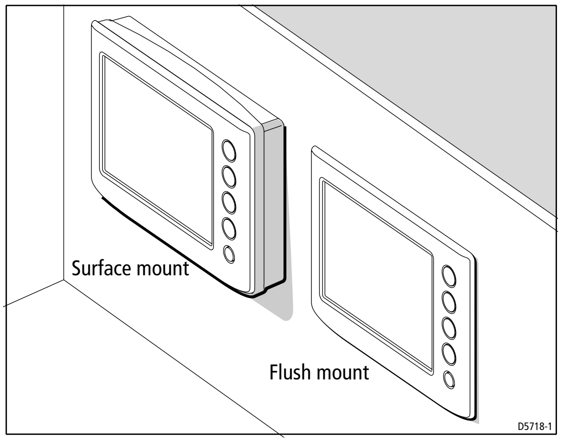


Figure 2-18: Mounting options

At each location, ensure that:

- The mounting panel is of a suitable thickness, (see *Section 6, Chapter 1, Table 1-1, Mounting surface thickness*).
- The mounting surface is clean, smooth and flat.
- There is sufficient space behind the mounting panel to accommodate the rear of the product and connectors.

Instrument & keypad seals

Each instrument and keypad is supplied with an edge seal and a surface mount seal. An edge seal must be fitted with each product, whether flush-mounted or surface-mounted.

Some seals, have a protective backing on each side and a self-adhesive surface on one side. All protective backing must be carefully peeled off before using the seal. It is recommended that you attach each self-adhesive seal to the instrument or keypad you are installing.

The keypad edge and surface mount seals are joined together when supplied, so must be carefully separated before use.

Procedures

The installation procedures are illustrated below. Although the illustrations show a digital instrument, the general method is similar for all ST290 instruments and keypads.

Flush mounting

To flush mount an instrument or keypad, use the procedure shown in *Figure 2-19* to *Figure 2-22* .

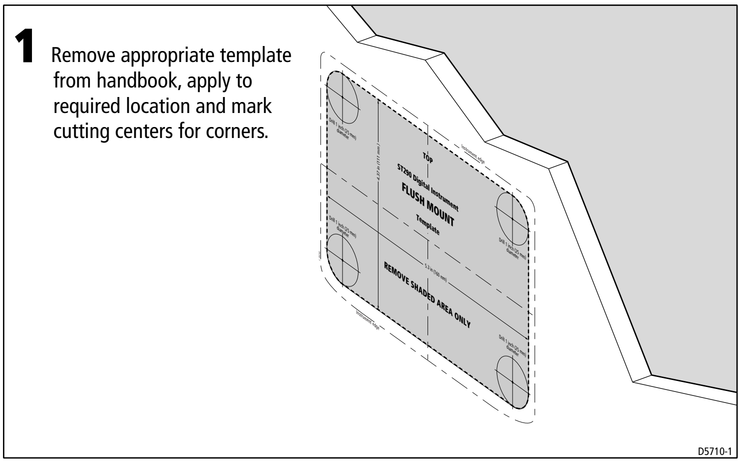


Figure 2-19: Flush mounting, step 1

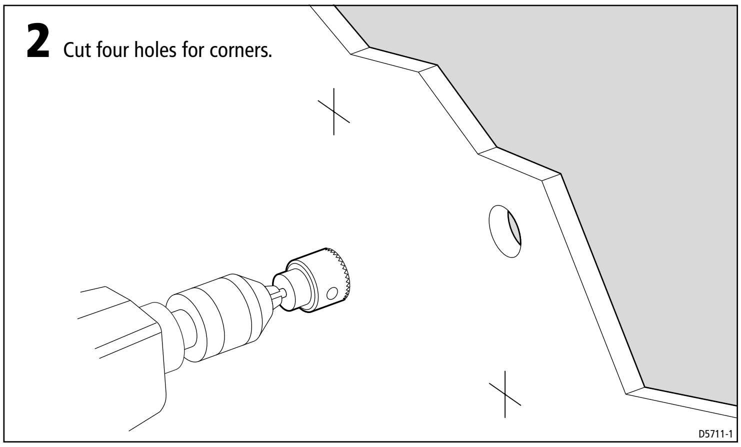


Figure 2-20: Flush mounting, step 2

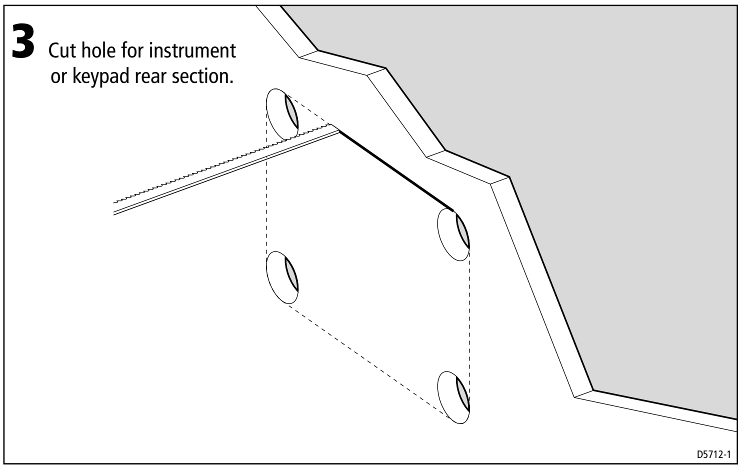


Figure 2-21: Flush mounting, step 3

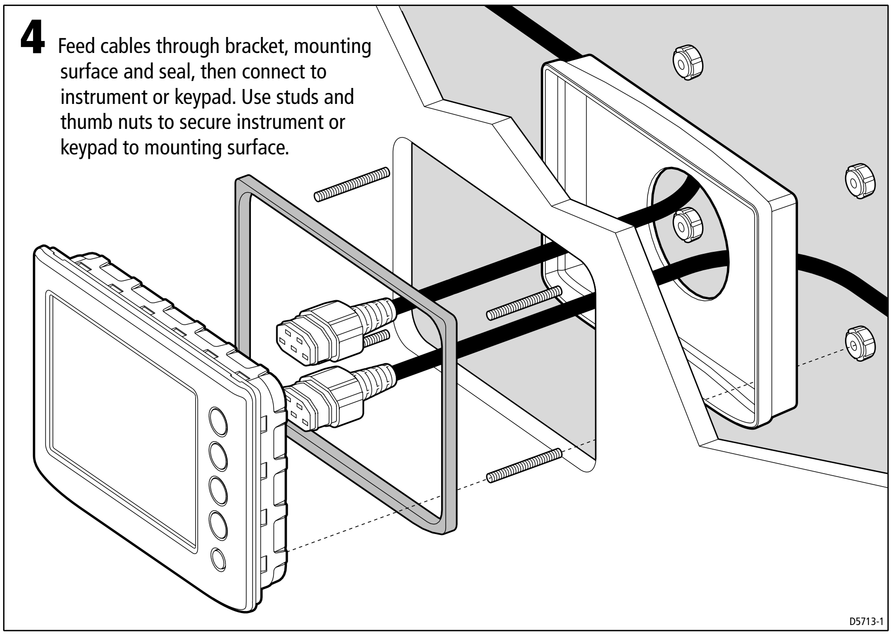


Figure 2-22: Flush mounting, step 4

Surface mounting

To surface mount an instrument or keypad, use the procedure shown in *Figure 2-23* to *Figure 2-26* .

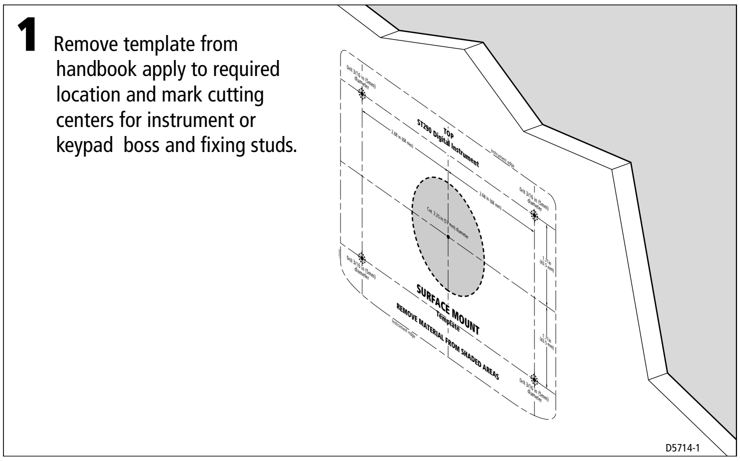


Figure 2-23: Surface mounting, step 1

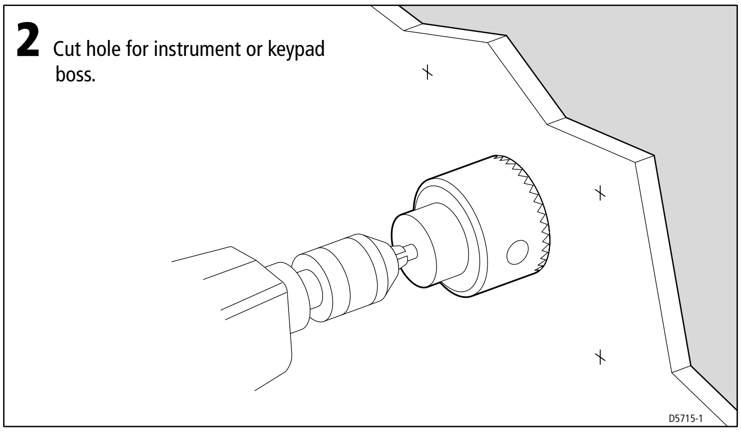


Figure 2-24: Surface mounting, step 2

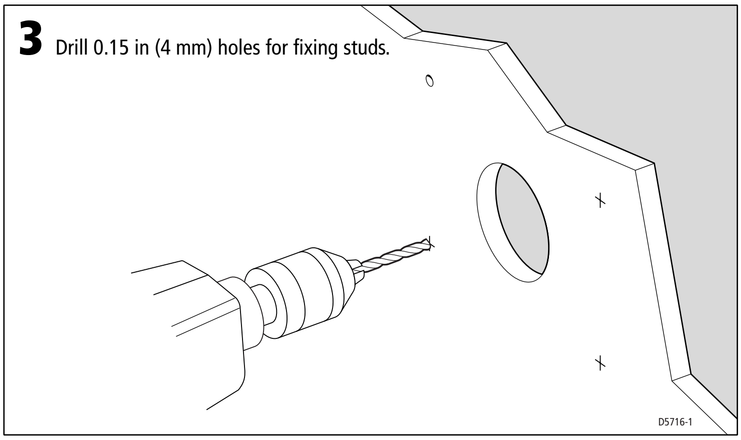


Figure 2-25: Surface mounting, step 3

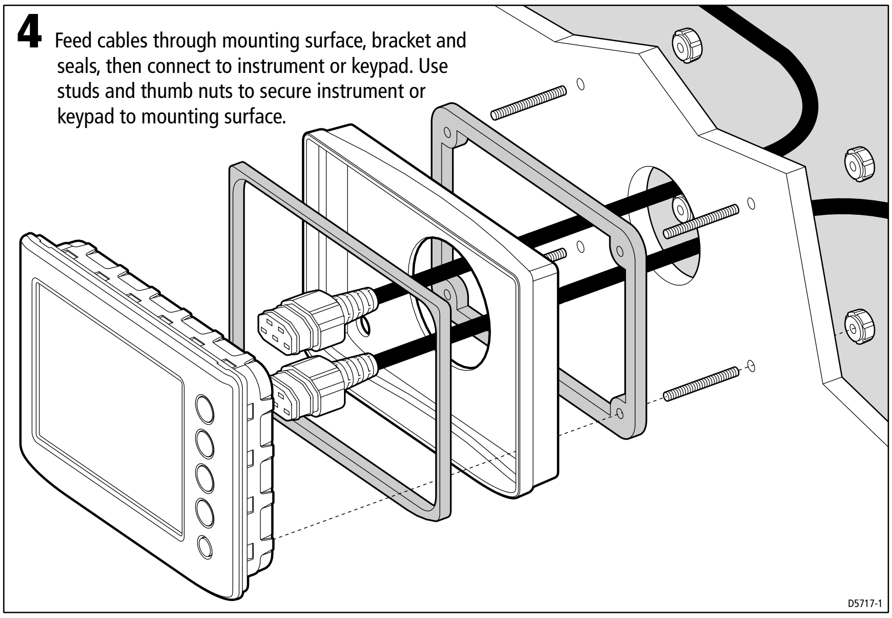


Figure 2-26: Surface mounting, step 4

Connecting instruments & keypads

The appropriate buses for the various ST290 products are detailed under *Running SeaTalk & SeaTALK2 cables*, but the general rule is that all transducer Pods and digital instruments connect to SeaTALK^2 whereas analog instruments and keypads connect to SeaTalk.

Connection methods

Each product has two bus connectors to enable 'daisy-chain' connection as shown in the following illustration This method can be used with both SeaTalk and SeaTALK^2 buses.

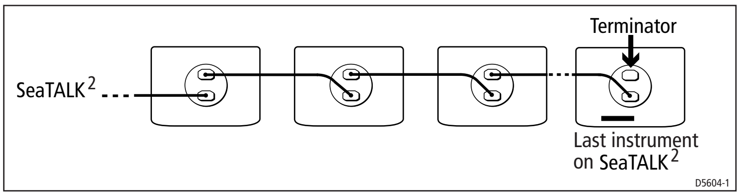


Figure 2-27: Connection methods

The exact manner in which connections are made to instruments and keypads depends on whether you are using made-up cables with pre-fitted connectors, or whether you are using cable from a drum and terminating it yourself.

Made-up cables

If you are using made up cables, plug the SeaTalk or SeaTALK^2 connectors, into the connectors on the appropriate instruments.

Unterminated SeaTALK^2 cable

If you are using unterminated cable for SeaTALK^2, prepare the cable for connection, as detailed below.

1. Slide a boot onto the cable (see *Figure 2-28*).

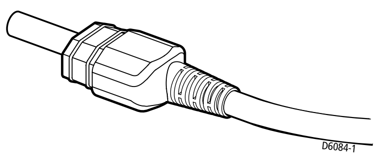


Figure 2-28: Cable boot

2. Prepare the cable for connection to the instrument as described under *Cable preparation* on page *6-2-5*.
3. Connect the crimps to the appropriate connector pins.

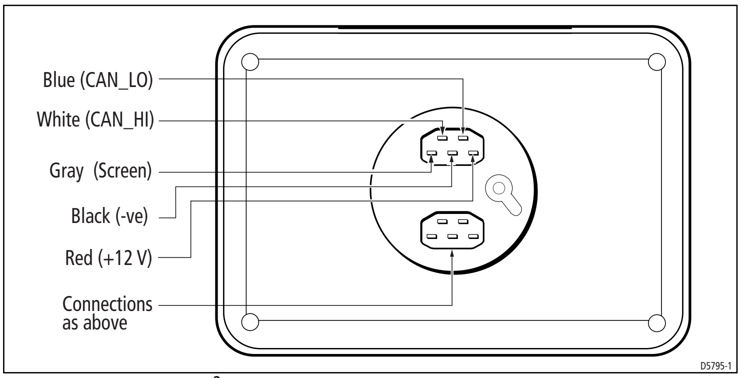


Figure 2-29: SeaTALK[2] instrument connections

4. Slide the boot fully home into the instrument connector (see *Figure 2-30*).

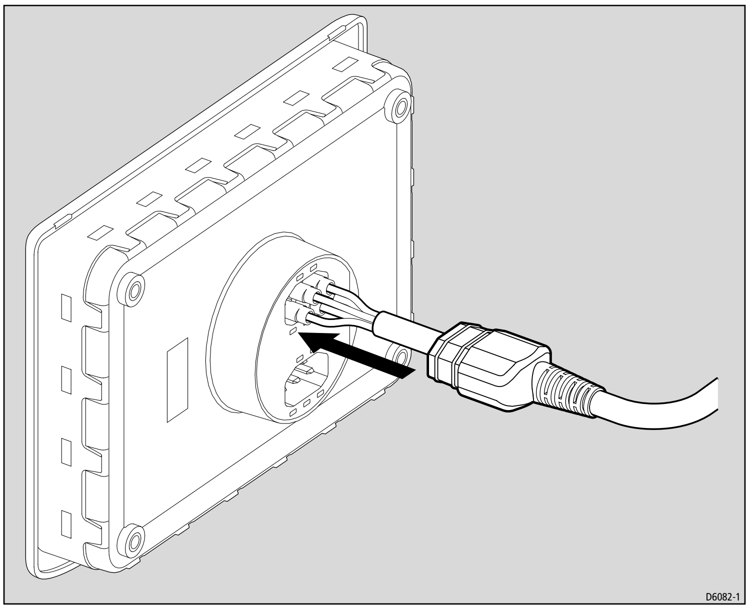


Figure 2-30: Sliding cable boot into position

Unused connectors

Insert the blanking plugs supplied, into any unused SeaTALK^2 connectors on the instruments, keypads and junction blocks.

2.8 Making power connections

Requirements

CAUTION:
Incorrectly connected power supplies could cause damage to the system. Ensure you do NOT deviate from the procedures in this handbook, when connecting power.

The ST290 system requires a 12 V dc supply. Power can be supplied either from a separate 12 V dc source (preferably from a 12 V battery) or, from SeaTalk. In either case, the power source for the ST290 system must be protected by a 5 A fuse or circuit breaker.

If your vessel only has a 24 V supply, a suitable down-converter must be used to provide 12 V.

Power for the system is connected to the DPU then distributed from there to the rest of the system via the SeaTalk and SeaTALK^2 buses.

Power supply capacity

The power supply information given here is valid for a typical ST290 system where the total of the LENs for all products on SeaTALK^2 is 100 or less (see *Section 6, Chapter 1*). If you are installing a large system where the total of the LENs is in excess of 100, please contact the Raymarine Technical Support Department, or your local Raymarine Dealer for advice on power supply connection.

Grounding the system

In order to meet the system EMC specification:

- The SeaTALK^2 cable screen must be connected to the vessel's RF ground point.
- The 12 V supply must remain floating. DO NOT connect any part of the 12 V supply to a ground point.

Using the grounding cable

Raymarine provide a made-up, RF grounding cable that you are recommended to use, to ground the ST290 system.

The grounding cable is yellow and has a connector at one end which provides a connection to the SeaTALK^2 cable screen when inserted in a SeaTALK^2 connector. The unterminated end of the cable is stripped, for connection to the vessel's RF ground point.

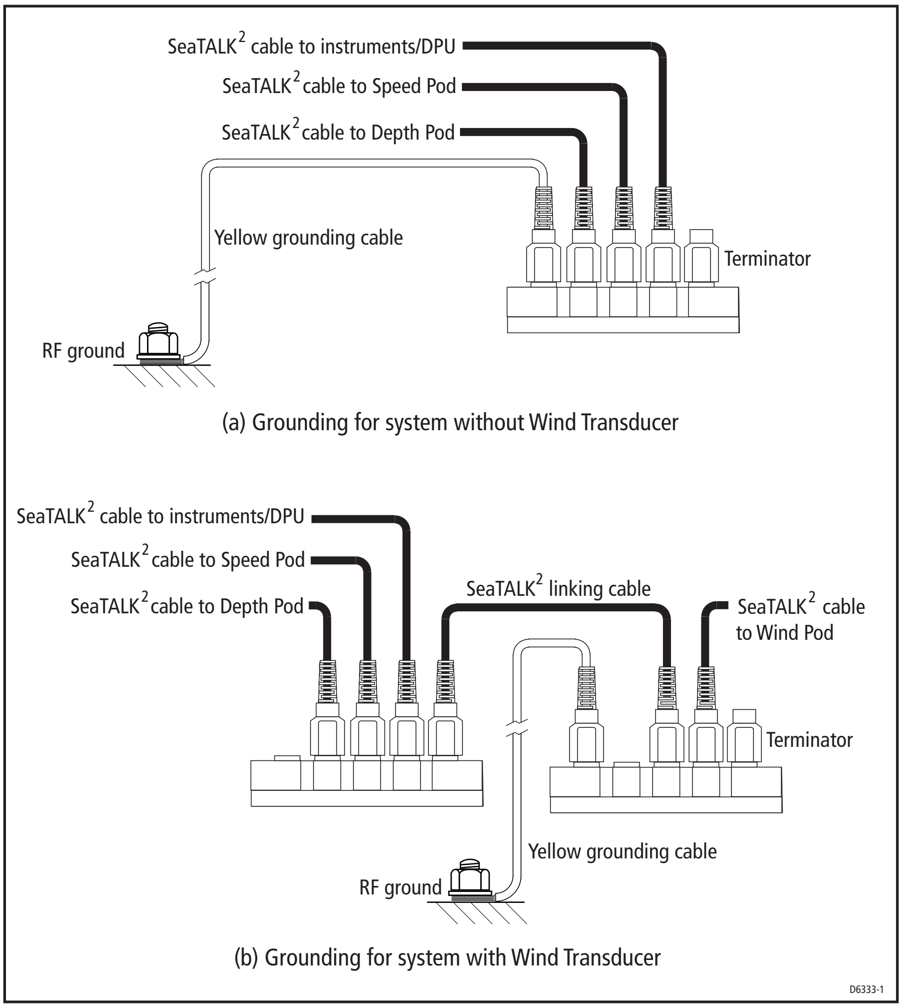


Figure 2-31:Recommended methods of grounding the system

If you require additional advice on grounding the ST290 system, please contact the Raymarine Technical Support Department, or your local Raymarine Dealer.

Procedures

CAUTION: POWER SUPPLY PROTECTION
Ensure that the power source for ST290 is protected by a 5 A fuse or circuit breaker.

Connecting to a system which includes a Raymarine autopilot

If an existing power source (e.g. a Raymarine autopilot or battery) is already connected to SeaTalk, this provides power for the entire ST290 system. In this case, DO NOT CONNECT ANY OTHER POWER SOURCE TO THE ST290 SYSTEM.

Connecting to a system without a Raymarine autopilot

CAUTION: MINIATURE SWITCH SETTINGS
The miniature switches on the DPU are correctly set during manufacture. Do NOT change these settings, or damage to your equipment could occur.

If your system is not connected to a Raymarine autopilot and if no other power source is connected to SeaTalk, connect the 12 V supply for the ST290 system is connected to the DPU as follows (see*Figure 2-32*):

1. Ensure the intended power source is switched off. If you are using a 12 V battery, ensure the power cable is not connected to the battery.

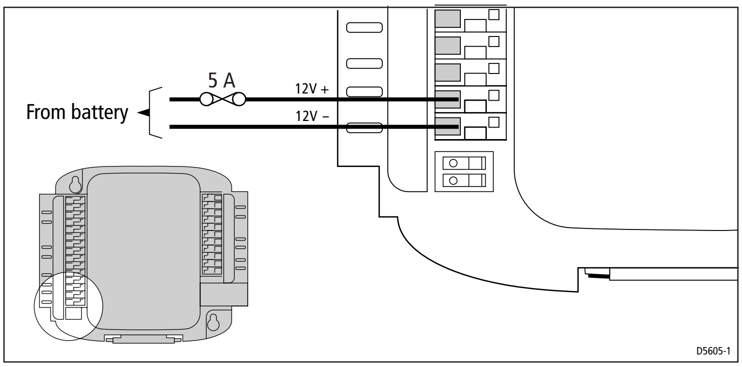


Figure 2-32: Power connections

2. Ensure a power source is not already connected to SeaTalk (e.g. from a Raymarine autopilot or battery).
3. Remove the DPU cover (see *Figure 2-7*).
4. Ensuring that the power source is protected by a 5 A fuse or circuit breaker, connect the 12 V positive and negative wires to the DPU as shown in *Figure 2-32* .
5. Replace the DPU cover.

2.9 Preparing ST290 for use

WARNING:AUTOPILOT SAFETY
If your ST290 system is connected to an autopilot system, ensure that the boat is securely moored and that all personnel are clear of the autopilot mechanism, before applying power to the system.

Before switching on power for the first time:

- Ensure the system has been installed in accordance with the procedures in this chapter.
- Ensure all cable connections are secure.
- Ensure all equipment covers are securely in place.
- If the system is connected to an autopilot, ensure that the boat is securely moored and that personnel are clear of the autopilot moving parts.

Initial checks

Once the installation is complete and power is applied for the first time:

- Check that each instrument is working satisfactorily.
- Each digital instrument will display a Profile Select screen. Use the ∧ or ∨ button to select the most appropriate profile for the boat (SAIL or POWER), as described in *Section 2, Chapter 1*.

Setup requirements

WARNING: SETUP REQUIREMENT
Do NOT use ST290 or any associated system before the setup procedures have been completed.

Before using your ST290 system for navigational purposes, prepare it for use as follows:

- Calibrate all transducers, in accordance with the procedures in *Section 7, Chapter 2*.
- Set up the autopilot system, in accordance with *Section 8, Chapter 4*.
- Set up each instrument, in accordance with *Section 7, Chapters 2, 3 & 4*.

EMC Conformance

Always check the installation before going to sea to make sure that it is not affected by radio transmissions, engine starting etc.

Section 7: System Setup

Contents

Chapter 1: Setup overview

1.1 Introduction

Use the instructions in this Section to prepare your ST290 system for use.

EMC conformance

Always check the installation before going to sea to make sure that it is not affected by radio transmissions, engine starting etc.

In some installations, it may not be entirely possible to prevent the equipment from being affected by external influences. Although this will not damage the equipment, it can lead to spurious resetting action, or momentarily may result in faulty operation.

Setup requirement

WARNING:Setup requirement
Using the ST290 system with incorrect settings applied could cause a safety hazard. In particular, the transducer calibration and autopilot commissioning procedures must be carried out, before using the ST290 system for operational purposes.

Setup procedures are presented as follows:

- Graphic Displays - *Section 7, Chapter 2.*
- Data Displays - *Section 7, Chapter 3.*
- Analog instruments - *Section 7, Chapter 4.*
- Autopilot - *Section 8, Chapters 4 & 5.*

Transducer calibration

The transducer calibration procedures optimize the performance of the transducers with the rest of the system, and so are a mandatory part of the User Setup procedures.

Note: *Transducer calibration procedures can be carried out from any Graphic Display.*

Autopilot setup

If you have one or more Pilot Keypads fitted as part of your ST290 system, you must carry out the Autopilot Commissioning procedures detailed in *Section 8, Chapter 4*, before first using the autopilot after installation.

How the User Setup values are applied

When you set up ST290, the values you set are applied in one of the following ways:

- **Locally**, to only the instrument you are setting up. Most setup values are applied in this manner.
- **Globally**. Values set at one instrument are applied to the entire ST290 system. The global setup functions are:
  - Transducer calibration (can be carried out at any Graphic Display).
  - Autopilot setup (can be carried out at any Graphic Display).
  - Data units.
  - Race timers.

Terminology

At many instrument types, you can set the instrument **response** and **display update rate**. These terms are described here, to avoid repetition.

Response

The response of an instrument defines its sensitivity to data changes, and is normally set as a numeric value in the range 1 to 15. A setting of 1 means the instrument will respond slowly to changes in data values, whereas a response setting of 15 means the instrument will respond very quickly to data changes.

Display update rate

The display update rate determines how often an instrument display refreshes the displayed data.

1.2 Digital instruments

The Data and Graphic Displays have a User Setup mode, which is entered from Normal operation, where it appears as a title in the chapter rollover.

The User Setup mode comprises a dedicated group of chapters and pages which are accessed in a similar manner to the chapters and pages used during Normal operation.

The User Setup routines enable you to:

- Set up the display responses.
- Define Favorite pages and set the operating mode for the Favorite chapter.
- Select instrument profile and set Custom profiles as required.
- Set various display options.
- Calibrate the transducers (from any Graphic Display).
- Set up autopilot parameters (from any Graphic Display), if the ST290 system is connected to an autopilot system. Refer to *Section 8, Autopilots*, for details.
- Set the data units you require.
- Define basic backlighting control parameters.

Display responses

On each type of digital instrument, you can set the display response and update rate. The response of an instrument defines its sensitivity to data changes. The display update rate determines how often an instrument display refreshes the displayed data. See *Terminology* on page 7-1-2.

Data responses

You can set the responses for the following data:

- Speed
- Depth
- Heading
- Wind angle
- Wind speed
- Cross track error (XTE)

Display update rate

Available update rates are from once per second to ten times per second.

Favorite pages

The method of setting up the Favorite pages is described in *Section 7, Chapter 2* for the Graphic Display and *Chapter 3* for the Data Display.

Choosing the best instrument profile

As part of User Setup, you can choose which operating profile to use. An operating profile is a set of chapters and pages selected to best suit a specific purpose. Each digital instrument has three preset profiles, namely FULL, SAIL and POWER.

As its name implies, the FULL profile offers the full functionality of the instrument. The SAIL and POWER profiles provide groups of chapters and pages best suited to these types of boats.

Details of the chapter and page structures for the preset profiles are given in *Section 2* of this handbook.

In addition to the preset profiles, each digital instrument type has at least one custom profile which you can edit, to best suit your methods of operation. For example, you could create dedicated custom profiles for racing and cruising.

Display options

The display options setup feature enables you to:

- Choose whether you display magnetic or true readings.
- Set the chapter and page selection method.
- Choose which page is displayed when a chapter is first selected.
- Set the button beep on or off.
- Set up the race timers.
- Data resolution for speed, depth, wind and distance.
- Set the local time offset.
- Set the remote control configuration.

Calibrating transducers

WARNING:
It is imperative that transducer calibration is completed before the system is first used after installation, to ensure safe navigation.

Transducer calibration can be carried out from any Graphic Display, to:

- Calibrate and align the compass, and set the variation.
- Calibrate and align the wind vane.
- Calibrate the speed.
- Set the depth transducer offset.
- Set the water temperature offset.
- Calibrate the displayed battery voltage value.

Setting up autopilot

WARNING:
The autopilot commissioning procedures in Section 8, Chapter 4 must be carried out, if your ST290 system has one or more Pilot Keypads, before the autopilot is first used after installation.

Any Graphic Display can be used to set up and calibrate a Raymarine autopilot connected to ST290. Three autopilot calibration chapters are provided:

- PILOT BASIC CAL.
- PILOT SEATRIAL CAL.
- PILOT ADVANCED CAL.

Details of how to setup and calibrate an autopilot are given in *Section 8* of this handbook under:

- Commissioning the autopilot (*Section 8, Chapter 4*).
- Autopilot calibration (*Section 8, Chapter 5*).

If the commissioning procedures in *Section 8, Chapter 4* are carried out satisfactorily, you may not need to use the autopilot calibration information in *Section 8, Chapter 5*. This is given primarily as reference material to provide an overall picture of the autopilot setup features and to give details of the autopilot factory default settings.

Data units

The data units setup function enables you to set:

- Speed units to either knots, kilometers per hour or miles per hour.
- Distance units to either nautical miles, kilometers or statute miles
- Depth units to either feet, fathoms or meters.
- Wind speed units to either knots or meters per second.
- Temperature to either degrees Celsius or degrees Fahrenheit.

Backlighting setup

The User Setup LAMPS page enables you to set the brightness of each lighting level for each digital instruments, in terms of percentage of total brightness. This enables you to set the most appropriate light levels for each instrument

1.3 Analog instruments

The setup requirements for analog instruments are described in *Section 7, Chapter 4*. You can:

- Apply factory defaults.
- Set the compass instrument to operate in locked mode or live mode.
- Select either true or magnetic bearing information.
- Set the pointer response,
- Set the digital display data response.

Chapter 2: Setting Up Graphic Displays

2.1 Starting setup

The Graphic Display setup procedures enable you to:

- Local parameters such as responses times, update rate, instrument profile, display options, data units and default backlighting levels, at each Graphic Display.
- Set the number of pages and the rollover operation of the Favorite chapter, at each Graphic Display.
- Calibrate the ST290 system Speed, Depth and Wind transducers (from any one Graphic Display).
- Set up autopilot parameters (see *Section 8* of this handbook), from any one Graphic Display, when an ST290 Pilot Keypad is being used to control an autopilot.

Enter User Setup as follows:

1. In normal operating mode, press the button to enter Chapter Select mode, then cycle to the USER SETUP chapter heading.
2. Press the button to display the SETUP ACCESS screen.

Figure 2-1: ENTER SETUP page

3. Hold down the button for 2 seconds to display the USER SETUP ENTRY screen (see *Figure 2-2*).
4. Within 5 seconds, press the button to complete the entry into User Setup mode. The DISPLAY RESPONSE chapter is displayed.

Figure 2-2: Confirm user setup screen

Using the diagram at *Figure 2-3* as a guide, set up each Graphic Display. To move to the different parts of User Setup, use the:

- button to move from chapter to chapter. Press to move in one direction, or hold down to move in the opposite direction.
- button to move from page to page within each chapter. Press to move in one direction, or hold down to move in the opposite direction.

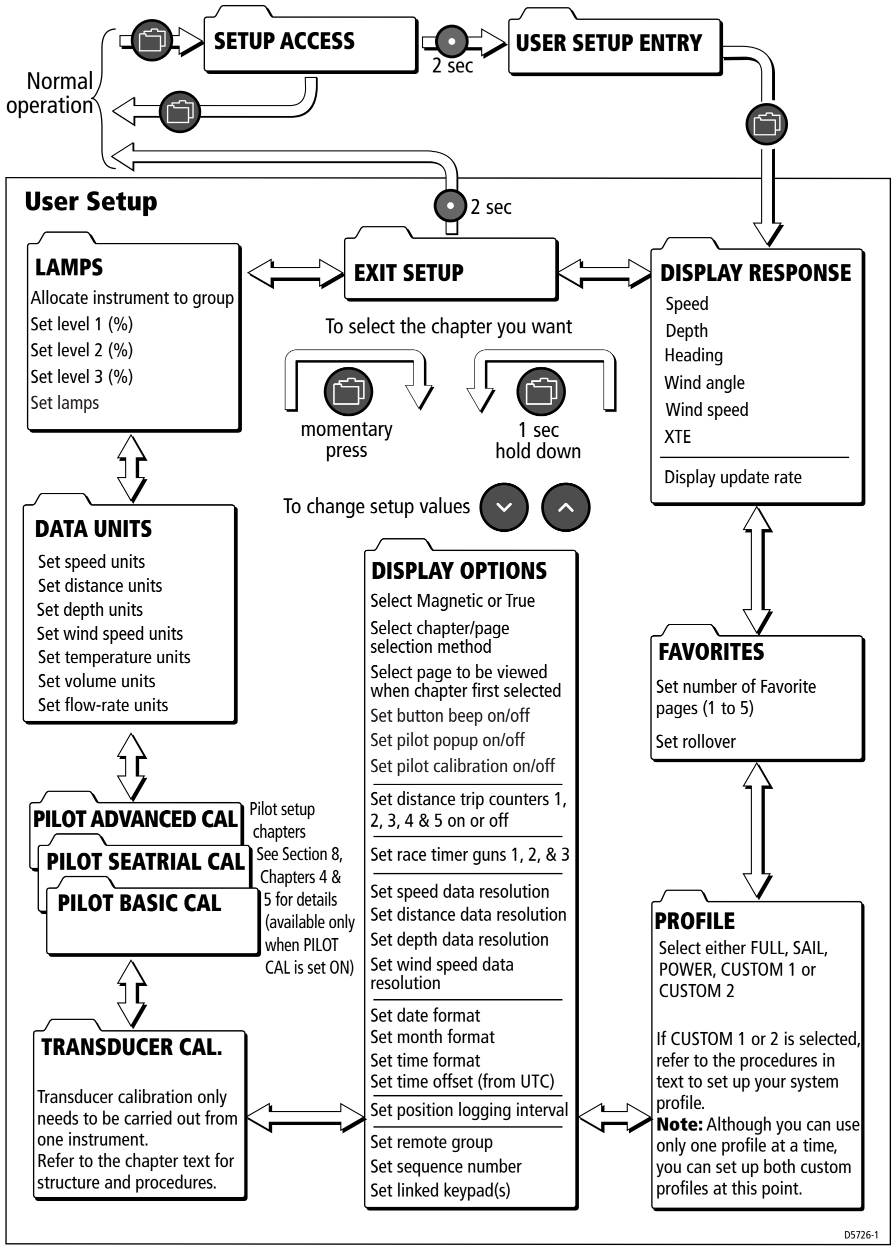


Figure 2-3: Graphic Display User Setup chapters and pages

2.2 Setting display response and update

The DISPLAY RESPONSE setup chapter enables you to set the display responses and update rate. To do this:

1. Select the DISPLAY RESPONSE setup chapter
2. Use the button to move to the required page.
3. Carry out the*Setting response values* and *Setting update rate* procedures (below).

Setting response values

To set the display responses (see *Figure 2-4*):

1. Select the page showing the data list for response setting.

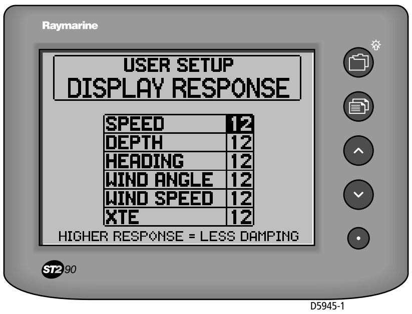


Figure 2-4: Display response

2. Use the ∧ or ∨ button to highlight the parameter you want to set.
3. Hold down the ⊙ button for 1 second to enter Edit mode. The highlighted value flashes to indicate you can adjust it.
4. Use the ∧ or ∨ button to set the response you want. Available values are from 1 to 15, (1 sets the slowest response and 15 the fastest).
5. Hold down the ⊙ button for 1 second to save the value you have set.
6. Repeat steps 1 to 5 for all parameters you want to set.

Setting update rate

To set the display update rate (see *Figure 2-5*):

1. Select the DISPLAY UPDATE page. As the update rate is the only editable value, it flashes to indicate it is in Edit mode.
2. Use the ∧ or ∨ button to set the update rate you want. Available update rates are from once a second (EVERY 10 X 100MSEC) to ten times per second (EVERY 1 X 100MSEC). The update rate of the large

figure at the bottom of the screen changes, to demonstrate the rate you have set.

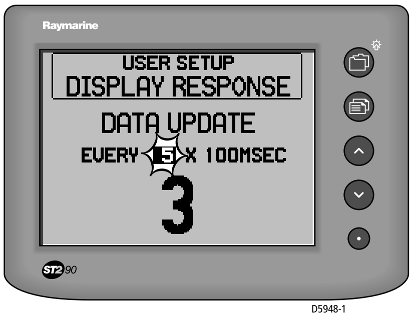


Figure 2-5: Display update rate

2.3 Setting up Favorite pages

The FAVORITES setup chapter enables you to define the number of Favorite pages available for viewing, and either set an automatic rollover for the Favorite pages, or switch the rollover off. To do this:

1. Select the FAVORITES setup chapter
2. Use the button to move to the required page.
3. Carry out the *Set number of Favorite pages* and *Define Favorite roll-over* procedures (below).

Set number of Favorite pages

To set the required number of Favorite pages:

1. Select the page which enables you to define the number of Favorite pages (see *Figure 2-6*).

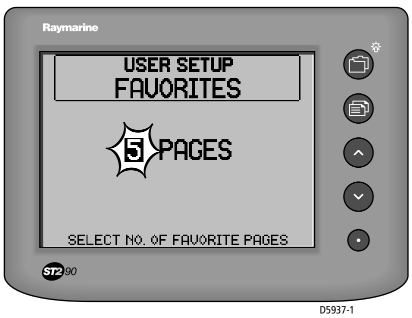


Figure 2-6: Number of Favorite Pages

Note: *As the number of Favorite pages is the only editable value, this is flashing to indicate it is in Edit mode.*

2. Use the ∧ or ∨ button to set the number of Favorite pages you want (from 1 to 5).

Define Favorite rollover

To define the Favorite page rollover:

1. Select the ROLLOVER PERIOD page (see *Figure 2-7*).

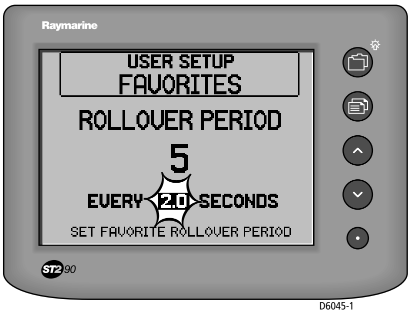


Figure 2-7: Set rollover

2. Use the ∧ or ∨ button to set the rollover period for each Favorite page. The update rate of the large figure in the middle of the screen changes, to demonstrate the rate you have set.
3. If you do not want the Favorite pages to rollover, use the ∨ button to set the value to OFF.

2.4 Setting an instrument profile

You can optimize the operation of each Graphic Display by choosing a profile which best suits you. The choices are:

- SAIL
- POWER
- FULL
- CUSTOM 1
- CUSTOM 2

The structures of SAIL, POWER and FULL profiles are preset, and you cannot customize any of these. Refer to *Section 2, Chapter 2* for details of the structure of these preset profiles.

The CUSTOM 1 and CUSTOM 2 profiles are fully editable.

Choosing a profile

To select the required operating profile:

In User Setup, use the button to cycle to the PROFILE setup chapter. The PROFILE select page is displayed (see *Figure 2-8*).

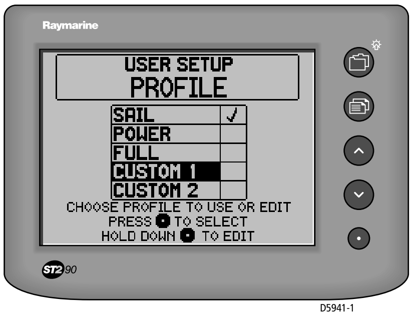


Figure 2-8: Profile select page

4. Use the ∧ or ∨ button to highlight the required operating profile. If you select either of the CUSTOM profiles, you can choose to edit it at this point (see *Editing Custom profiles*, below).
5. To confirm the highlighted profile as the operating profile, press the ⦿ button. A ✓ is displayed next to the highlighted profile and this profile is applied to the instrument.

Introduction to Custom profiles

You can use CUSTOM profiles to set up a Graphic Display to show the particular data and groups of data most convenient to you. You can:

- Create custom chapters.
- Delete chapters.
- Rename any chapter, for example, to summarize its purpose (DOCKING, CRUISING etc).
- Add any page to any chapter (except the User Setup chapter).
- Delete pages from chapters.

The default content of a CUSTOM profile is only the User Setup chapter. Therefore, when you first select a CUSTOM profile, you must use the *Editing Custom profiles* procedure to add chapters and pages you want in the profile.

Editing Custom profiles

On Graphic Displays, custom profiles are edited in two stages:

- **Chapter edit**. Enables you to add chapters to, and delete them from, a custom profile. You can also give each chapter an appropriate name.
- **Page edit**. Enables you to add pages to and remove pages from each chapter in a custom profile.

When editing custom profiles, use the button to switch from chapter edit to page edit, and the button to switch from page edit to chapter edit.

Starting profile edit

To edit a custom profile:

1. With the PROFILE select page displayed, use the ∧ or ∨ button to highlight either CUSTOM 1 or CUSTOM 2, as required.
2. Hold down the ⊙ button for 1 second, to enter custom edit mode.

When you enter custom edit mode, the chapter edit screen is displayed. If this is the first time you are editing a profile, the only chapter in the profile is the User Setup chapter, as in *Figure 2-9* .

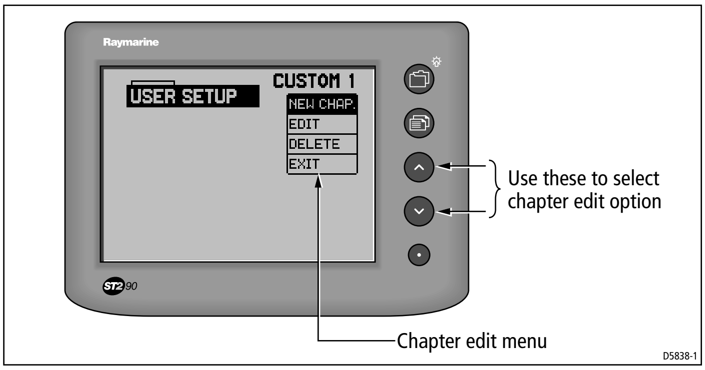


Figure 2-9: Chapter edit screen

Chapter edit

The chapter edit screen enables you to:

- Create a new chapter. (see *Creating a new chapter*).
- Edit the name of any chapter (see *Changing chapter name*).
- Delete any chapter (see *Deleting a chapter*), **except** the User Setup chapter.

Creating a new chapter

To create a new chapter:

1. With the chapter edit screen displayed, use the button to highlight the name of the chapter immediately above the point at which you want to insert a new chapter.
2. Use the ∧ or ∨ button to highlight NEW CHAP on the edit menu.
3. Hold down the ⊙ button for 1 second. A new chapter is inserted below the highlighted chapter.

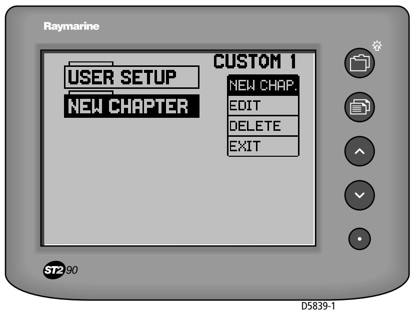


Figure 2-10: Creating new chapter

Changing chapter name

To change the name of a chapter:

1. Use the button to highlight the chapter name you want to edit.
2. Use the ∧ or ∨ button to highlight EDIT on the chapter edit menu.
3. Hold down the ⊙ button for 1 second. The first character of the chapter name flashes (see *Figure 2-11*) to indicate you can edit it.

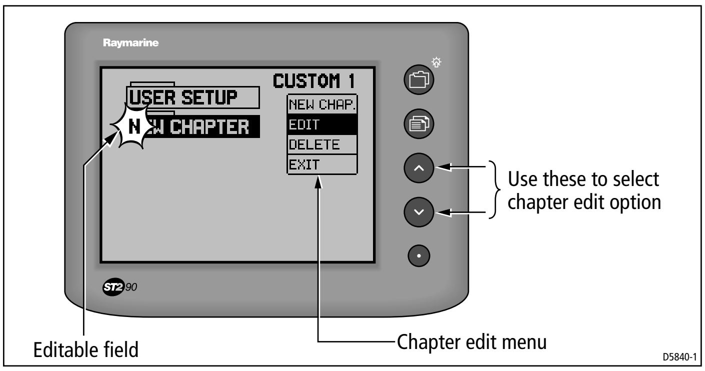


Figure 2-11: Edit chapter name

4. Use the ∧ or ∨ button to cycle through the available alphanumeric characters until the character you want is present at the flashing cursor.
5. Press the ⊙ button to accept this character and move the flashing cursor to the next character position.
6. Repeat steps 4 and 5 until the chapter has the required name.
7. Hold down the ⊙ button for 1 second, to save the chapter name and leave the chapter name edit mode.

Deleting a chapter

If you delete a chapter, the chapter title and all pages in the chapter are removed from the custom profile you are editing. However, they are still available on the system and can be reinstated if required, by carrying out the *Creating a new chapter* and *Adding a new page* procedures.

To delete a chapter:

1. Use the button to highlight the chapter you want to delete.
2. Use the ∧ or ∨ button to highlight DELETE on the edit menu.
3. Hold down the ⊙ button for 1 second. The selected chapter is then deleted from the Custom profile.

Page edit

Adding a new page

To add pages:

1. With the chapter edit screen displayed, use the button to highlight the name of the chapter to which you want to add a page.
2. Press the button to display the page edit screen.

Note: *As chapters must contain at least one page, a SPEED page is automatically added to each new chapter. You can change this as necessary.*

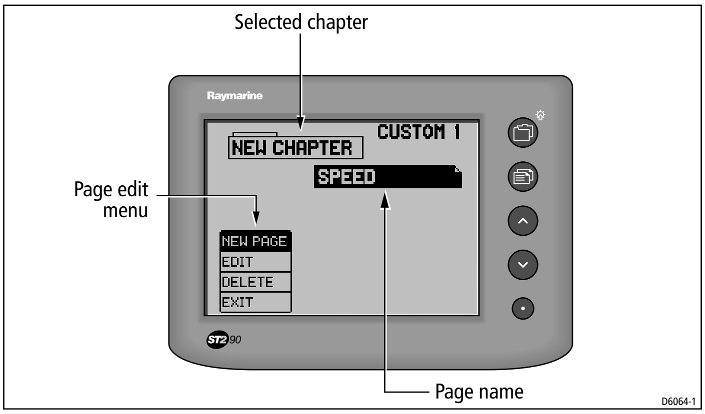


Figure 2-12: Page edit

3. Highlight the name of the page immediately above the point at which you want to insert a new page.
4. Use the ∧ or ∨ button to highlight NEW PAGE on the page edit menu.
5. Hold down the ⊙ button for 1 second. A new (SPEED) page is inserted below the highlighted chapter. You can either:
   - Accept this page as it is
     or
   - Use the *Selecting page information* procedure, to show different data.

Selecting page information

To set the required data on a custom page:

1. With the page edit screen displayed, use the button to highlight the page you want to change.
2. Use the ∧ or ∨ button to highlight EDIT on the edit menu.
3. Hold down the ⊙ button for 1 second so the highlighted page name flashes to indicate you can change it.
4. Use the ∧ or ∨ button to step through the available pages, until the name of the page you want is displayed in the flashing field. All the pages in the Graphic Display Full profile are available.
5. Hold down the ⊙ button for 1 second to save this configuration.

Deleting a page

To delete a page:

1. Use the button to highlight the page you want to delete.
2. Use the ∧ or ∨ button to highlight DELETE on the edit menu.
3. Hold down the ⦿ button for 1 second. The selected page is then deleted from this chapter.

Leaving profile edit

To leave the profile edit mode:

1. Use the ∧ or ∨ button to highlight EXIT on the edit menu (on the chapter edit screen or the page edit screen).
2. Hold down the ⦿ button for 1 second, to return to the PROFILE select page.

2.5 Display options

The DISPLAY OPTIONS setup chapter structure is shown in *Figure 2-13* . Use the button to move to the required pages.

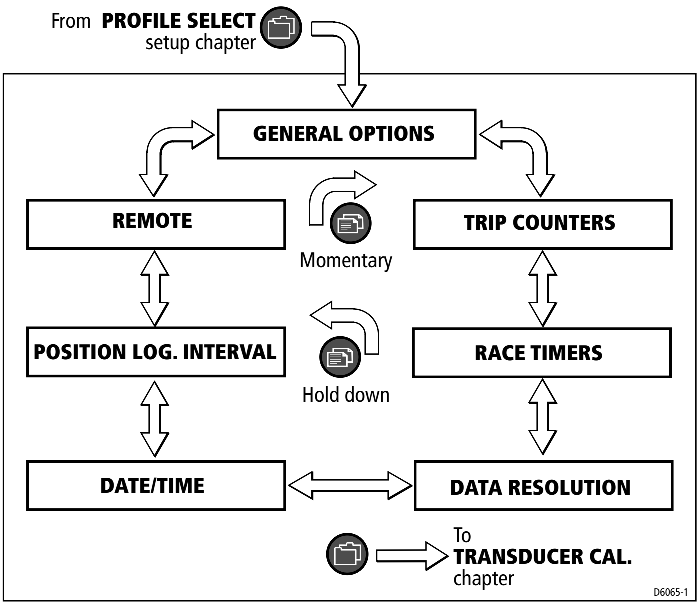


Figure 2-13: DISPLAY OPTIONS setup chapter

The DISPLAY OPTIONS setup chapter enables you to set:

- General options.
- Trip counters.
- Race timers.
- Data resolution.
- Date & time.
- Position logging interval.
- Remote control configuration.

General options

You can set the following general options (see *Figure 2-14*):

- HEADING information to be displayed as either MAG(netic) or TRUE.
- CHAP TITLES. Determines the method of chapter and page selection, during Normal operation. The options are MENU/POPUP. These are described in *Section 2, Chapter 2*.
- PAGE VIEWED. Determines which page is displayed when you go to a new chapter during Normal operation. The options are:
    - FIRST - to display the first page in the chapter.
    - PREV. - to display the page that was displayed when the relevant chapter was last used.
- KEY BEEP. Either ✓ (on) or ✗ (off).
- PILOT POPUP. Either ✓ (on) or ✗ (off).
- PILOT CAL. Either ✓ (on) or ✗ (off). When set to on, the Pilot Basic, Seatrial and Advanced Calibration are accessible. When PILOT CAL. is set to off, these Pilot calibration functions are bypassed.

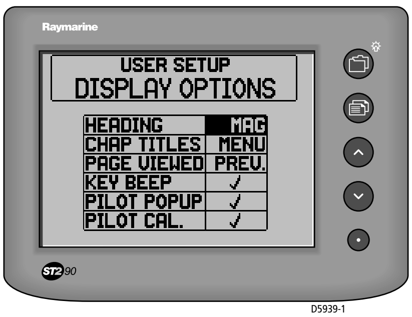


Figure 2-14: Display general options setup

To set up each option:

1. With the general options page displayed (*Figure 2-14*), use the ∧ or ∨ button to highlight the option you want to set.
2. Hold down the ⊙ button for 1 second to enter edit mode. The selected option then flashes.
3. Use the ∧ or ∨ button to set the selected option to the value you want.
4. Hold down the ⊙ button for 1 second to save the value.

Setting trip counters

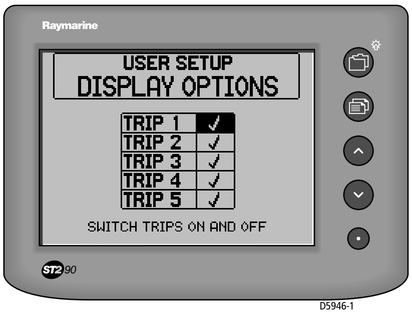


Figure 2-15: Trip counters setup

To set up the trip counters:

1. With the trip counters page displayed (*Figure 2-15*), use the ∧ or ∨ button to highlight the required counter.
2. Hold down the ⊙ button for 1 second to enter edit mode.
3. Use the ∧ or ∨ button to set the counter either ✓ (on) or ✗ (off) as required.
4. Hold down the ⊙ button for 1 second to save your setting.
5. Repeat steps 1 to 4 for each counter.

Setting race timers

You can set each race gun timer to any whole-minute value between 1 and 15 minutes.

To set the race timer:

1. With the race timers page displayed s (*Figure 2-16*), use the ∧ or ∨ button to highlight the required timer (GUN 1, GUN 2 or GUN 3).

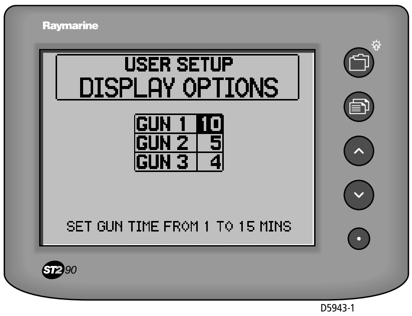


Figure 2-16: Race timers setup

2. Hold down the ⊙ button for 1 second to enter edit mode. The selected option then flashes.
3. Use the ∧ or ∨ button to set the selected gun to the time you want.
4. Hold down the ⊙ button for 1 second to save the value.

Setting data resolution

You can set the number of decimal places in displayed data. The degree of resolution is dependent on data type and value.

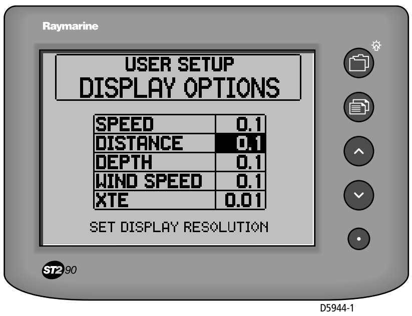


Figure 2-17: Data resolution setup

To set the resolution of each parameter:

1. With the resolution page displayed (*Figure 2-17*), use the ∧ or ∨ button to highlight the option you want to set.
2. Hold down the ⊙ button for 1 second to enter edit mode. The selected option then flashes.
3. Use the ∧ or ∨ button to set the selected option to the resolution you want.
4. Hold down the ⊙ button for 1 second to save the value.

Setting date and time

The date/time setup page enables you to define date and time formats, and set the local time.

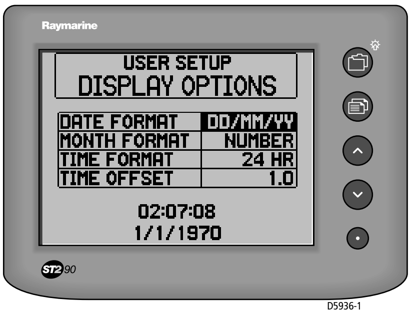


Figure 2-18: Date/time setup

Setting the format

To set the date and time format, select the date and time page (*Figure 2-18*) then set DATE FORMAT, MONTH FORMAT and TIME FORMAT in turn, using the following procedure for each one:

1. Use the ∧ or ∨ button to highlight the function to be edited.
2. Hold down the ⊙ button for 1 second to enter edit mode. The editable field then flashes.
3. Use the ∧ or ∨ button to set the required format. The options are:
   - For DATE FORMAT, either DD/MM/YY or MM/DD/YY.
   - For MONTH FORMAT, either NAME or NUMBER.
   - For TIME FORMAT, either 12HR or 24HR.
4. Hold down the select button for 1 second to save the value.

Setting local time

Date and time information are derived from the GPS, and displayed at the bottom of the date/time setup screen. A TIME OFFSET function enables you to accurately set the local time. If the local time is not correct:

1. Use the ∧ or ∨ button to highlight the TIME OFFSET field.
2. Hold down the ⊙ button for 1 second to enter edit mode. The offset value then flashes.
3. Use the ∧ or ∨ button to change the TIME OFFSET value, until the local time is correct.
4. Hold down the ⊙ button for 1 second to save the TIME OFFSET value.

Position logging interval

The position logging interval page (see *Figure 2-19*) enables you to define how often the ST290 system logs the boat's position.

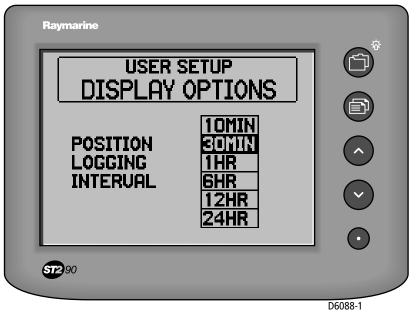


Figure 2-19: Position logging interval setup

With the POSITION LOGGING INTERVAL page displayed, use the ∧ or ∨ button to highlight the interval you want. The options are 10MIN, 30MIN, 1HR, 6HR, 12HR and 24HR.

The selected value is set when you leave this page.

Setting remote control configuration

The remote control setup page (see*Figure 2-20*) enables you to define the remote group, the sequence within the remote group and the associated Remote Keypad(s), for an instrument.

Note: *The manner in which instruments are remotely controlled is described in Section 4, Chapter 2.*

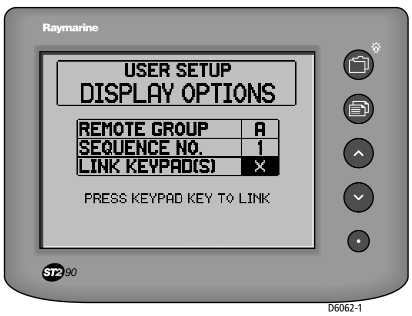


Figure 2-20: Remote control setup

Use the following procedure for each instrument you want to be able to remotely control:

1. With the remote setup page displayed (*Figure 2-20*), use the ∧ or ∨ button to highlight the REMOTE GROUP field. This enables you to allocate the instrument as part of a remotely controlled group
2. Hold down the ⊙ button for 1 second to enter edit mode. The field value flashes.
3. Use the ∧ or ∨ button to select the remote control group for this instrument. This can be in any one of eight groups, identified by letter, from A to H.
4. Hold down the ⊙ button for 1 second to leave the edit mode.
5. Use the ∧ or ∨ button to highlight the SEQUENCE NO. field.
6. Hold down the ⊙ button for 1 second to enter edit mode. The field value then flashes.
7. Use the ∧ or ∨ button to set a number, to define the sequence in which the instrument is selected within its remote group.
8. Hold down the ⊙ button for 1 second to leave the edit mode.
9. Use the ∧ or ∨ button to highlight the LINK KEYPAD(S) field. This enables you to define which Remote Keypad(s) you want to use to control the instrument. If a Remote Keypad is not already allocated, ✗ is displayed.
10. At each Remote Keypad you want to use to control this instrument, press any button on, to link the instrument and keypad. Once a link is created, a ✓ is displayed against the LINK KEYPAD(S) field.

2.6 Transducer calibration procedures

Requirement

Transducer calibration ensures that the data provided by the transducers gives correct readings at the instruments.

Transducer calibration is applied globally to the ST290 system, and so only needs to be done once from one Graphic Display.

An overview of the transducer calibration functions is given in *Figure 2-21* .

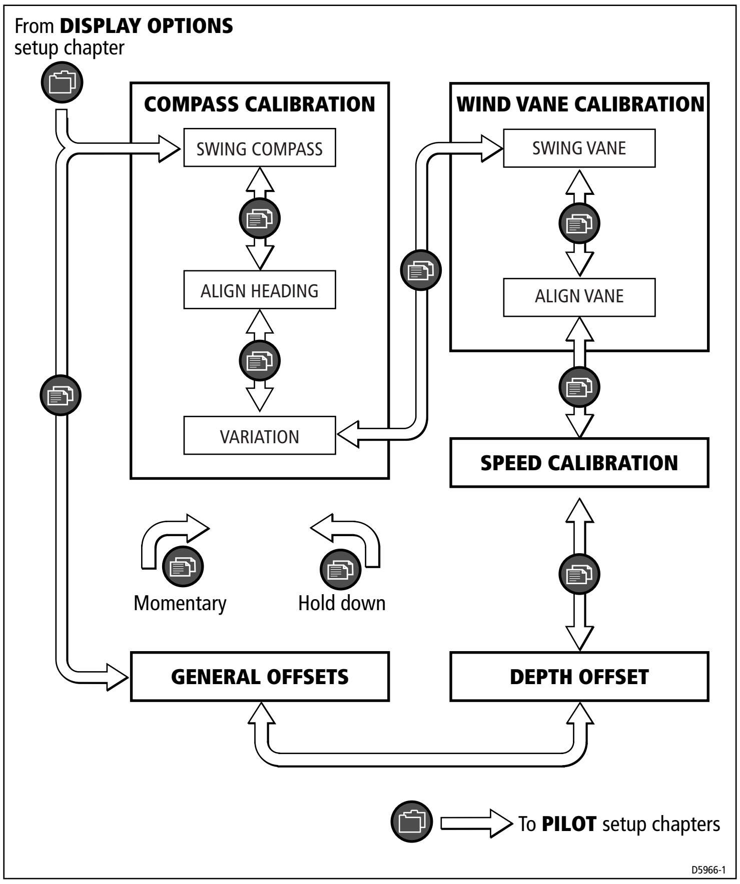


Figure 2-21: Transducer calibration overview (Graphic Display)

Starting calibration

The calibration procedures are accessed via pages in the Transducer Calibration chapter, and are described here in the order in which they are selected. To carry out transducer calibration:

1. In User Setup, select the TRANSDUCER CALIBRATION chapter.
2. Press the button to move to the calibration procedure you want to carry out (see *Figure 2-21*).

Compass calibration

The object of the compass calibration is to correct for magnetic deviation and to set the correct compass alignment.

The compass calibration procedure is summarized in *Figure 2-22* .

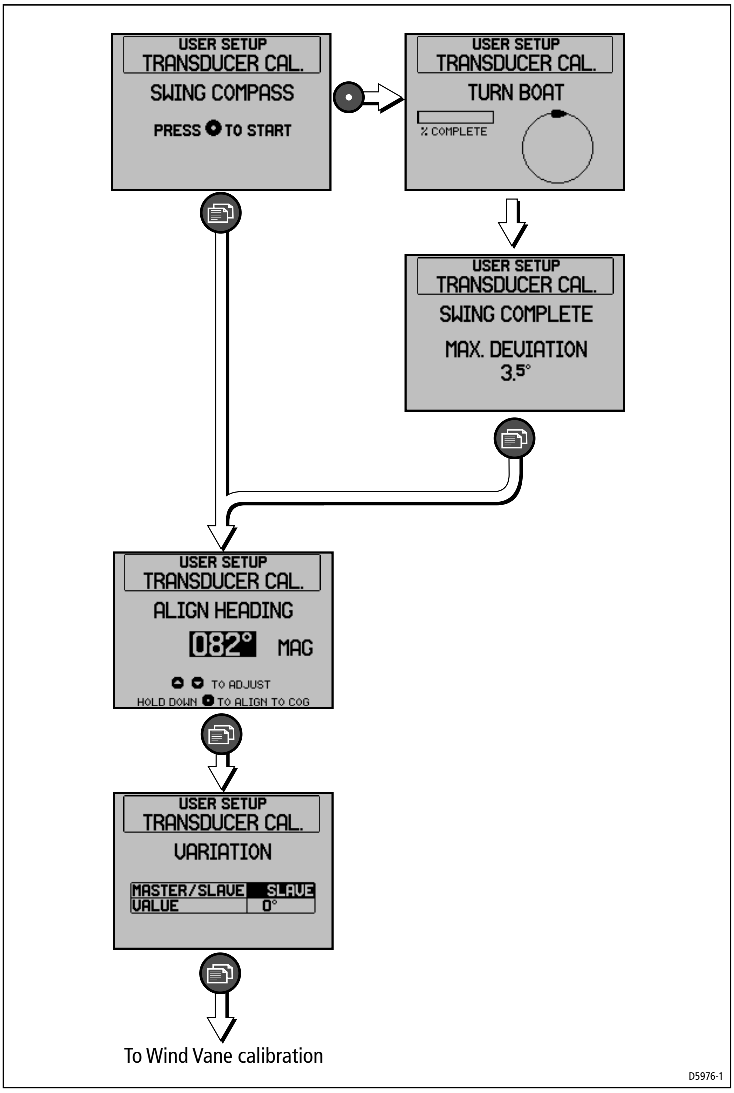


Figure 2-22: Compass calibration (Graphic Display)

Compass calibration requirement

If you have a Raymarine autopilot, the autopilot will supply heading information, and you should calibrate the compass in accordance with the appropriate autopilot procedures in *Section 8, Chapter 4.*

If your ST290 system has its own, dedicated Smart Heading Sensor and is not receiving heading information from any other source, use the following procedures to calibrate the compass.

Swinging the compass to correct for magnetic deviation

To correct for magnetic deviation, ensure the SWING COMPASS page (see *Figure 2-22*) is displayed, then:

1. Press the ⊙ button to display the TURN BOAT page (see *Figure 2-22*).
2. Start turning your boat in circles. Do not turn too quickly. A 360° turn should take at least 3 minutes. If the boat is turning too quickly, the message TURN RATE TOO HIGH is displayed. If this occurs, immediately reduce the rate of turn.
3. When the procedure is complete, the SWING COMPLETE screen is displayed, and the amount of deviation is shown.
4. Press the ⊙ button to proceed to the ALIGN HEADING page.

Note: *If the deviation figure exceeds 15° or the display shows no deviation value, the compass is being affected by ferrous objects on your boat. You should move the compass to a better location. Higher deviation figures are acceptable on steel boats.*

Setting compass alignment

After completing the deviation correction procedure (swinging the compass), check the compass alignment:

To carry out compass alignment:

1. Select the ALIGN HEADING page (see *Figure 2-22*).
2. Either:
   - Steer your boat on a steady course at a speed that enables you to hold that course, and use the ∧ or ∨ button to manually set the correct heading value.

     or
   - If you have GPS, steer your boat at a speed above 4 knots then hold down the ⊙ button for 1 second, to set the COG as the head-

ing value.If you are using this method, you should do so in conditions of zero tide and current, to ensure that COG is accurate.

3. Check the heading reading against a number of known headings, and calculate the lowest **average** alignment error.
4. Adjust the reading on the ALIGN HEADING screen to remove the average error value, calculated in step 3.

Note: *If the average heading error is more than 5°, you should perform the compass deviation correction procedure again, circling more slowly and in more favorable conditions.*

Setting system variation

On a SeaTALK^2 system, only one product can define the magnetic variation. This product is designated as the 'variation master'. All other products are 'slaves' and use the variation value set by the master.

If no other product on the SeaTALK^2 system is allocated as a master, you should designate one ST290 Graphic Display as the master and carry out all setting up from this instrument. All other instruments on the system should be set as slaves.

Slave

To set an instrument as a slave:

1. Select the SYSTEM VARIATION page (see *Figure 2-22*).
2. If the MASTER/SLAVE indicator is not SLAVE:
   i. Use the ∧ or ∨ button to highlight the MASTER/SLAVE field.
   ii. Hold down the ⊙ button for 1 second to enter edit mode. The MASTER/SLAVE indicator flashes.
   iii. Use the ∧ or ∨ button to set the MASTER/SLAVE indicator to SLAVE.
   iv. Hold down the ⊙ button for 1 second to save the setting.

Master

To set the system variation at a master instrument:

1. Select the SYSTEM VARIATION page (see *Figure 2-22*).
2. If the MASTER/SLAVE indicator is not MASTER:
   i. Use the ∧ or ∨ button to highlight the MASTER/SLAVE field.
   ii. Hold down the ⊙ button for 1 second to enter edit mode. The MASTER/SLAVE indicator flashes.

iii. Use the ∧ or ∨ button to set the MASTER/SLAVE indicator to MASTER.

iv. Hold down the ⦿ button for 1 second to save the setting.

3. Refer to a chart for the area in which you are operating, and ascertain the magnetic variation.
4. Use the ∧ or ∨ button to highlight the VALUE field, then:

i. Hold down the ⦿ button for 1 second to enter edit mode. The value then flashes.

ii. Use the ∧ or ∨ button to set the correct magnetic variation value.

iii. Hold down the ⦿ button for 1 second to save the value.

Wind vane

The object of wind vane calibration is to match the characteristics of the wind vane to the rest of the system and to align the wind vane to the vessel.

The wind vane calibration procedure is summarized in *Figure 2-23* .

Linearizing

You need at least 6 knots of wind when linearizing the wind vane, to keep the wind vane in the direction of the wind when turning your vessel.

To linearize the wind vane:

1. Ensure the SWING VANE page is displayed.
2. Press the ⦿ button so the TURN BOAT page is displayed (see *Figure 2-23*).
3. Start turning your boat. If the boat is turning too quickly, the message TURN RATE TOO HIGH is displayed. If this occurs, immediately reduce the rate of turn.
4. When the procedure is complete, the SWING COMPLETE screen is displayed.

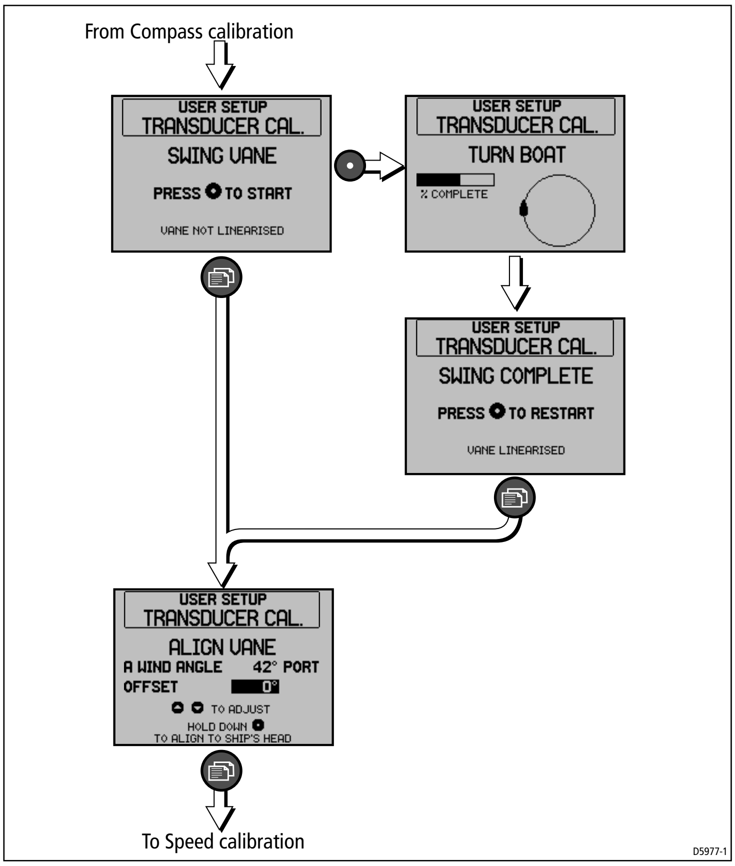


Figure 2-23: Wind vane calibration (Graphic Display)

Aligning

To align the wind vane:

1. Select the ALIGN VANE page (see *Figure 2-23*).
2. Either:
   - Use the ∧ or ∨ button to manually set the correct wind vane direction

     or
   - Motor directly into the wind, then hold down the ⊙ button for 1 second to set the vessel's heading as the alignment value.

Note: *On a calm day, motor fast enough to 'create your own wind'.*

Calibrating the Speed transducer

Speed calibration principles

The object of speed calibration is to ensure that the speed readings at the ST290 instruments are true indications of the boat speed, ideally over the operating speed range of the vessel, i.e. from stationary to top speed.

In order to take into account the changes in water-flow characteristics across the hull, for the different speeds, it is advisable carry out speed calibration at as many speeds as possible, up to the maximum of five, provided by the calibration screen (see *Figure 2-24*). **This is particularly important for planing vessels**.

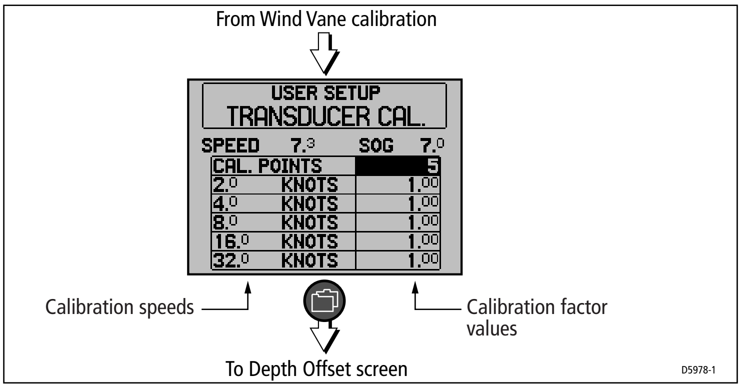


Figure 2-24: Speed transducer calibration (Graphic Display)

The correct calibration at each speed is achieved by applying a calibration factor to the indicated speed reading. The correct value for the calibration factor is obtained by one of two methods:

- If SOG information is available, you can apply this to the system so that the calibration factor is automatically adjusted to give a speed reading that equals the SOG value.
- If SOG information is not available, you need to manually calculate and apply the correct calibration factor.

Procedures

In order to achieve accurate results, speed calibration must be carried out in conditions of **zero tide and zero current**.

Carry out the *Start calibration* procedure followed by the *Set to SOG* or *Manual calibration* procedure, as required.

Start calibration

To calibrate the Speed transducer:

1. Use the ∧ or ∨ button to highlight the CAL.POINTS value field (as in *Figure 2-24*). This value defines the number of different speeds you want to use for speed calibration.
2. Press the ⊙ button for 1 second to enter edit mode. The CAL.POINTS value field flashes, to indicate you can change the value.
3. Use the ∧ or ∨ button to set the required number of different speeds for speed calibration.
4. Hold down the ⊙ button for 1 second to save the setting.
5. Use the ∧ or ∨ button to highlight the calibration factor value field for the first calibration speed.
6. Apply the correct calibration factor by using either the *Set to SOG* or *Manual calibration* procedure, as required.

Set to SOG

To use SOG to determine the correct calibration factor (and therefore speed):

1. Carry out the *Start calibration* procedure (above).
2. In conditions of zero tide and zero current, run your vessel at approximately the calibration speed, using the SOG reading as a guide.
3. Press the ⊙ button, to apply the value of SOG as the indicated SPEED. The highlighted calibration factor value changes as appropriate.
4. Use the ∧ or ∨ button to highlight the calibration factor value field for the next calibration speed.
5. Repeat *Set to SOG* steps 2 to 4, until all calibration factor values are correct.

Manual calibration

To manually apply the correct calibration factor:

1. Carry out the *Start calibration* procedure (above).
2. In conditions of zero tide and zero current, run your vessel at a steady speed approximately that of the highlighted calibration speed, over a measured distance.When you do this, make a note of:
   - The speed indicated by the instrument.
   - The time it takes to cover the measured distance.

3. Calculate the actual speed over the measured distance.
   - If this is the same as the indicated speed, calibration is correct at this speed, so proceed from *Manual calibration* step 5.
   - If the true speed is not the same as the indicated speed:
     i. Calculate a new, corrected calibration factor, as follows

$$\text{new calibration factor} = \frac{\text{measured speed}}{\text{true speed x old calibration factor}}$$

     ii. Hold down the ⊙ button for 1 second to enter edit mode. The highlighted calibration factor value field flashes
     iii. Use the ∧ or ∨ button to change the highlighted calibration factor value, to the new value, then hold down the ⊙ button for 1 second.
4. Repeat *Manual calibration* steps 2 and 3, until the indicated SPEED is the same as the actual speed.
5. Use the ∧ or ∨ button to highlight the calibration factor value field for the next calibration speed.
6. Repeat *Manual calibration* steps 2 to 5, until all calibration factor values are correct.

Depth transducer offset

WARNING:
The use of incorrect depth offset values could result in misleading depth information being displayed with a consequent risk of running aground.

Depths are measured from the Depth transducer to the seabed. However, you can apply an offset to the actual distance measured so that the displayed depth reading represents either the depth from the waterline or from the bottom of the keel (see *Figure 2-25*).

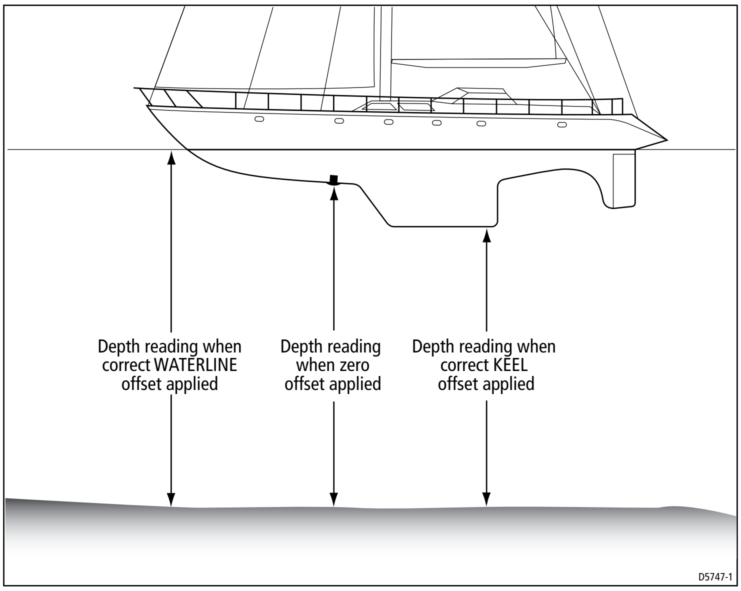


Figure 2-25: Setting depth offsets

To set the required offset, ascertain the vertical distance between the transducer location and the required offset point (waterline or bottom of the keel), then:

1. In the Transducer Calibration chapter, use the button to move to the DEPTH OFFSET adjust page (see *Figure 2-26*). The screen displayed depends on what type of depth offset is currently set, either WATERLINE, TRANSDUCER (zero offset) or KEEL.
2. Use the ∧ or ∨ button to set the required offset value, using the following guidelines:
   - The ∧ button moves the offset value away from KEEL, through zero, to WATERLINE values.
   - The ∨ button moves the offset value away from WATERLINE, through zero, to KEEL values.
   - The annotation and the arrows on the screen show how the offset is applied.

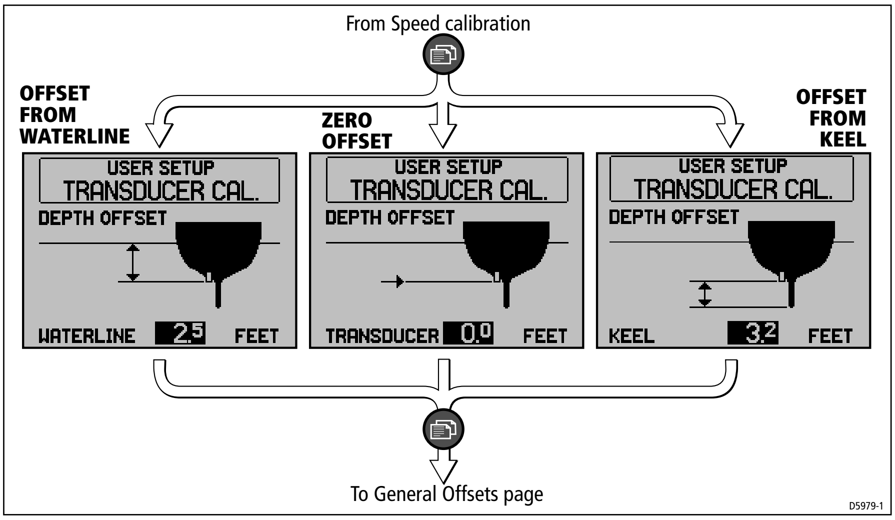


Figure 2-26: DEPTH OFFSET screens

General offsets

The GENERAL OFFSETS page enables you calibrate your system so that the water temperature and system voltage values shown on the ST290 pages are true indications.

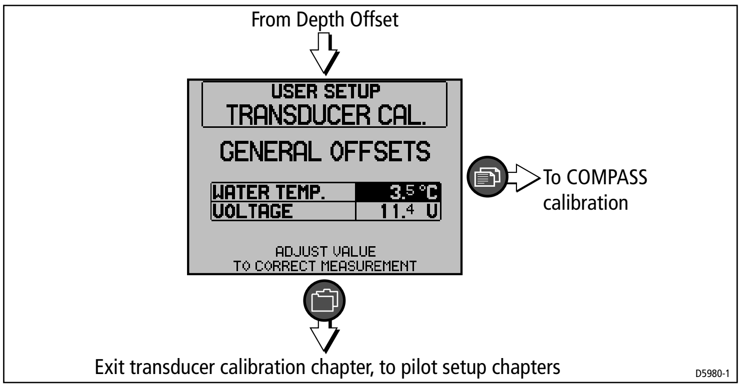


Figure 2-27: GENERAL OFFSETS page

Set water temperature

1. Display the GENERAL OFFSETS page.
2. Use the ∧ or ∨ button to select the WATER TEMP value field.
3. Measure the water temperature.
4. If the displayed temperature value is different from the measured water temperature, hold down the ⊙ button for 1 second to enter edit mode. The WATER TEMP value flashes.
5. Use the ∧ or ∨ button to set WATER TEMP to the measured value.
6. Hold down the ⊙ button for 1 second to save the value.

Set system voltage reading

You can set the displayed voltage reading on the ST290 system to be the same as that at any point on the boat's 12 V system you want to monitor, by setting theST290 VOLTAGE reading so it is the same as the voltage at the required point. To do this:

1. Display the GENERAL OFFSETS page.
2. Use the ∧ or ∨ button to select the VOLTAGE value field.

WARNING:
High voltages can cause death or serious injury. Always take appropriate precautions when working with electricity. Before accessing the electrical system, ensure you know the location of the high voltage points and stay well clear of them.

3. Measure the voltage at the point in the boat's 12 V electrical system that you want to monitor.
4. If the displayed voltage value is different from the measured voltage, hold down the ⊙ button for 1 second to enter edit mode. The VOLTAGE value flashes.
5. Use the ∧ or ∨ button to set VOLTAGE to the measured value.
6. Hold down the ⊙ button for 1 second to save the value.

2.7 Pilot setup

WARNING:
It is imperative that autopilot setup is completed before the autopilot is used, to ensure safe navigation.

If you are intending to use an ST290 Pilot Keypad to control an autopilot, you must carry out the autopilot setup procedures. Three autopilot setup chapters are provided as part of User Setup:

- BASIC
- SEATRIAL
- ADVANCED

For details on the autopilot setup requirement and procedures, refer to *Section 8, Autopilots*.

2.8 Data Units

The DATA UNITS page enables you to set the units in which data is displayed. You can set:

- SPEED units to either KNOTS, KM/H or MPH.
- DISTANCE units to either NM, KM or SM.
- DEPTH units to either FEET, FATHOMS or METERS.
- WIND SPEED units to either KTS or M/S.
- TEMPERATURE units to either °C or °F.
- FLOW RATE units to either G/H or L/H.

The DATA UNITS are **global** settings (the units you set are applied to the whole ST290 system), so only need to be made at one instrument.

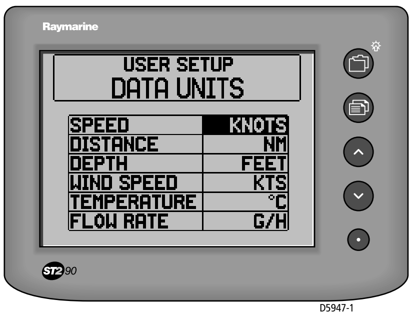


Figure 2-28: Setting data units

To set up the display units:

1. Select the DATA UNITS page.
2. Use the ∧ or ∨ button to highlight the unit you want to set.
3. Hold down the ⊙ button for 1 second to enter edit mode. The selected option then flashes.
4. Use the ∧ or ∨ button to set the required units for selected option.
5. Hold down the ⊙ button for 1 second to save the value.

2.9 Backlighting setup

The User Setup LAMPS page enables you to:

- Set the brightness of each backlighting level for each Graphic Display, in terms of percentage of total brightness.
- Check the operation of the system backlighting level.

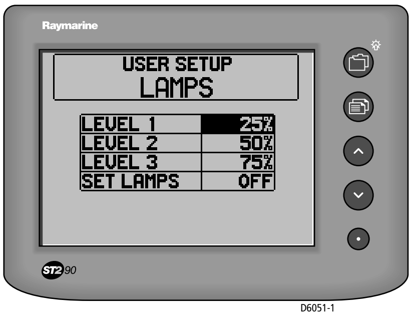


Figure 2-29: LAMPS setup screens

Setting levels

At each instrument set LAMPS parameters as follows:

1. Use the ∧ or ∨ button to select LEVEL 1.
2. Hold down the ⊙ button for 1 second to enter edit mode.
3. Use the ∧ or ∨ button to adjust the level to the required percentage lighting value.
4. Hold down the ⊙ button for 1 second to save the value you have set.
5. Repeat steps 1 to 4, for LEVEL 2 and LEVEL 3.
6. If required, use the *Checking operation* procedure (below) to check the system lighting levels

Checking operation

The SET LAMPS field enables you to cycle through the backlighting levels to check that they levels are as required at each instrument in the system, To do this:

1. With the User Setup LAMPS page displayed, use the ∧ or ∨ button to select SET LAMPS.
2. Hold down the ⦿ button for 1 second to enable the lighting check.
3. Use the ∧ or ∨ button to select each lighting level in turn, and check all instruments.
4. Hold down the ⦿ button for 1 second to end the lighting check.

If the levels at any instrument are unsatisfactory, carry out the *Setting levels* procedure (above) at the relevant instrument(s), to correct the levels.

2.10 Leaving setup

To leave User Setup:

1. Use the 🗀 button to move to the USER SETUP EXIT screen.
2. Hold down the ⦿ button for 2 seconds. The instrument returns to Chapter Select mode.
3. Either press the ⦿ button or wait for 5 seconds, to return to Normal operation.

Chapter 3: Setting up Data Displays

3.1 Starting setup

The Data Display User Setup procedures enable you to set:

- Local parameters such as responses times, update rate, instrument profile, display options, data units and default backlighting levels, at each Data Display.
- The Favorite chapter operation and content, at each Data Display.

To enter User Setup:

1. In Normal operating mode, use the button to scroll to the User Setup chapter heading. This is shown in the active display area (in *Figure 3-1* , this is the upper area).

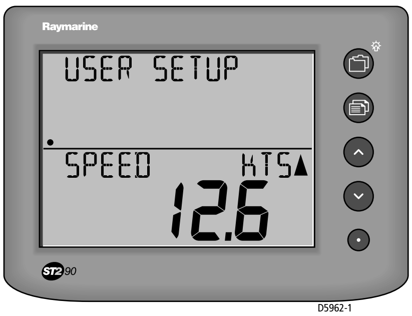


Figure 3-1: User Setup chapter heading

2. Hold down the ⊙ button for 2 seconds to display the User Setup entry screen (see *Figure 3-2*).

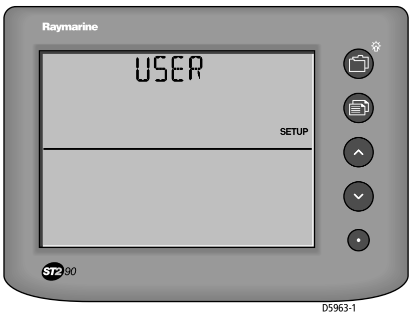


Figure 3-2: User Setup entry screen

3. Within 5 seconds, press the button to complete the entry into User Setup mode. The display shows the RESPONSE setup chapter.

In User Setup mode, the upper display area shows the setup chapter title, and the lower display area shows the page selected for adjustment, along with the current data value.

On setup pages, editable values flash on and off.

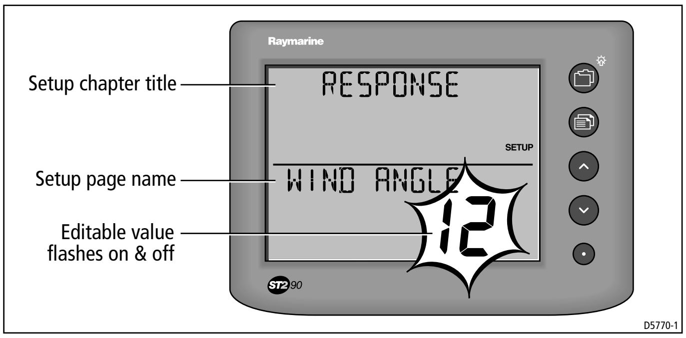


Figure 3-3: Typical User Setup display

Using the diagram in *Figure 3-4* as a guide, set up each Data Display. Use the:

- button to move from chapter to chapter within User Setup. Press to move in one direction, or hold down to move in the opposite direction.
- button to move from page to page within each chapter. Press to move in one direction, or hold down to move in the opposite direction.
- ∧ or ∨ button to change editable data and to select the required options (e.g. on or off), on the setup pages.

The values you set are saved, when you move to a new page or a new chapter.

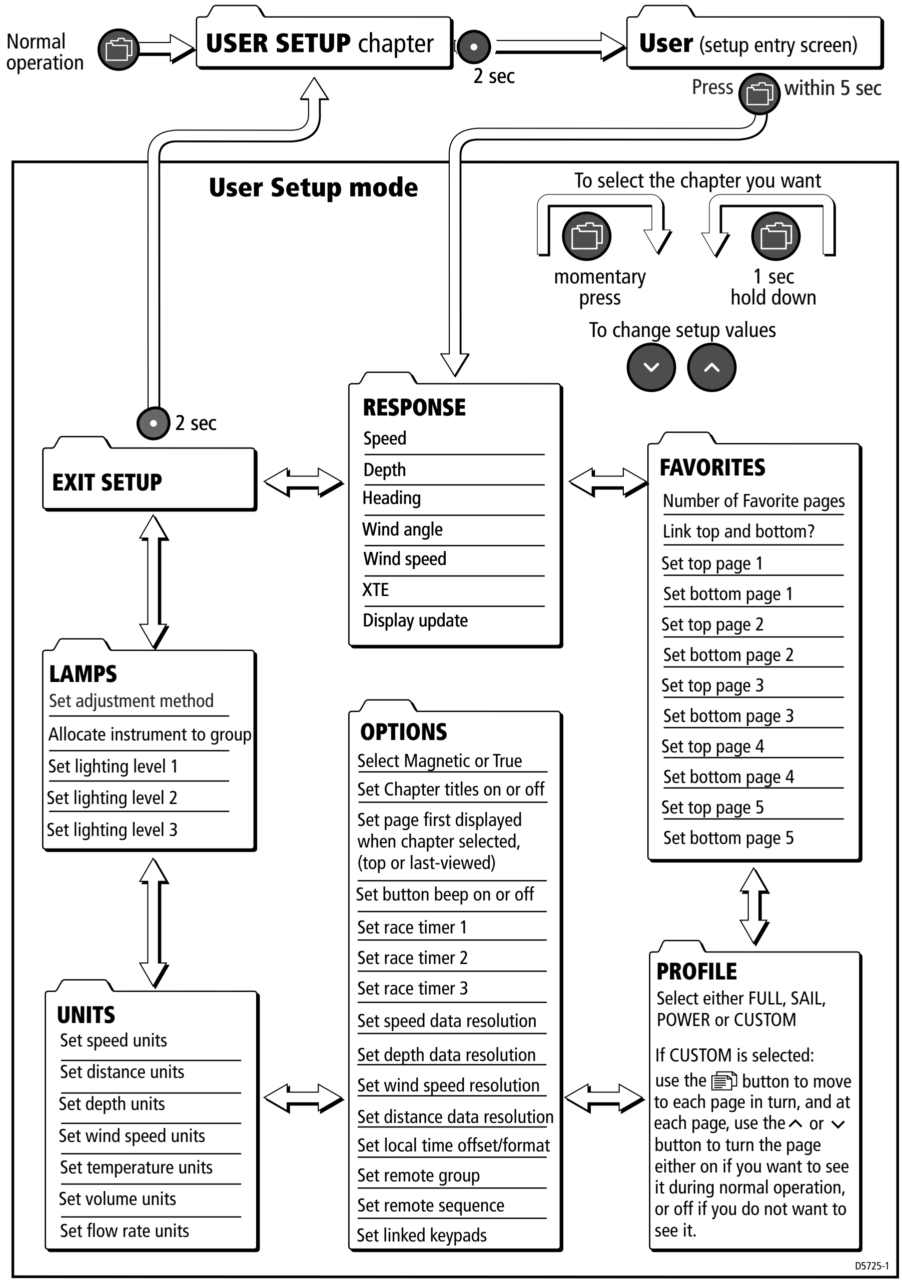


Figure 3-4: Data Display User Setup chapters and pages

3.2 Display responses setup

The RESPONSE setup chapter enables you to set the instrument display responses and the display update rate.To set the required values:

1. In User Setup, select the RESPONSE chapter.
2. Use the button to select each page in turn and as each setup page is displayed, use the ∧ or ∨ button to set the required values:
   - Display response values. These are set at SPEED, DEPTH, HEADING, WIND ANGLE , WIND SPEED and XTE response-setup pages. Values are from 1 (slowest response) to 15 (fastest response).
   - Display update rate. This is set at an UPDATE setup page. Values are from once per second (set a value of 1.0) to ten times per second (set a value of 0.1).

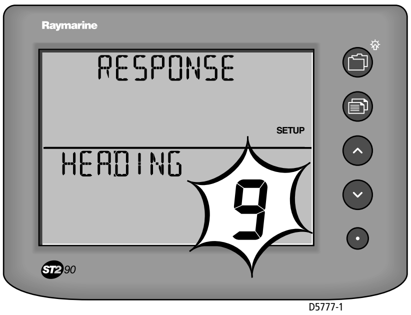


Figure 3-5: Typical RESPONSE setup display

3.3 Favorite chapter setup

Introduction

The FAVORITES setup chapter enables you to define which pages you want as Favorite pages:

- The first Favorites setup page (headed PAGES) is used to set the number of operational Favorite pages, from 1 to 5.
- The second Favorites setup page (headed LINKED) is used to set relationship of the upper and lower display areas of the operational Favorite pages. You can set either:
  - YES. This sets the upper and lower display areas as **linked pairs of pages** (e.g. speed/depth, BTW/DTW etc.) which change together when a new Favorite page is selected,

    or

  - NO. This sets the upper and lower display areas to **operate separately**, so the upper and lower display areas each has a group of Favorite pages which can be selected independently.
- The remaining Favorites setup pages enable you to define the data you will see on the operational Favorite pages. You can define separately what is displayed in the upper and lower display areas. The trend arrows indicate which display area you are setting up, i.e. the increase arrow indicates you are setting the upper display area, and the decrease arrow, the lower.

  All the pages in the Data Display Full profile are available. In addition to these, if ST290 is connected to a computer running Raymarine RayTech, the RayTech pages are also available to be allocated as Favorite pages.

Procedure

To set up your Favorite pages:

1. In User Setup, select the FAVORITES setup chapter. The PAGES setup page is displayed (see *Figure 3-6*), with the number of Favorite pages flashing, to indicate you can change it.

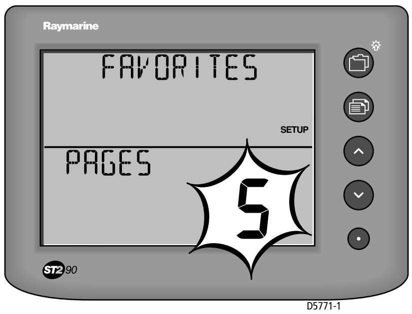


Figure 3-6: Setting required number of Favorite pages

2. Use the ∧ or ∨ button to set the required number of Favorite pages, from 1 to 5.
3. Press the button to move to the LINKED setup page (see *Figure 3-7*) and use the ∧ or ∨ button to select either nO to unlink, or YES to link, the upper and lower screen areas when Favorite pages are displayed.

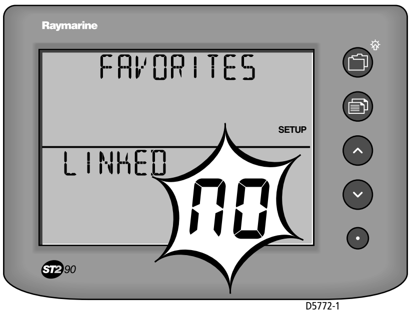


Figure 3-7: Linking/unlinking Favorite pages

4. Press the button to move to the next Favorite setup page. The up trend arrow is displayed to indicate you can now set which data will be in the upper display area of the first operational Favorite page (see *Figure 3-8*).

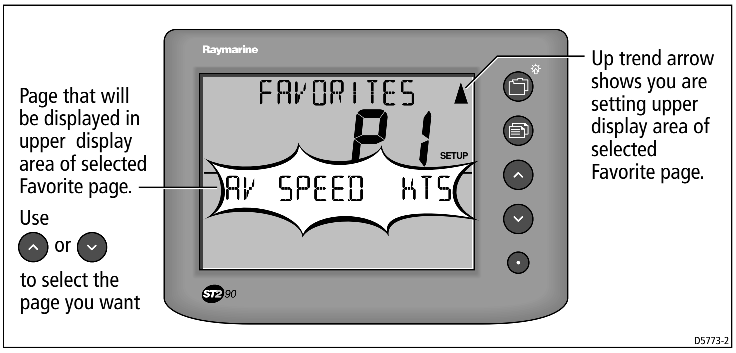


Figure 3-8: Setting Favorite page for upper display area

5. Use the ∧ or ∨ button to scroll through the pages, until the page you want is displayed in the flashing field.
6. Press the button to move to the next Favorites setup page. The down trend arrow is displayed to indicate you can now set which data will be in the lower display area of the first operational Favorite page.
7. Use the ∧ or ∨ button to scroll through the pages until the page you want is displayed in the flashing field.
8. Repeat the procedure in steps 4 to 7 for the upper and lower display areas of the remaining Favorite pages.

3.4 Setting an instrument profile

You can optimize the operation of each Data Display by using the PROFILE setup chapter to choose a profile which best suits you. The choices are:

- SAIL
- POWER
- FULL
- CUSTOM

The structures of SAIL, POWER and FULL profiles are preset, and you cannot customize any of these. Refer to *Section 2, Chapter 3* for details of the structure of these preset profiles.

The default content of the CUSTOM profile is only the User Setup chapter. Therefore, when you first select the CUSTOM profile, you must use the *Editing the Custom profile* procedure to the pages you want to the profile.

Choosing a profile

To select the required operating profile:

1. In User Setup, select the PROFILE chapter. The name of the current profile is displayed in the lower display area. The name is flashing to indicate you can change it.
2. Use the ∧ or ∨ button to select the required operating profile.

If you selected one of the preset profiles, the profile selection is complete.

Editing the Custom profile

If you select the CUSTOM profile, you can streamline the operation of a Data Display, by selecting only the pages you want to see on a day-to-day basis. All the pages in the Data Display Full profile are available.

To select pages for the CUSTOM profile:

1. With the PROFILE page displayed and CUSTOM selected, press the button to display the first page of the rollover in the lower display area.
2. Use the ∧ or ∨ button as necessary, to select either On, to make the displayed page, available as part of the CUSTOM profile, or OFF, to exclude it from the CUSTOM profile.

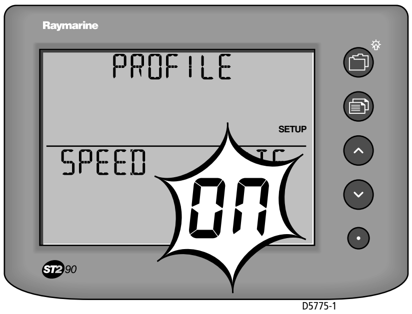


Figure 3-9: Setting up CUSTOM profile

3. Press the button to display the next page of the rollover in the lower display area.
4. Repeat steps 2 and 3 until you have displayed all pages, and either enabled or disabled each one.

This completes the setup for the CUSTOM profile. When the instrument returns to Normal operation, only the pages you have enabled will be available, until you either select a different profile or edit the CUSTOM profile again.

3.5 Display options

The display OPTIONS setup chapter enables you to set up each instrument to best suit you. To do this:

1. In User Setup, select the OPTIONS chapter.

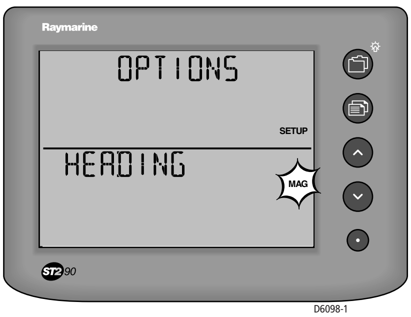


Figure 3-10:Typical OPTIONS setup screen

2. Press the button to move to each page in turn, and as each page is displayed, use the ∧ or ∨ button to select the required option. The parameters you can set are:

- HEADING (as in *Figure 3-10*). Select either MAG(netic) or TRUE.
- CHAP TITLES. Select either on or OFF.
- The page that is first displayed when you select a new chapter during Normal operation. You can set this as either TOP PAGE (the top page in the chapter) or LAST VIEWED (the page that was last displayed when the chapter was last used).
- KEY BEEP. Select either on or OFF.
- Race timers, GUN 1, GUN 2 and GUN 3. Use the procedure under *Setting race gun timers* below, to set each of these.
- SPEED , DEPTH, WIND SPEED and DISTANCE units resolution. The degree of resolution is dependent on data type and value (either 1.0, 0.1 or 0.01). Note that for some data values, the implementation of this feature may be limited by the constraints of the display.
- TIME OFFSET. Set to give local time.
- TIME FORMAT. Choose 12 or 24 hour clock.
- MONTH TEXT. Choose YES or nO.
- DATE FORMAT. Choose USA or EU.
- REM GROUP. Enables you to allocate the instrument as part of a remotely controlled group. Refer to *Setting remote control configuration*, below.
- REM SEQUENCE. Enables you to define the sequence in which the instrument is selected within its remote group Refer to *Setting remote control configuration*, below.
- REM LINK. Enables you to allocate a Remote Keypad to control the remote group. Refer to *Setting remote control configuration*, below

Setting race gun timers

To set any of the race gun timers:

1. In the OPTIONS chapter, select the required GUN timer page.
2. Press the ⦿ button for 1 second, to enter Edit mode. The seconds value flashes.
3. Use the ∧ or ∨ button to set the required seconds value.
4. Press the ⦿ button for 1 second, to edit the minutes. The minutes value flashes.
5. Use the ∧ or ∨ button to either set the required minutes value.
6. Press the ⦿ button for 1 second, to leave the edit mode and save the new value.

Setting remote control configuration

The remote control setup pages enable you to define the remote group, the sequence within the remote group and the associated Remote Keypad(s), for an instrument.

To set the remote control configuration for any Data Display:

1. Ensure the REM GROUP page is displayed (see *Figure 3-11*). This enables you to allocate the instrument as part of a remotely controlled group.
2. Use the ∧ or ∨ button to allocate the instrument to the required remote group. This can be any one of eight groups, identified by letter, from A to H.

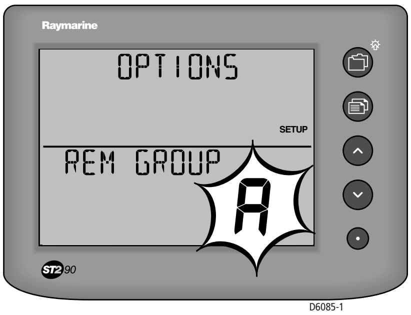


Figure 3-11: Set remote group

3. Press the button to move to the REM SEQUENCE page (see *Figure 3-12*).

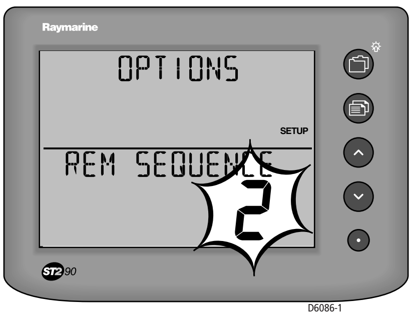


Figure 3-12: Set remote sequence

4. Use the ∧ or ∨ button to set a number, to define the sequence in which the instrument is selected within its remote group.

5. Press the button to move to the REM LINK page (see *Figure 3-13*). This enables you to define which Remote Keypad(s) you want to use to control the instrument. If a Remote Keypad is not already allocated, nO is displayed.

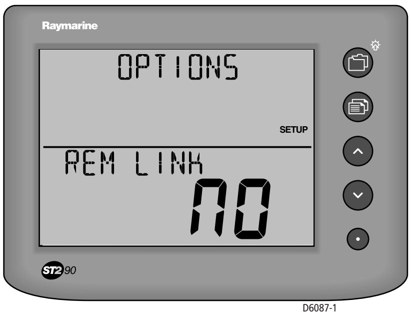


Figure 3-13: Link keypad

6. At each Remote Keypad you want to use to control this instrument, press any button, to link the instrument and keypad. Once a link is created, YES is displayed on the REM LINK page.

3.6 Data Units

The data UNITS page enables you to set the units in which data is displayed.These are **global** settings (the units you set are applied to the whole ST290 system), so only need to be made at one digital instrument.

To set the data units:

1. In User Setup, select the UNITS chapter.

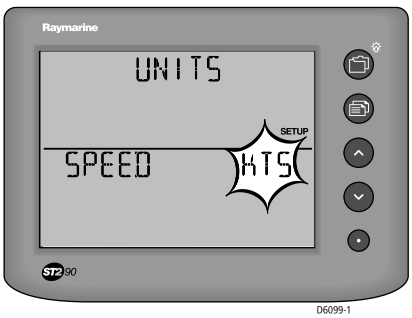


Figure 3-14:Typical data UNITS page

2. Press the button to move to each page in turn.

3. As each page is displayed, use the ∧ or ∨ button to select the required units. You can set:
   - SPEED units (as in *Figure 3-14*) to either knots, kilometers per hour or miles per hour (KTS, K/H or MPH).
   - DISTANCE units to nautical miles, kilometers or statute miles (NM, KM or SM).
   - DEPTH units to feet, fathoms or meters (FT, FA or M).
   - WIND SPD (speed) units to knots or meters per second KTS or M/S.
   - TEMP(erature) units to either °C or °F.
   - VOLUME units to gallons or liters (GAL or LTR).
   - FLOW rate units to gallons per hour or liters per hour G/H or L/H.

3.7 Backlighting setup

The User Setup LAMPS page enables you to set the brightness of each lighting level for each Data Display, in terms of percentage of total brightness.

Set the required backlighting parameters at each instrument, as follows:

1. In User Setup, select the LAMPS chapter.
2. Press the button to move to the LOCAL LEVEL 1 page.
3. Use the ∧ or ∨ button to set LOCAL LEVEL 1. This is the backlighting brightness of the first backlighting level, for this instrument.
4. Repeat steps 2 and 3 for the next two LAMPS setup pages, i.e. for LOCAL LEVEL 2 and LOCAL LEVEL 3 (preset levels 2 and 3), respectively.

3.8 Leaving setup

To leave User Setup:

1. Use the button to move to the USER SETUP EXIT screen.
2. Hold down the ⊙ button for 2 seconds. The instrument displays the USER SETUP entry screen.
3. Use the button to move to the required chapter in Normal operation.

Chapter 4: Setting up Analog Instruments

4.1 Introduction

This Section describes how to set up your analog Wind, Close Hauled Wind and Compass instruments.

4.2 Analog instrument setup

Wind and Close Hauled Wind instruments

At each Wind and Close Hauled Wind instrument, use the procedure in *Figure 4-1* to:

- Set wind angle response.
- Set wind speed response.
- Set VMG response.
- Apply factory defaults (if required).

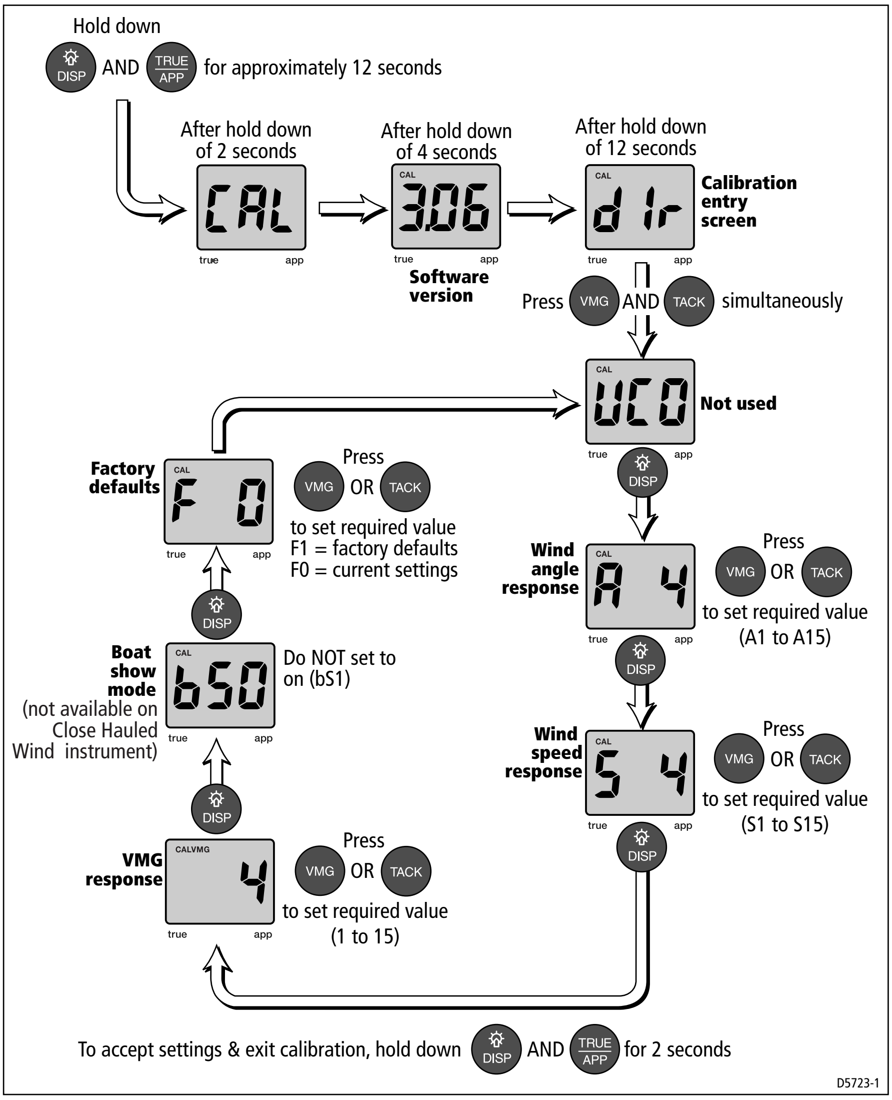


Figure 4-1: Setting up Wind and Close Hauled wind instruments

Compass instrument

The Compass instrument is set up using two stages of calibration.

The first stage enables you to:

- Choose which data you see on the digital display, when operating in Locked mode. Either the locked (or 'Fixed') bearing, or the current bearing.
- Choose whether you display true or magnetic bearing data.

The second stage enables you to:

- Set the instrument pointer response
- Set the digital display response.
- Select a Boat Show mode. **It is strongly recommended that you do NOT switch on this mode**. Always ensure it is set to off (bs0). This is the factory set value.
- Apply the factory default values.

At each Compass instrument, carry out the first stage of calibration (see *Figure 4-2*) followed by the second stage (see *Figure 4-3*).

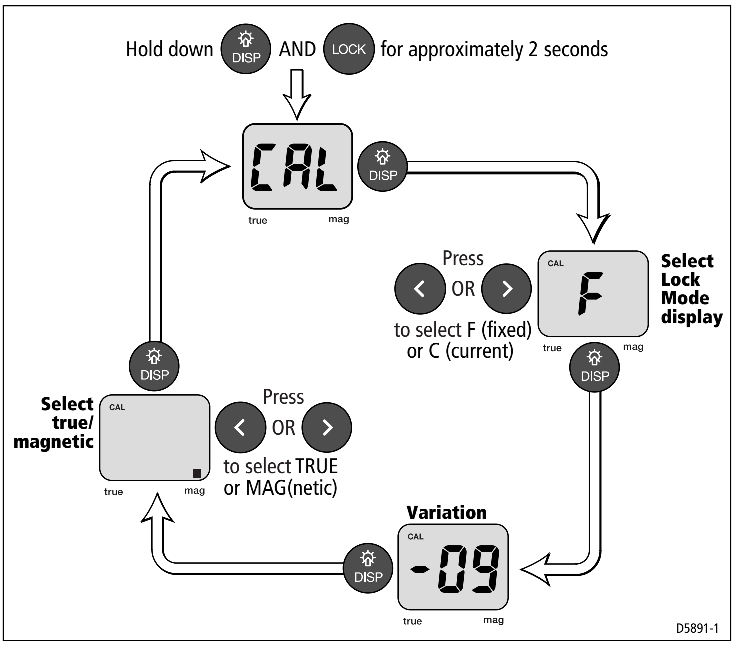


Figure 4-2: Compass instrument calibration first stage

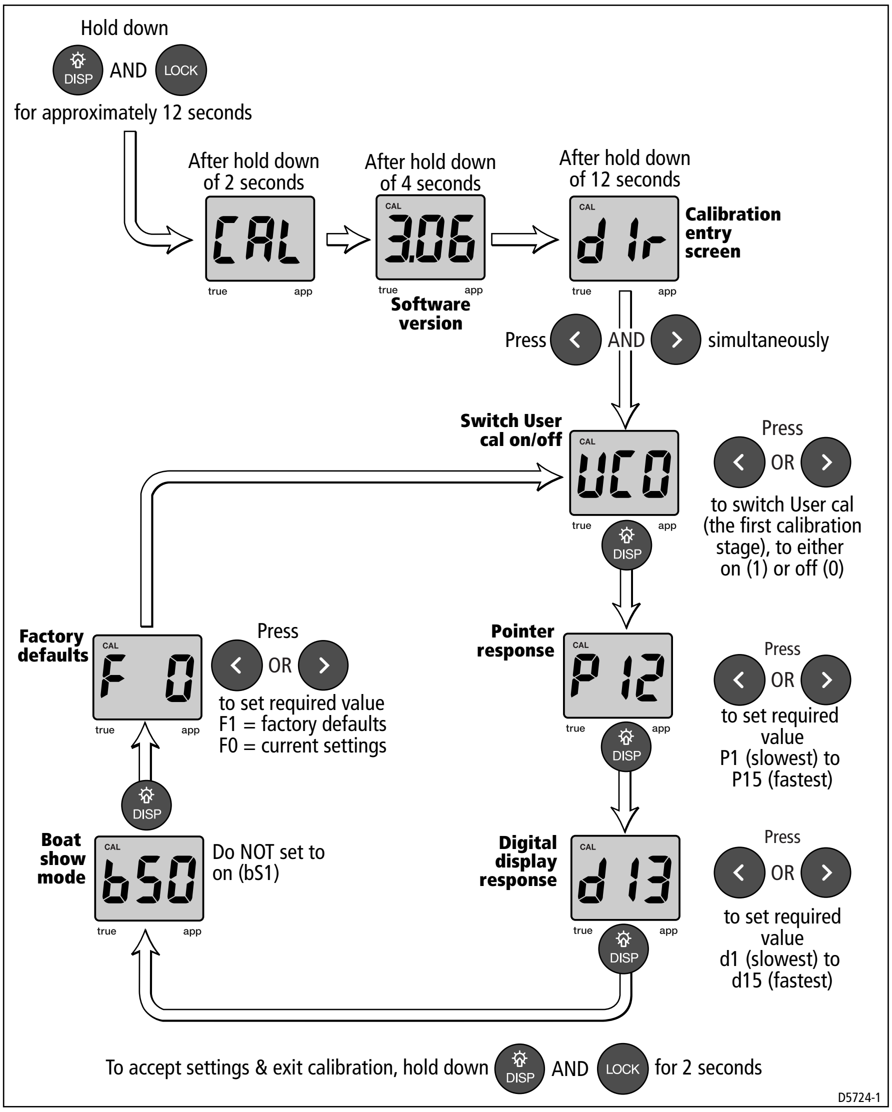


Figure 4-3: Compass instrument calibration second stage

Section 8: Autopilots

Contents

Chapter 1: Introduction to Autopilots

1.1 Applicability

You can use the ST290 Pilot Keypad, in conjunction with an ST290 instrument system, to control Raymarine autopilot systems which use T150, 150G, T400 and 400G course computers. Autopilot data is shown on specified ST290 Graphic Displays.

1.2 Autopilot operating modes

The autopilot has the following modes:

- **Standby**: the autopilot is off and you have manual control of your boat.
- **Auto**: the autopilot steers the boat to maintain a set compass heading.
- **Track**: the autopilot follows a track created on a chart plotter or other navigation aid.
- **Wind Vane**: the autopilot steers the boat to maintain a course relative to a true or apparent wind angle.
- **Calibration**: enables you to adjust the autopilot for optimum performance with your boat (see *Section 8, Chapter 5*). This includes automatic compass deviation correction (all autopilots) and AutoLearn automatic steering calibration (150G and 400G systems only).

Additional autopilot features:

- Automatic tack (AutoTack) in Auto and Wind Vane modes.
- Waypoint advance feature in Track mode.

Figure 1-1:Pilot Keypad

Autopilot functions

Raymarine 150G and 400G autopilots

The Raymarine 150G and 400G autopilots use the internal GyroPlus yaw sensor. This provides enhanced course keeping using AST (Advanced Steering Technology). These autopilots can be calibrated automatically using an AutoLearn feature.

Raymarine T150 and T400 autopilots

The Raymarine T150 and T400 autopilots do not have a GyroPlus yaw sensor fitted, but provide full basic functionality, using the Raymarine steering algorithm without AST.

ST290 system data

The autopilot uses the following ST290 system information:

- Wind information, for Wind Vane steering.
- Waypoint information, to provide track control.
- Boat speed information, to optimize steering and track-keeping performance.
- Course over ground (COG) to set compass heading.

You can also use an autopilot with any navigation aid (GPS/Loran) or wind instrument that transmits National Marine Electronics Association (NMEA) 0183 data.

1.3 Safety information

Setup requirement

WARNING:
Autopilots are normally calibrated to default settings intended to provide initial stable performance for most boats. However, to ensure optimum performance on your boat, you must complete the commissioning procedures in Section 8, Chapter 4 before using the autopilot.

Navigation aid

WARNING:
Although we have designed this product to be accurate and reliable, many factors can affect its performance. As a result, it should only be used as an aid to navigation and should never replace common sense and navigational judgement. Always maintain a permanent watch so you can respond to situations as they develop.

It is the skipper's responsibility to ensure the safety of the boat at all times by following these basic rules:

- Ensure that someone is present at the helm AT ALL TIMES, to take manual control in an emergency.
- Make sure that all members of crew know how to disengage the autopilot.
- Regularly check for other boats and any obstacles to navigation – no matter how clear the sea may appear, a dangerous situation can develop rapidly.
- Maintain an accurate record of the boat's position by using either a navigation aid or visual bearings.
- Maintain a continuous plot of your boat's position on a current chart.
- Ensure that the locked autopilot heading will steer the boat clear of all obstacles.
- Make proper allowance for tidal set – the autopilot cannot.
- Even when your autopilot is locked onto the desired track using a navigation aid, always maintain a log and make regular positional plots. It is possible for navigation aids to produce invalid data in some circumstances and the autopilot will not be able to detect this.

Chapter 2: Autopilot Operation

2.1 Introduction

This chapter describes how to use the ST290 Pilot Keypad to control Raymarine autopilot systems which use T150, 150G, T400 and 400G Course Computers. All controls mentioned in this chapter are on the ST290 Pilot Keypad, unless otherwise stated.

2.2 Using the Pilot Keypad

Keypad functions

The Pilot Keypad enables you to control autopilot operation by means of button presses. Each button press is confirmed by a short beep. Although most functions are controlled by a single button press, there are also some simultaneous two-button operations.

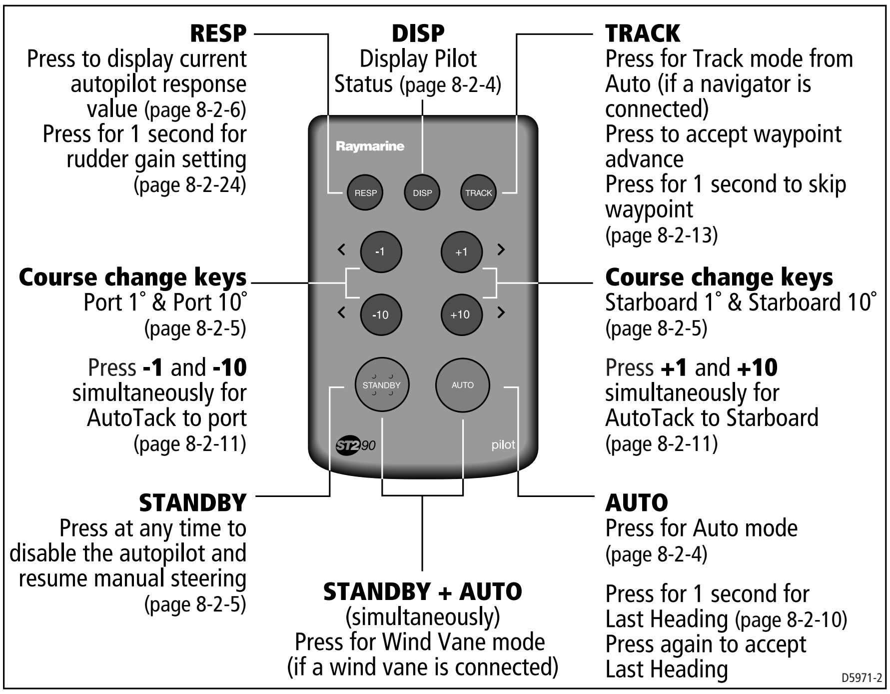


Figure 2-1: Pilot Keypad controls

2.3 Display layout

General Operation

Autopilot information is displayed on the ST290 Graphic Display in either single, dual- or quad-screen modes.These modes are used for general operation and configuration of the autopilot alongside other features of the ST290. You can configure these screens as part of the Graphic Display User Setup procedure (*see Section 7, System Setup*).

Note: *When your boat is under the control of the autopilot and you wish to access other information on the displays, we recommend that you use the dual- or quad-screen mode so that one view can be dedicated to displaying the autopilot status.*

Example of pilot information on a single-element page. This shows:

- Mode
- Heading
- Heading type: MAG/TRUE
- Rudder bar (-/+ 30°) or XTE bar

Example of pilot information in the upper screen area of a dual-element page. This shows:

- Mode
- Heading
- Heading Type: MAG/TRUE
- Scaled down rudder bar (-/+30°)

Example of pilot information in the lower, right-hand area of a quad-element page. This shows:

- Mode
- Heading
- Heading Type: (M)AG/(T)RUE

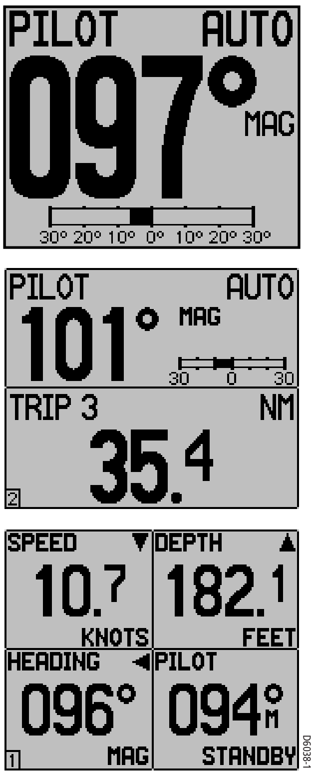


Figure 2-2: ST290 display modes

Pop-up message modes

Alarm and Information messages

Autopilot alarms, information and temporary setting changes are displayed using “pop-up” style messages. These messages appear in front of the current display (single-, dual or quad-element screen) and indicate a button with an associated action. On taking an action, the display returns to the normal operating mode.

Example pop-up alarm message:

This shows an autopilot off course alarm and silence action button, in a pop-up window, over a quad-element page.

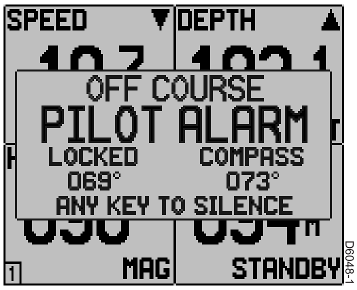


Figure 2-3: Pop-up alarm message

Pop-up pilot mode

Autopilot mode or course changes can also be displayed in a “pop-up” window (see *Figure 2-4*). You can enable or disable this feature as described in the Graphic Display User Setup procedure (*see Section 7, System Setup*).

Example pop-up course-change message:

This example shows a new locked heading, following a commanded course change in AUTO mode.

The pop-up is displayed for 4 seconds.

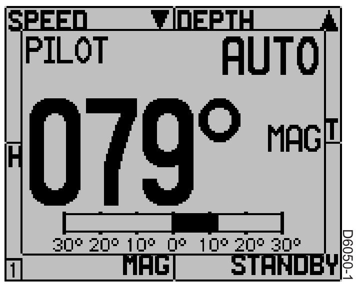


Figure 2-4: Pop-up pilot mode

2.4 Start-up mode

The autopilot always powers up in Standby mode (manual steering).

2.5 Accessing the Autopilot display page

Autopilot information is displayed on ST290 Graphic Display. You can access the information using either the Graphic Display buttons or the Pilot Keypad buttons.

Using an ST290 Graphic Display:

1. Press the instrument button to enter Chapter Select mode.
2. Use the or ∧ or ∨ button to highlight the PILOT chapter.
3. Either wait for 5 seconds or press the ⦿ button to display the PILOT status page.

Using the Pilot Keypad, press the Keypad **DISP** button once. All ST290 Graphic Displays with PILOT POPUP enabled (see *Section 7, User Setup*) will immediately show the pilot status on a pop-up page.

2.6 Using Auto mode

WARNING:
Before using Auto mode, make sure that the pilot has been correctly commissioned, as detailed in Section 8, Chapter 4.

Engaging the autopilot (Auto mode)

WARNING:
Autopilots make boating easier, but they are NOT a substitute for good seamanship. ALWAYS maintain a permanent watch at the helm.

To engage the autopilot:

1. Steady the boat on the required heading.
2. Press **AUTO**. The autopilot will now steer the boat on the current heading (locked heading).
3. The PILOT screen of the ST290 Graphic Display will display the autopilot status and the locked heading. The display in *Figure 2-5* shows the autopilot in control of the boat maintaining a locked heading of 097º.

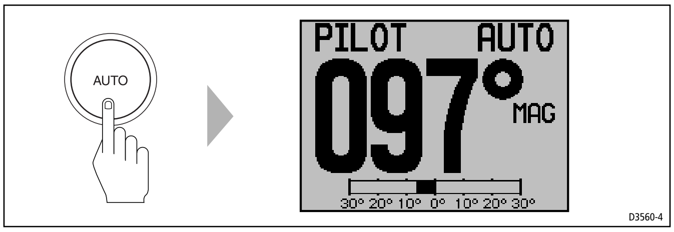


Figure 2-5: Engaging the autopilot

Disengaging the autopilot (Standby mode)

To disengage the autopilot, press **STANDBY**:

- In Standby mode, the display shows the current compass heading.
- The last locked heading is memorized and can be recalled.

To return to manual steering AT ANY TIME, press STANDBY.

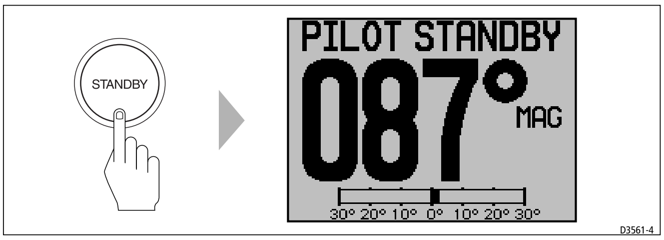


Figure 2-6: Disengaging the autopilot

Changing course in Auto mode

In Auto mode, use the **-1** and **-10** (port) and **+1** and **+10** (starboard) buttons to change the locked heading in steps of 1° or 10°. For example: press **-10** three times for a 30° course change to port.

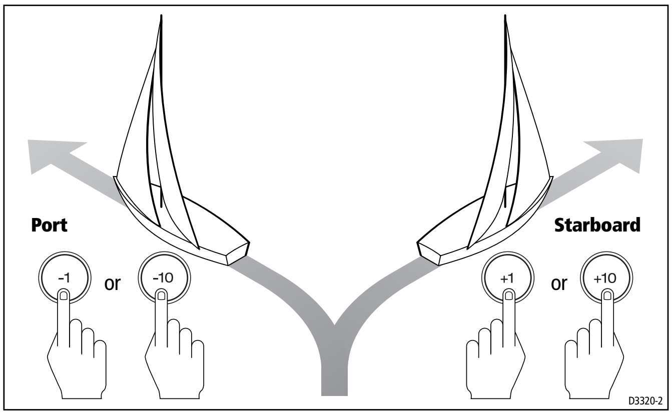


Figure 2-7: Changing course in AUTO mode

Adjusting autopilot response

You can adjust the performance of Raymarine autopilot systems by changing the response level. This is the only user adjustment you should need to make to the autopilot on a regular basis.

The response level controls the relationship between the autopilot's course keeping accuracy and the amount of helm/drive activity.

You can set the default power-up response level, by using the Pilot Basic or Advanced Calibration (see *Section 8, Chapter 5*) to adjust the **default** response level.

However, when using your autopilot on a day-to-day basis, you can make **temporary** adjustments to the response level. By doing this you can set the autopilot performance to suit different conditions.

150G & 400G autopilot systems

150G and 400G autopilot systems have nine response level options:

Level 1 gives the least pilot activity to conserve power, but may compromise short-term course-keeping accuracy.

Levels 4 to 6 should give good course keeping with crisp, well-controlled turns under normal operating conditions.

Level 9 gives the tightest course keeping and greatest rudder activity, but may lead to a rough passage in open waters as the autopilot may 'fight' the sea.

When you require extra tight course keeping (e.g. for pilotage in confined and sheltered waters), use a higher response value. If you want to minimize drive activity and conserve battery power, use a lower value.

Temporary changes to response

Taking the above points into account, use the following procedure if you need to make temporary adjustments to the response level of 150G and 400G autopilots, as required:

1. Display the RESPONSE screen by pressing the **RESP** button.

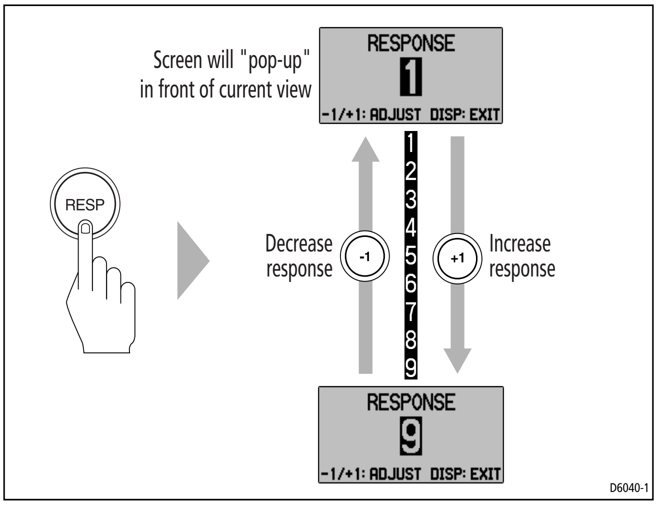


Figure 2-8: Making temporary changes to 150G/400G response

2. Press **-1** or **+1** to change the response level.
3. Press **DISP** or wait for 10 seconds to return to the previous display.

Note: *You will lose these temporary changes to response level whenever the system is powered off. You can make PERMANENT adjustments in Pilot Basic or Advanced Calibration (see Section 8, Chapter 5).*

T150 & T400 autopilot systems

T150 and T400 (non-GyroPlus) autopilot systems have three response level options:

Level 1 - AutoSeastate on (Automatic deadband):

- Autopilot gradually ignores repetitive boat movements and only reacts to true variations in course.
- Provides the best compromise between power consumption and course keeping accuracy.

Level 2 - AutoSeastate off (minimum deadband):

- Provides tighter course keeping.
- Increased power consumption and drive unit activity.

Level 3 - AutoSeastate off and counter rudder yaw damping:

- Provides tightest possible course keeping by introducing counter rudder yaw damping (see *Section 8, Chapter 5*).

Temporary changes to response

To make a temporary change to the response setting of T150 and T400 autopilots:

1. Display the RESPONSE screen by pressing the **RESP** button.
2. Press **-1** or **+1** to change the response between levels 1 to 3.
3. Press **DISP** or wait for 10 seconds to return to the previous display.

Note: *You will lose these temporary changes to response level whenever the system is powered off. You can make PERMANENT adjustments in Pilot Basic or Advanced Calibration (see Section 8, Chapter 5).*

Off Course warning

If an OFF COURSE warning occurs, pop-up window appears displaying the locked and compass bearings.

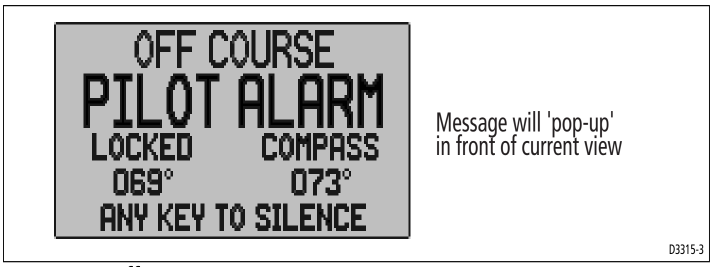


Figure 2-9: Off course warning

The autopilot initiates an OFF COURSE warning when the boat has been off course from the locked heading by more than the specified angle* for longer than 20 seconds.

*** Note:** *You can adjust the specified off course angle in Pilot Advanced Calibration (see Section 8, Chapter 5).*

To cancel an OFF COURSE warning, press **STANDBY** to return to hand steering:

- If you are under sail, check whether your boat is carrying too much sail, or whether the sails are badly balanced. You can usually significantly improve course keeping by improving the sail balance.
- If you are using a powerboat, ensure that the trim tabs are correctly set.

Note: *The warning clears automatically if the heading recovers, or if you change the course or if you change the operating mode.*

Dodging obstacles then resuming previous course

When your boat is under autopilot control, you can dodge an obstacle and then resume your previous course.

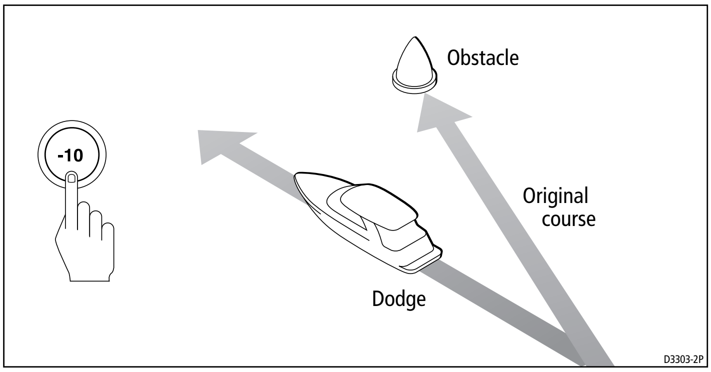


Figure 2-10: Dodging an obstacle

Dodging an obstacle

To dodge an obstacle:

1. Select a course change in the appropriate direction. For example, press **-10** three times for a 30° dodge to port.

2. When safely clear of the obstacle, you can either:
   - Reverse the previous course change (e.g. press **+10** three times), or
   - Return to the previous locked heading (LAST HEADING) as described below.

Returning to the previous heading

When the boat is in Auto mode and you have steered the boat away from the selected locked heading for any reason (for example, to carry out a dodge maneuver), you can return to the **previous locked heading** (the most recent heading held for 20 seconds). To do this:

1. Press **AUTO** for 1 second. The display flashes and shows the previous locked heading (LAST HEADING) for 10 seconds. The arrow will show the direction the boat will turn.
2. To accept this heading, press **AUTO** when the display is flashing.

Note: *If you do not press* **AUTO** *while the display is flashing, the autopilot will maintain the current heading.*

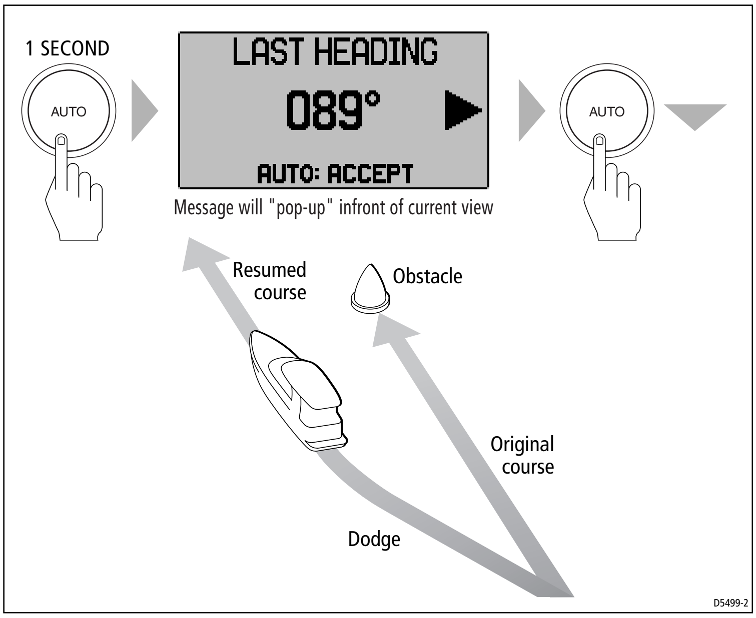


Figure 2-11: Return to last heading

You can also return to the last Auto heading from Standby mode by pressing **AUTO** for 1 second and pressing **AUTO** again at the LAST HEADING prompt.

Using sail boat features in Auto mode

Automatic tack (AutoTack)

The ST290 Pilot Keypad has a built in automatic tack facility (AutoTack) that turns the boat through a preset angle in the required direction. The default angle is 100º.

If you have set the vessel type to SAIL BOAT, you can adjust the default AutoTack angle in Pilot Basic or Advanced calibration (see *Section 8, Chapter 5*):

- To AutoTack to **port**: press the **-1** and **-10** buttons together.
- To AutoTack to **starboard**: press the **+1** and **+10** buttons together.

WARNING:
When making major course changes, the trim on the boat may change substantially. Because of this, the autopilot may take some time to settle accurately onto the new course.

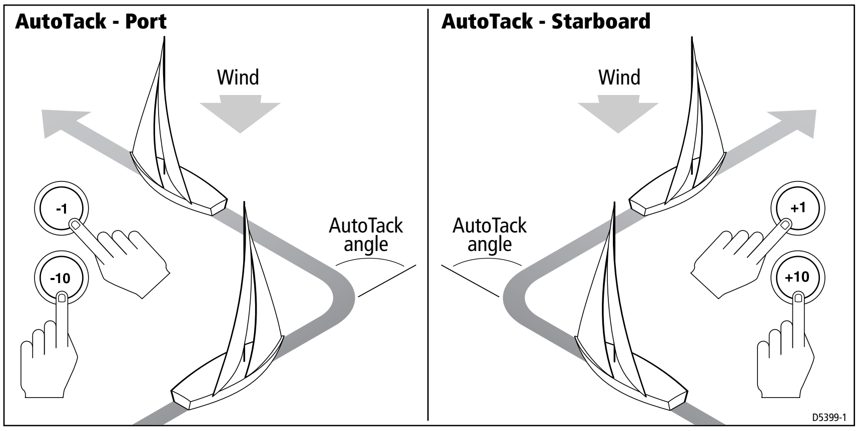


Figure 2-12: Using AutoTack

Preventing accidental gybes

Note: *For the gybe inhibit feature to work, the autopilot must receive suitable wind information.*

A gybe inhibit feature stops AutoTack maneuvers away from the wind thereby preventing accidental gybes. You can turn this feature on or off, as required:

- With gybe inhibit **on,** you can perform an AutoTack only into the wind.
- With gybe inhibit **off**, you can perform an AutoTack into or away from the wind.

Note: *Gybe inhibit is switched on as a default. You can switch it off in Pilot Basic or Advanced Calibration (see Section 8, Chapter 5).*

Gusty conditions

In gusty conditions, the course may tend to wander slightly, particularly if the sails are badly balanced. If you take the appropriate measures, the autopilot will maintain competent control even in gale force conditions.

You can significantly improve course keeping by:

- Improving the sail balance:
- Not allowing the boat to heel over excessively.
- Easing the mainsheet traveller to leeward to reduce heeling and weather helm.
- If necessary, reefing the mainsail a little early.

In very strong winds and large seas:

- Avoid sailing with the wind dead astern.
- Ideally, bring the wind at least 30° away from a dead run.

In severe conditions, you may also need to remove the mainsail and sail under headsail only.

2.7 Using Track mode

In Track mode, the autopilot maintains a track between waypoints created on a navigation system. The autopilot makes any course changes necessary to keep your boat on track, automatically compensating for tidal streams and leeway.

Selecting Track mode

WARNING:
When you enter Track mode, the autopilot will bring the boat onto the track in a controlled way. The closer the boat is to the correct heading and track, the quicker the autopilot will settle the boat onto the new course. To avoid an unexpected turn, it is good practise to align the boat with the required track before entering Track mode.

To select Track mode:

1. Ensure the autopilot is in Auto mode.
2. Press **TRACK** to enter Track mode.
3. Wait for the Waypoint Advance warning to sound. The display will show the bearing to the next planned waypoint and the direction the boat will turn to reach this waypoint.
4. Check that it is safe for the boat to turn onto the new course.
5. Press the **TRACK** button. When you do this:
   - The autopilot will turn the boat onto the new course in a controlled way.
   - The display shows the heading required to achieve the required track.

Note: *The closer the boat is to the correct heading and track when you press* **TRACK**, *the quicker the autopilot will bring the boat onto the new course. If the boat is more than 0.3 nm from the track, the Large Cross Track Error warning will sound.*

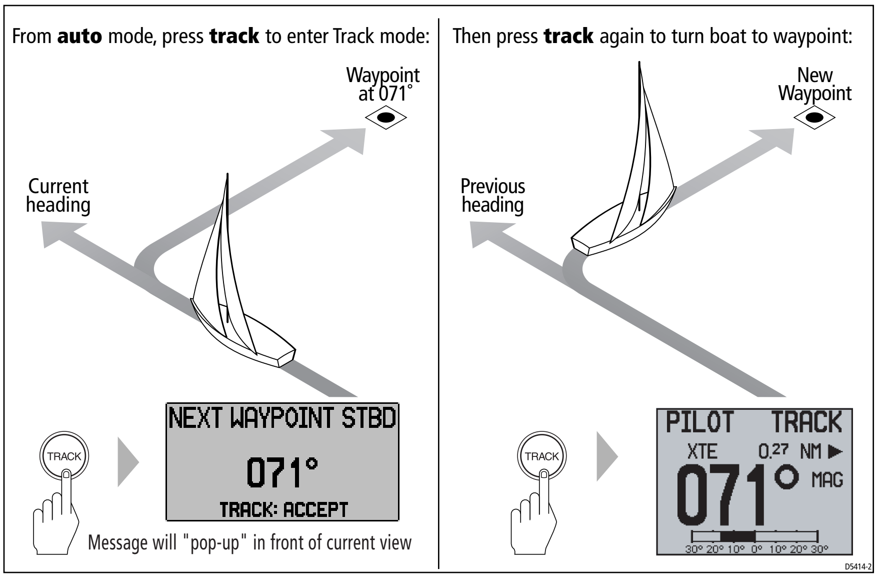


Figure 2-13: Automatic Track Acquisition

Exiting Track mode

To exit Track mode, either:

- Press **AUTO** to return to Auto mode, or
- Press **STANDBY** to steer manually in Standby mode.

Cross track error

Cross track error (XTE) is the distance between the current position and a planned route. The autopilot receives the cross track error information from the navigation equipment, and uses this to get back on course.

If the cross track error is greater than 0.3 nm, a Large XTE warning will occur. The display will show how far port or starboard of the track you are and the direction you need to steer to get back on track.

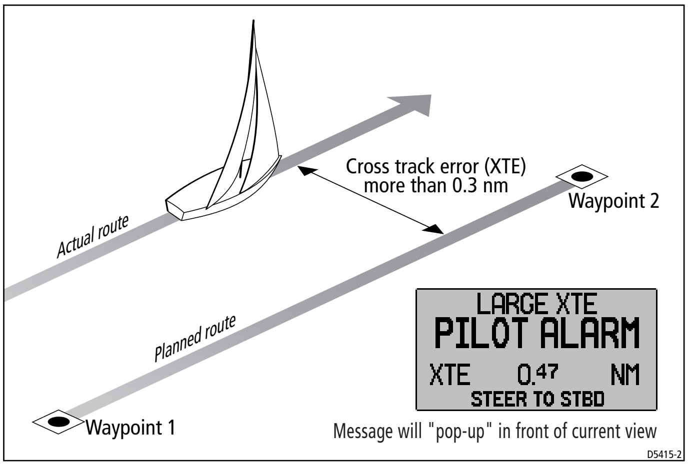


Figure 2-14: Large Cross Track Error

Tidal stream compensation

Under most conditions, the autopilot will hold the selected track to within ±0.05 nm (300 ft) or better. The autopilot takes account of the boat's speed when computing course changes to ensure optimum performance over a wide range of boat speeds.

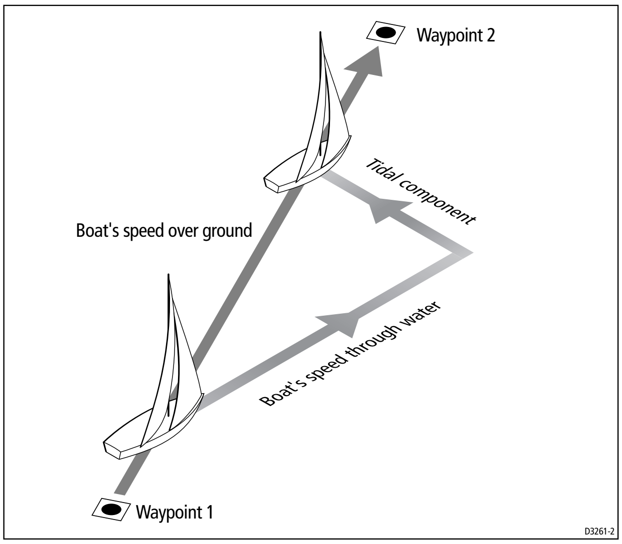


Figure 2-15: Tidal stream compensation

In order of preference, the autopilot uses:

- Measured boat speed (speed through water)
- Speed over ground (SOG), if measured boat speed is not available.
- The cruise speed specified in Pilot Advanced Calibration (see *Section 8, Chapter 5*), if neither measured boat speed or SOG are available.

Waypoint arrival and advance

Note: *Waypoint advance operates only if valid bearing to waypoint and waypoint name information are available from the navigation system.*

On arrival at a waypoint, the autopilot will display the Waypoint Advance (NEXT WAYPOINT) screen and sound an alarm. The alarm screen shows the bearing to the next waypoint and the direction the boat will turn to acquire the new heading.

- If it is safe to make the turn, press the **TRACK** button to accept the new heading. The autopilot will turn the boat and cancel the alarm.
- If you do not press **TRACK** then the boat will maintain the existing heading. Pressing **AUTO** or **STANDBY** will cancel the alarm, abandon the track and return to automatic or manual mode as appropriate.

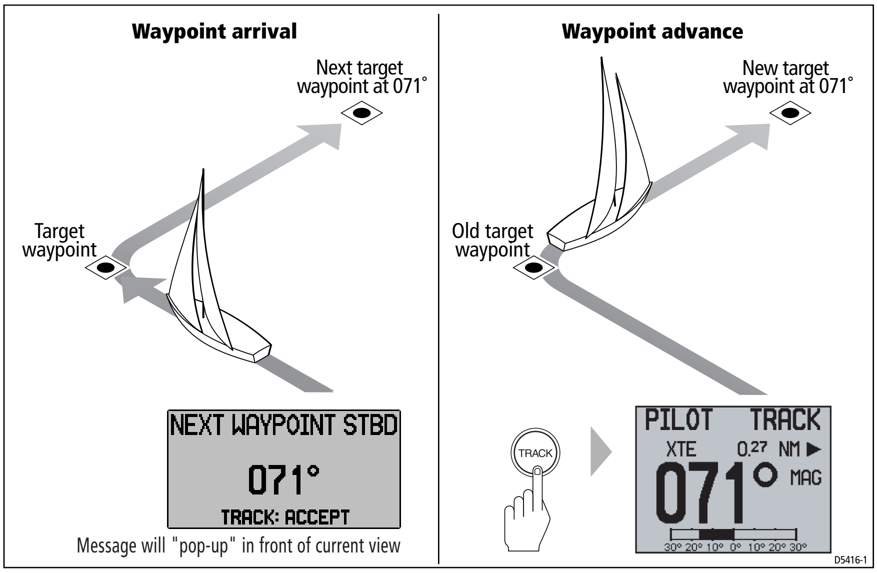


Figure 2-16: Waypoint Arrival and Advance

Man Overboard (MOB) functionality

On some navigation aids a Man Overboard function exists to aid rescue of personnel. When a MOB button is activated, the position of the boat at that time is stored and sent to the autopilot as a new waypoint. The autopilot can acquire this waypoint via a waypoint advance alarm and automatically track to the MOB location.

Skipping a waypoint –SeaTalk navigators only

WARNING:
Skipping a waypoint will take you straight to the next waypoint. Check your navigation before making the turn.

If you want to advance to the next waypoint **before** you have arrived at the target waypoint, you can skip a waypoint by pressing **TRACK** for 1 second. The display will then show the Waypoint Advance screen for the next waypoint. Check it is safe to turn, then press **TRACK** to turn the boat towards the next waypoint.

Route Complete indication

When you have reached the last waypoint on a route in Track mode, either a NO DATA message or a ROUTE COMPLETE message is displayed.

When this occurs, either:

- Press **AUTO** to continue on the same heading, or
- Press **STANDBY** to return to hand steering.

If you do not press a button, the autopilot will continue to steer the boat on the present heading whilst displaying the NO DATA or ROUTE COMPLETE message.

Dodges in Track mode

When the autopilot is in Track mode you still have full control from the keypad.

Initiating a dodge maneuver

In Track mode, you can make a dodge maneuver by using the course change buttons (**-1**, **+1**, **-10** or **+10**) to select the desired course change.

Cancelling a dodge maneuver

After you have avoided the hazard, you can cancel the dodge course change by making an equal course change in the opposite direction.

Safety in Track mode

WARNING:
Although Track mode provides accurate track keeping even in complex navigational situations, it is still the skipper's responsibility to ensure the safety of the boat at all times by means of careful navigation and frequent position checks.

Sailing in Track mode assists precise navigation and removes the tasks of compensating for wind and tidal drift. However, you **MUST** still maintain an accurate log with regular plots.

Confirming position at the start of a journey

At the start of a journey you must always use an easily identifiable fixed object to confirm the fix given by the navigation system. Check for fixed positional errors and compensate for them.

Verifying computed positions

Always verify the computed position with a dead reckoned position, calculated from the average course steered and the distance logged.

Plot frequency

In open water, you should make plots at least every hour.

In confined waters or when near to potential hazards, you should make plots more frequently.

2.8 Using Wind Vane mode – sail boats

Introduction

Note: *To use Wind Vane mode, the autopilot must receive suitable wind information.*

When the autopilot is in Wind Vane mode it keeps the boat at a set angle to the wind, using wind and compass references.

As changes in the wind angle occur, the autopilot adjusts the locked compass heading to maintain the set angle to the wind.

True and apparent wind

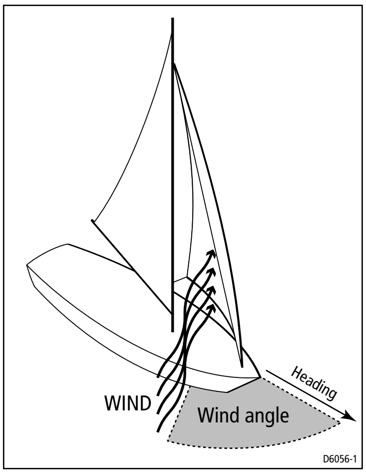
In WIND VANE mode, T150, 150G, T400 and 400G autopilots can maintain a course relative to either:

- **apparent wind**, the autopilot maintains the apparent wind angle, or
- **true wind**, the autopilot maintains the true wind angle.

You can adjust the factory default setting of apparent wind, in Pilot Basic or Advanced Calibration (see *Section 8, Chapter 5*).

WindTrim

In Wind Vane mode the autopilot uses WindTrim to eliminate the effects of turbulence and short term wind variations. This provides smooth and precise performance with minimal power consumption. You can adjust the WINDTRIM RESPONSE level in Pilot Basic or Advanced Calibration (see *Section 8, Chapter 5*) to control how quickly the autopilot responds to changes in the wind direction. Higher wind trim settings will result in a pilot that is more responsive to wind changes.



Selecting Wind Vane mode

To select Wind Vane mode from either Standby or Auto mode:

1. Steady the boat onto the required wind angle.
2. Press **STANDBY** and **AUTO** simultaneously to select Wind Vane mode. and lock the current wind angle. The display shows the locked heading, wind type and the wind angle.

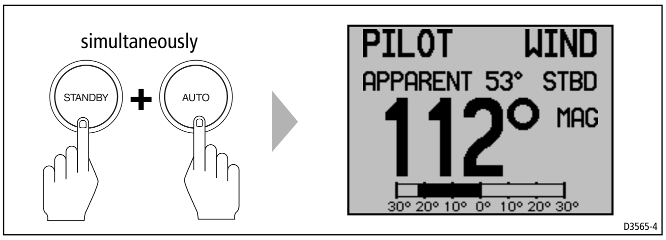


Figure 2-17: Selecting Wind Vane mode

In Wind Vane mode:

- The display shows the locked heading, wind type and the wind angle.
- The autopilot adjusts the boat's heading to maintain the locked wind angle.

If the autopilot will not enter Wind Vane mode, it is not receiving wind data. If this occurs, check the instrument and connections

Exiting Wind Vane mode

To exit Wind Vane mode, press either:
AUTO to return to Auto mode, or
STANDBY to steer manually in Standby mode.

Adjusting the locked wind angle

You can adjust the locked wind angle by using the **-1**, **+1**, **-10** and **+10** buttons to change course.

For example, to bear away by 10° when the boat is on a starboard tack, press **-10** to turn the boat 10° to port. The locked wind angle and locked heading will both change by 10°.

The autopilot will then adjust the locked heading as required to maintain the new wind angle.

Note: *Because turning the boat affects the relationship between true and apparent wind angles, you should only use this method to make MINOR adjustments to the wind angle. For major changes, return to Standby mode, steer onto the new heading, then reselect Wind Vane mode.*

Dodges in Wind Vane mode

When the autopilot is in Wind Vane mode you still have full control from the keypad.

Initiating a dodge maneuver

In Wind Vane mode, you can make a dodge maneuver by using the course change buttons (**-1**, **+1**, **-10** or **+10**) to select the desired course change. The autopilot will adjust both the locked heading and locked wind angle.

Completing a dodge maneuver

After you have avoided the hazard, reverse the previous course change.

Wind Shift warning

If the autopilot detects a sustained wind shift of more than 15° a WINDSHIFT alarm will occur (*Figure 2-18*):

- To cancel the alarm, retain the existing wind angle and accept the new heading, press any key on the ST290 Graphic Display.
- To cancel the alarm and keep to the existing heading, either:
  - Adjust the locked wind angle using the **-1**, **+1**, **-10** and **+10** buttons, or
  - Press **STANDBY** to return to hand steering. Steer onto the required heading and press **STANDBY** and **AUTO** simultaneously to return to Wind Vane mode with the new wind angle.

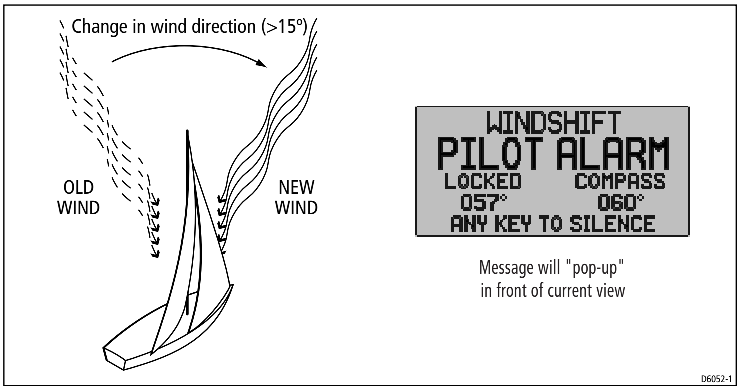


Figure 2-18: Windshift Alarm

Using AutoTack in Wind Vane mode

Note: *If you intend using AutoTack in Wind Vane mode, ensure the wind vane has been centered accurately.*

When AutoTack is used in Wind Vane mode, the boat turns through the AutoTack angle and the autopilot will then trim the heading to mirror the locked wind angle from the previous tack.

- To AutoTack to **port**: press the **-1** and **-10** buttons together.
- To AutoTack to **starboard**: press the **+1** and **+10** buttons together.

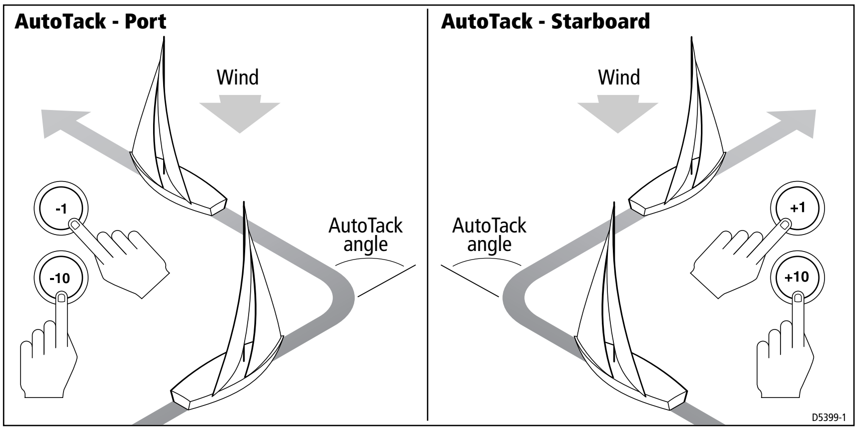


Figure 2-19: Using AutoTack

Note: *If you have set the vessel type to* SAIL BOAT, *you can adjust the default AutoTack angle in Pilot Basic or Advanced calibration (see Section 8, Chapter 5).*

Operating hints for Wind Vane mode

- Always trim your sails carefully to minimize the amount of standing helm.
- Reef the headsail and mainsail a little early rather than too late.
- In Wind Vane mode the pilot will react to long-term wind shifts, but will not correct for short-term changes such as gusts.
- In gusty and unsteady inshore conditions, it is best to sail a few degrees further off the wind so that changes in wind direction can be tolerated.

2.9 Adjusting the rudder gain

WARNING:
1. Incorrect rudder gain values on planing craft will lead to poor steering performance and can be dangerous at high speeds. You must set the rudder gain correctly.

2. If you increase the rudder gain setting on a 150G or 400G autopilot, you must also increase the counter rudder setting.

Note: *Although the rudder gain feature is available on all systems, you should not need to adjust the rudder gain setting on 150G or 400G autopilot systems once AutoLearn has been completed (see Section 8, Chapter 4).*

On T150 and T400 (non-GyroPlus) systems, you can make temporary adjustments to rudder gain to change the autopilot's steering characteristics. Rudder gain is a measure of how much helm the autopilot will apply to correct course errors (see *Figure 2-20*):

- If rudder gain is adjusted **correctly**, the course changes should result in a crisp turn followed by an overshoot of no more than 5°
- If rudder gain is **too high**, courses change will result in a distinct overshoot (**A**)
- If rudder gain is **too low**, the boat will feel sluggish – it will take a long time to make the turn and there will be no overshoot (**B**)

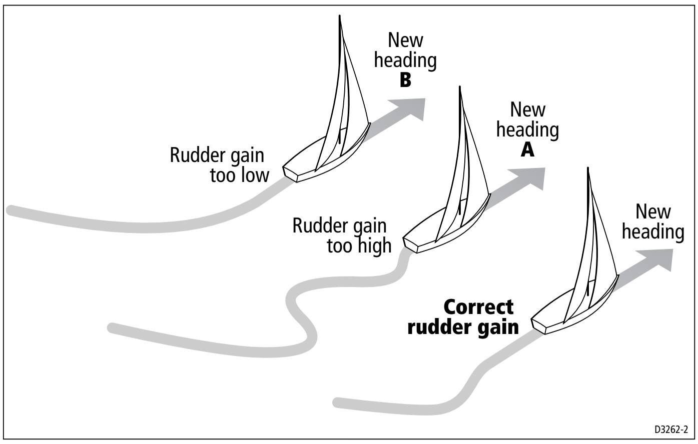


Figure 2-20: The effect of incorrect Rudder Gain settings

Note: *See Section 8, Chapter 5 for a full explanation of rudder gain and how to adjust it correctly.*

If necessary, you can make a **temporary** change to rudder gain as follows:

1. Press the **RESP** button for **1 second** to display the rudder gain (RUDDER GAIN) screen:
2. Press **-1** or **+1** to change the rudder gain.
3. Press **DISP** or wait for 10 seconds to return to the previous display.

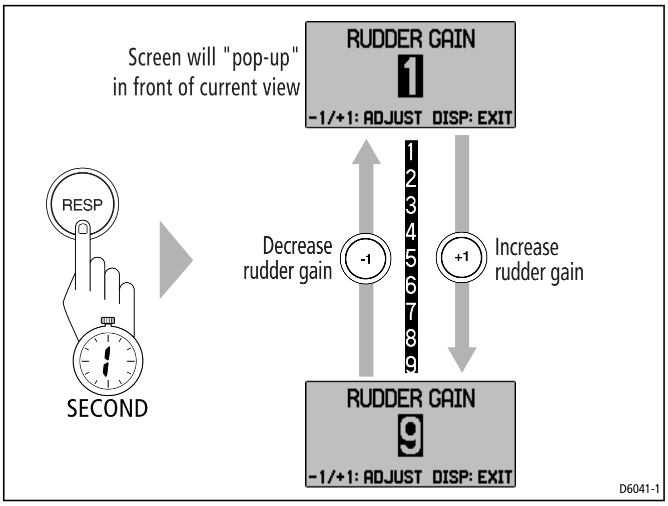


Figure 2-21: Adjusting Rudder Gain

Note: *You will lose these temporary changes to rudder gain whenever the system is powered off. You can make PERMANENT adjustments in Pilot Basic or Advanced Calibration (see Section 8, Chapter 5).*

Chapter 3: Autopilot Troubleshooting

3.1 Introduction

All Raymarine products are designed to provide many years of trouble-free operation. They are subject to comprehensive testing and quality assurance procedures before shipping.

This chapter provides information to identify autopilot problems, and on how to interpret autopilot alarm messages, maintain your autopilot system and obtain product support.

If a problem occurs with your autopilot, use the troubleshooting tables in this section to help identify the problem and provide a solution. If you cannot resolve the problem yourself, refer to the product support information.

Servicing and safety

- Raymarine equipment should be serviced only by authorized Raymarine service technicians. They will ensure that service procedures and replacement parts used will not affect performance. There are no user-serviceable parts in any Raymarine product.
- Some products generate high voltages, so never handle the cables/connectors when power is being supplied to the equipment.
- When powered up, all electrical equipment produces electromagnetic fields. These can cause adjacent pieces of electrical equipment to interact with one another, with a consequent adverse affect on operation. In order to minimize these effects and enable you to get the best possible performance from your Raymarine equipment, guidelines are given in the installation instructions, to enable you to ensure minimum interaction between different items of equipment, i.e. ensure optimum Electromagnetic Compatibility (EMC).
- Always report any EMC-related problem to your nearest Raymarine dealer. We will use any such information to improve our quality standards.
- In some installations, it may not be possible to prevent the equipment from being affected by external influences. In general this will not damage the equipment but it can lead to spurious resetting action, or momentarily may result in faulty operation.
- Always switch off the power to Raymarine equipment before working on it.

3.2 Fixing faults

Fault	Possible cause	Action
Rudder bar display moves in opposite direction to rudder.	Rudder position sensor connections are connected the wrong way round.	Reverse the red and green rudder position sensor connections at the course computer.
Displayed compass heading does not agree with the boat's compass.	Compass not calibrated.	Carry out the compass alignment and deviation procedures.
The autopilot will not communicate with other SeaTalk instruments.	A break in the SeaTalk cabling connection or SeaTalk fuse failure.	Ensure all SeaTalk cables are sound and connected properly. Replace SeaTalk fuse in course computer.
Waypoint information not received.	Navigator not transmitting the correct data.	Ensure navigator is operating correctly. Check wiring between navigator and autopilot systems. For NMEA connected navigators, check that the output is enabled at the navigator.
When holding a constant course in Standby mode, the autopilot heading changes continuously.	There may be magnetic interference on the compass. There may be a fault with the compass.	Check there are no electrical, magnetic, or metallic objects near the compass unit. Move the compass to another location. Carry out the compass alignment and deviation procedures. Call a Raymarine service agent.
Boat turns slowly and takes a long time to come onto course.	Rudder gain too low (see Section 8, Chapter 5).	Complete AutoLearn or increase setting.
Boat overshoots when turning onto a new course.	Rudder gain too high (see Section 8, Chapter 5).	Complete AutoLearn or decrease setting,
The autopilot appears to be unstable in Track mode, or track-holding is slow.	Tide speed exceeds 35% of boat speed, and boat speed is not available via SeaTalk.	Change the CRUISE SPEED setting in Pilot Advanced Calibration to the boat's cruising speed (see Section 8, Chapter 5).

Fault	Possible cause	Action
The autopilot appears to be unstable on Northerly headings in the Northern hemisphere (or Southerly headings in the Southern hemisphere).	Northerly/Southerly heading correction (AutoAdapt) is not set up. [Does not apply to 150G/400G systems.]	Set up Northerly/Southerly heading correction (AutoAdapt). (see Section 8, Chapter 5).
The autopilot will not auto advance to the next waypoint.	Bearing to waypoint information not received from the navigator.	Ensure Navigator is operating correctly. For NMEA connected navigators, check that the correct messages are enabled at the navigator.
You cannot enter Pilot Seatrial Calibration mode.	Seatrial calibration lock is on.	Turn off the calibration protection feature in Pilot Advanced Calibration (see Section 8, Chapter 5).

3.3 Autopilot alarm messages

When the autopilot detects a fault or failure on the system, it will initiate an alarm message.

- Before you attempt to resolve the problem, press **STANDBY** to clear the alarm and return to hand steering, unless otherwise stated.
- In some situations, the autopilot will raise more than one alarm. When you have dealt with the first alarm, the autopilot will display the next alarm.

Alarm message	Cause	Action
PILOT DISENGAGED	Possible fault with rudder position sensor. OR Stern (I/O) drives only – you have taken manual control of steering with AutoRelease on.	Check connections and mechanical linkage. The alarm cancels automatically after 10 seconds.
CURRENT and LIMIT	Serious drive failure – the drive is taking too much current.	Check the drive unit for a jam and cabling for a short circuit. If fault persists, call a Raymarine service agent.
DRIVESTOPPED	The autopilot is unable to turn the rudder (this occurs if the weather load on the helm is too high, or if the rudder position sensor has passed beyond the preset rudder limits or rudder end-stops).	Check drive and rudder position sensor.
LOW BATTERY	Supply voltage has dropped below acceptable limits.	Press STANDBY to clear the alarm and return to hand steering THEN Start the engine to recharge the battery.
MOT POW and SWAPPED	Motor cables are connected to power terminals (and power cables are connected to motor terminals) at course computer.	Turn off power, check and swap over connections.

Alarm message	Cause	Action
NO DATA Note: The autopilot stops adjusting the heading as soon as it loses data.	In Track mode, the autopilot is not receiving SeaTalk navigation data OR The position sensor (GPS, Decca) is receiving a low strength signal.	Check the connections to the compass, wind instrument and navigator. Alarm will clear when the position sensor receives a satisfactory signal.
NO PILOT	The display unit is not receiving data from the course computer.	Check connections and check course computer is switched on.
RG FAIL	GyroPlus yaw sensor has failed.	• If you have a 150G/400G course computer with internal GyroPlus sensor – call a Raymarine service agent. • If you have a T150/400 course computer with external GyroPlus yaw sensor – check the sensor and connections, then call a Raymarine service agent.
SEATALK and FAIL 1 or 2	SeaTalk data problem on one of the SeaTalk lines.	Ensure all SeaTalk cables are properly connected to the course computer.
PILOT CALIBRATION REQUIRED	Occurs at power up.	Calibrate autopilot. (See Section 8, Chapter 5)
DATA ERROR ALARM	NMEA XTE data flagged as invalid or poor GPS fix.	Check the navigation system is receiving a good GPS signal and is able to calculate a valid fix.
NO COMP	Course computer is not receiving compass data.	Ensure all SeaTalk cables are properly connected.
NO WIND	Course computer is not receiving wind data.	Ensure all SeaTalk cables are properly connected.
NO SPEED	Course computer is not receiving speed data.	Ensure all SeaTalk cables are properly connected.

3.4 Product support

Raymarine products are supported by a worldwide network of distributors and Authorized Service Representatives. If you encounter any difficulties with this product, please contact either your national distributor, service representative, or the **Raymarine Technical Services Call Center**. Refer to *Section 5* of this handbook for details.

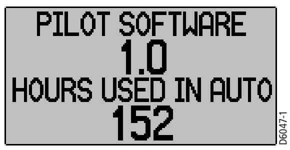
Before you consider returning the autopilot, make sure that the power supply cable is sound and that all connections are tight and free from corrosion. If the connections are secure, refer to the Fault Finding section in this chapter.

If you cannot trace or rectify the fault, contact your nearest Raymarine dealer or Service Center, specifying:

- The course computer serial number, printed under its connector cover.
- The course computer software version number.

The following illustration shows how to display the software information:

- At the Pilot Keypad, hold down **STANDBY** for 4 seconds:
  - You will then see a screen displaying the course computer software version and the total number of hours the autopilot has been used in Auto mode.
  - This information will remain visible for 10 seconds before returning to Standby**.**



Message will "pop-up" in front of current view

Chapter 4: Commissioning the Autopilot

4.1 Introduction

WARNING:
All newly-installed autopilot systems MUST be commissioned.

Before using a newly installed T150, 150G, T400 or 400G course computer autopilot system, you must commission the autopilot system in two stages:

Dockside checks

The dockside checks are carried out with the boat safely tied up, and comprise initial system checks and the adjustment of some fundamental settings.

Seatrial calibration procedures

The seatrial comprises compass calibration and the optimization of the autopilot settings, for your boat.

Pilot calibration procedures

Parts of the commissioning process use the pilot calibration procedures (see *Figure 4-1*). These are accessed from any ST290 Graphic Display with PILOT CAL enabled, as separate User Setup chapters entitled, PILOT BASIC CAL., PILOT SEATRIAL CAL. and PILOT ADVANCED CAL. (see *Section 7, Chapter 2*). Details of the pilot calibration structures are given in *Section 8, Chapter 5*.

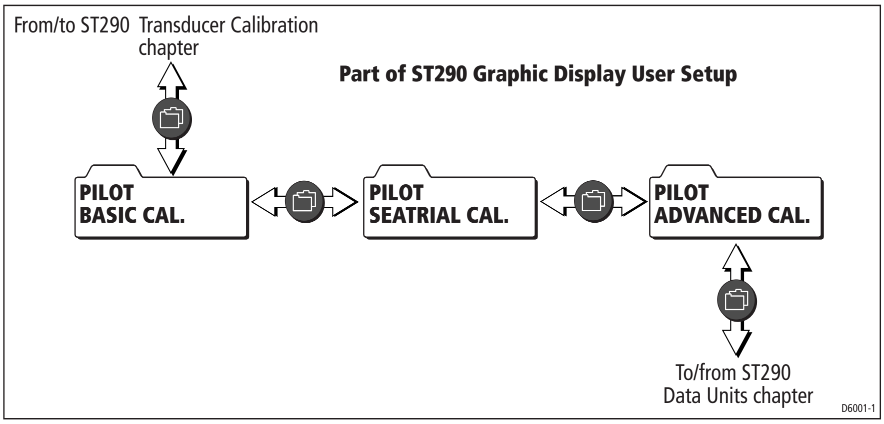


Figure 4-1: Pilot calibration overview

Controls

Pilot Keypad

The Pilot Keypad buttons are: **RESP**, **DISP**, **TRACK**, **-1**, **+1**, **-10**, **+10**, **STANDBY** and **AUTO**.

Graphic Display

The Graphic Display buttons are: , , ∧, ∨ and ⊙.

Pre-commissioning

At the ST290 Graphic Display, select the PILOTS chapter Status page.

4.2 Dockside Checks

With the boat safely tied up, complete the following dockside checks:

1. Switch on.
2. Check the autopilot rudder control.
3. Set fundamental autopilot parameters.

WARNING:
For safe control of your boat, you MUST complete the dockside checks before starting the initial seatrial.

Step 1: Switch on

When you have installed the ST290 Pilot Keypad and the autopilot system, switch on the main power breaker:

- If the Pilot Keypad and autopilot are active, the keypad will beep.
- After 4 seconds, a PILOT STANDBY screen is displayed on the Status page. Check that this shows a live compass heading and a rudder bar.

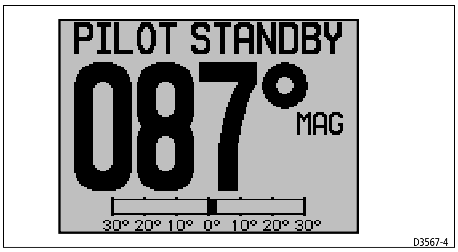


Figure 4-2: Autopilot Standby screen

Step 2: Check the autopilot rudder control

Check the rudder position sensor

WARNING:
Do NOT attempt to change autopilot connections with the power applied.

1. Turn the wheel manually to starboard.
2. At the PILOTS chapter Status page, check that the rudder bar moves to starboard. If the rudder bar display moves the wrong way:
   i. Turn off the power.
   ii. Reverse the red and green wires connected to the **RUDDER** inputs on the course computer.
   iii. Switch on the power and re-check.

Check the autopilot steering control

1. Manually center the wheel, then at the Pilot Keypad, press the **AUTO** button to place the autopilot in Auto mode. Check that the PILOTS chapter Status page displays AUTO.

WARNING:
Before commencing the next step, be ready to press the STANDBY button if the rudder moves hard over.

2. At the Pilot Keypad, press the **+10** button once. Check that the rudder moves to starboard a few degrees and then stops. If the rudder drives hard over, **immediately** press **STANDBY** to prevent further rudder movement.

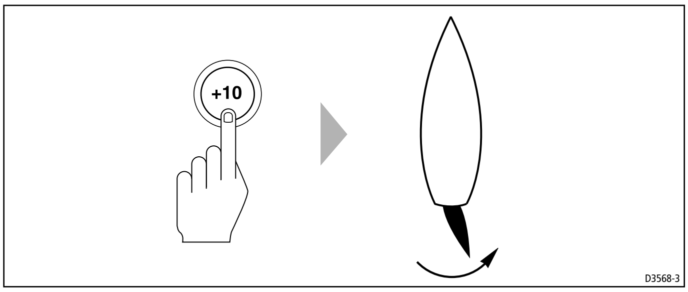


Figure 4-3: Checking rudder connection

3. If the rudder moves to port or the rudder drives hard over:
   i. Press **STANDBY.**
   ii. Turn off the power.

iii. Reverse the **motor wires** connected to the course computer.
iv. Switch on the power and re-check.

Note: *If the rudder overshoots and has to drive back or starts to hunt back and forth, increase the rudder damping level as described on page 8-4-8.*

Step 3: Adjusting fundamental autopilot settings

Use the Pilot Advanced Calibration mode, to adjust certain fundamental autopilot parameters.

Note: *For more information on pilot calibration, refer to Section 8, Chapter 5 of this handbook.*

To enter Pilot Advanced Calibration:

1. Press **STANDBY** to return the autopilot to Standby mode.
2. Using an ST290 Graphic Display (*Figure 4-4*), enter User Setup, as described in *Section 7* of this handbook. Then press the button to scroll to the PILOT ADVANCED CAL setup chapter (see *Figure 4-5*)

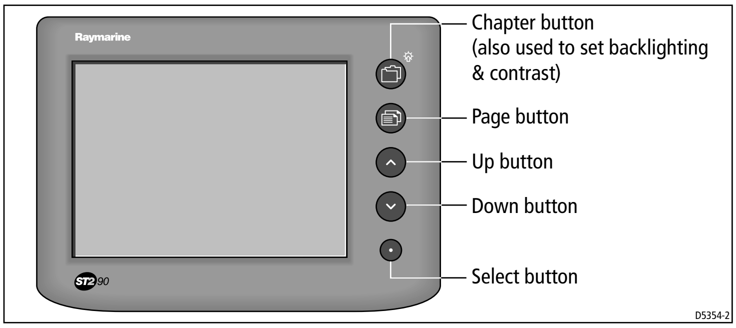


Figure 4-4: The ST290 Graphic Display

Using the Calibration mode

When you enter a pilot calibration screen, press the button to move between the individual calibration pages, or hold down the button to move backwards through the calibration pages.

Use the ∧ or ∨ buttons as necessary, to change calibration values.

To move to the next setting press the button. To leave the current calibration chapter and save all setting changes, press the button.

Note: *You must leave the calibration chapter by using the button to save all calibration changes. If the system loses power or is powered off before this stage then all configuration changes made will be lost.*

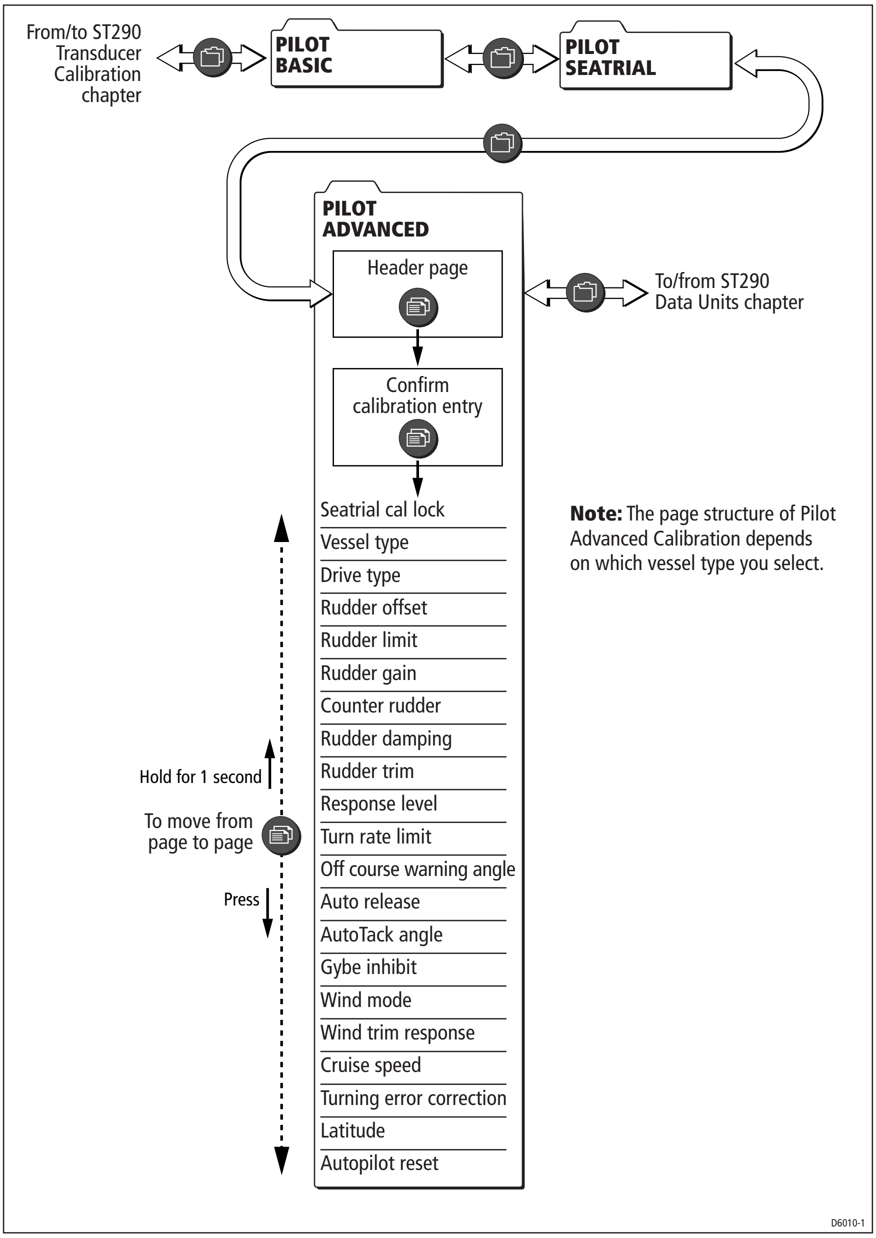
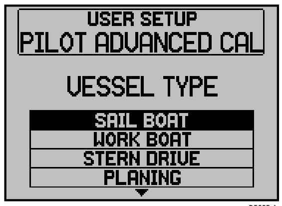


Figure 4-5: Pilot Advanced Calibration mode

Setting the vessel type

In Pilot Advanced Calibration:

1. Use the button to scroll to the VESSEL TYPE page.
2. Use the ∧ or ∨ button to select the appropriate vessel type. Options are:



D5985-1

   SAIL BOAT

   WORK BOAT

   STERN DRIVE- Planing powerboat with I/O drive (stern drive).

   PLANING - Planing powerboat.

   SEMI-DISPLACEMENT - Semi-displacement powerboat.

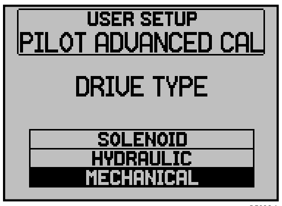
   DISPLACEMENT - Displacement powerboat.
3. To move to the next setting press the button, or to leave the current calibration chapter and save all setting changes, press the button.

Note: *When you change the vessel type, the autopilot will set appropriate defaults for the other calibration settings. Refer to the table in Section 8, Chapter 5 for default values. All previous calibration will be lost.*

Setting the autopilot drive type

In Pilot Advanced Calibration:

1. Use the button to scroll to the DRIVE TYPE page.
2. Use the ∧ or ∨ button to highlight the appropriate drive type. The options are:



D5986-1

   SOLENOID - for solenoid valve, spool valve or constant running pump drive systems.

   HYDRAULIC - for hydraulic drives.

   MECHANICAL - for mechanical drives.

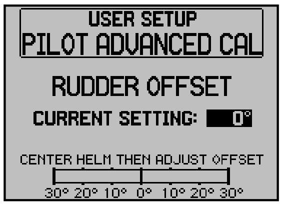
To move to the next setting press the button, or to leave the current calibration chapter and save all setting changes, press the button. Use the DRIVE TYPE screen to set the autopilot drive type so it is the same as the autopilot drive fitted to the vessel.

Setting the rudder offset

Use the RUDDER OFFSET screen to center the rudder bar display after installing the autopilot system.

In Pilot Advanced Calibration:

1. Use the button to scroll to the RUDDER OFFSET page.
2. Use the wheel to manually center the rudder.
3. Use the ∧ or ∨ button to adjust the bar graph to zero. The adjustment can be made from -7° to +7°, in 1° steps.
4. To move to the next setting press the button, or to leave the current calibration chapter and save all setting changes, press the button.



D5987-1

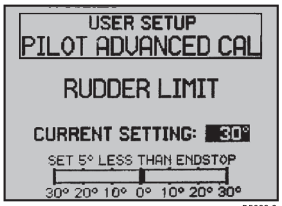
Note: *You can also zero the rudder bar with the boat under way during the initial seatrial, by manually steering a straight course then accessing the* RUDDER OFFSET *screen in Pilot Seatrial Calibration, to adjust the offset.*

Setting the rudder limit

Use the RUDDER LIMIT screen to set the limits of autopilot rudder control just inside the mechanical end stop, to avoid putting the steering system under unnecessary load.

In Pilot Advanced Calibration:

1. Use the button to scroll to the RUDDER LIMIT page.
2. Use the wheel to move the rudder:
   - To the port end stop and note the angle.
   - To the starboard end stop and note the angle.
3. Use the ∧ or ∨ button to set the rudder limit to 5° less than the lowest angle you have noted The adjustment can be made from 10° to 40°, in 1° steps.
4. To move to the next setting press the button, or to leave the current calibration chapter and save all setting changes, press the button.



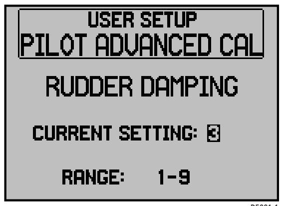
D5988-2

Setting the rudder damping

Note: *You need to adjust the rudder damping value only if the autopilot 'hunts' when trying to position the rudder. Increasing the rudder damping value reduces hunting.*

In Pilot Advanced Calibration:

1. Use the button to scroll to the RUDDER DAMPING page.
2. Use the ∧ or ∨ button to select the required value. The adjustment can be made from 1 to 9.
3. To move to the next setting press the button, or to leave the current calibration chapter and save all setting changes, press the button.



D5991-1

Save the new settings

When you have adjusted these basic settings, press the button to leave Pilot Advanced Calibration and save all setting changes.

Note: *You must leave the calibration chapter by using the button to save all calibration changes. If the unit loses power or is powered off before this stage then all configuration changes made will be lost.*

4.3 Seatrial Calibration

When you have completed the dockside calibration, you must then complete the setup by carrying out a short sea trial, using the Pilot Seatrial Calibration mode. There are two stages in the Seatrial.

1. Compass calibration:
   - Setting automatic deviation correction.
   - Aligning the compass heading.
2. Optimizing the autopilot to your boat:
   - Automatically, using an AutoLearn function, on 150G and 400G autopilot systems.
   - Manually on T150 and T400 (non-GyroPlus) autopilot systems.

Note: *For more information about pilot calibration, refer to Section 8, Chapter 5 of this handbook.*

Seatrial safety

IMPORTANT

You can return to hand steering at any time during the seatrial by pressing STANDBY, on the Pilot Keypad.

To ensure the seatrial is carried out safely and that results are valid, you should perform the initial seatrial **only**:

- When you have successfully completed the dockside calibration.
- In waters that are clear of any obstructions with plenty of clear space to maneuver.
- In conditions of light wind and calm water, so you can assess autopilot performance without the influence of strong winds or large waves.

Before you start your seatrial, ensure you have switched on the necessary ancillary equipment, such as a GPS (to provide course over ground (COG), speed over ground (SOG) and latitude (LAT) data), or a speed log (to provide speed through the water). This information will help the autopilot achieve best performance.

EMC conformance

Always check the installation before going to sea to make sure that it is not affected by radio transmissions, engine starting etc.

Seatrial Calibration mode

To enter Pilot Seatrial Calibration:

1. Press **STANDBY** to return the autopilot to Standby mode.
2. Using an ST290 Graphic Display, enter User Setup, as described in *Section 7* of this handbook. Then press the button to scroll to the PILOT SEATRIAL CAL. setup chapter.

Note: *If you cannot access Seatrial Calibration, turn off the calibration lock in Pilot Advanced Calibration.(see Section 8, Chapter 5).*

Using the Calibration mode

When you enter a pilot calibration screen, press the button to move between the individual calibration pages, or hold down the button to move backwards through the calibration pages.

Use the ∧ or ∨ buttons to alter calibration values.

To move to the next setting press the button. To leave the current calibration chapter and save all setting changes, press the button.

Note: *You must leave the calibration chapter by using the button to save all calibration changes. If the system loses power or is powered off before this stage then all configuration changes made will be lost.*

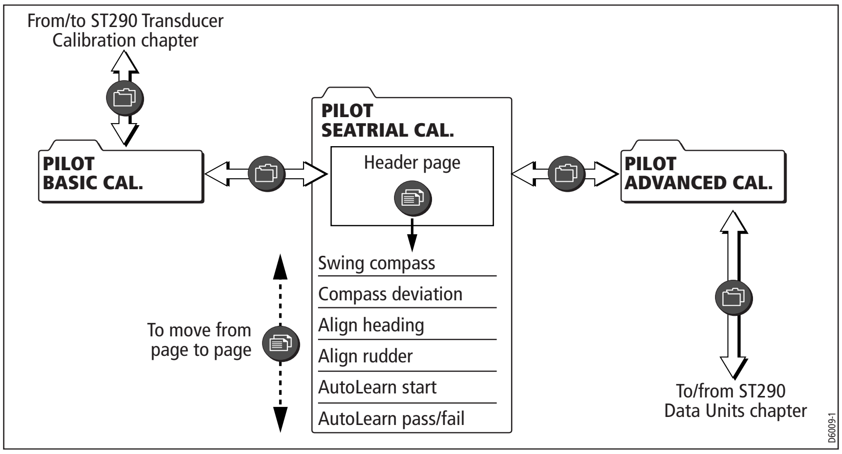


Figure 4-6: Pilot Seatrial Calibration mode

Step 1: Calibrating the compass

Note: *This section does not apply if an NMEA compass is connected to your autopilot system. In this case, refer to the information supplied with the compass to determine the appropriate calibration routines.*

Magnetic materials in the vicinity of the compass, can cause significant compass errors. The compass calibration procedure (see *Figure 4-7*) reduces these errors to a few degrees, so you **MUST** perform this as the first item in the seatrial.

Calibration is achieved by turning your boat in slow, wide circles, in calm conditions and preferably on flat water (this is called 'swinging the compass'). For optimum calibration it is recommended that each turn of the boat takes at least 2 minutes at a boat speed of under 2 knots.

If you fail to complete the deviation correction, autopilot performance will be impaired.

Correcting for magnetic deviation

To correct for magnetic deviation, enter Seatrial Calibration, then:

1. Use the button to scroll to the SWING COMPASS page.
2. Use the ∧ or ∨ buttons to select ON.
3. Check that there is enough clear sea space to complete the maneuvers required.
4. Press the button to begin the SWINGING COMPASS procedure.
5. Start turning your boat in slow, wide circles (typically 2 to 3 complete turns will be needed):
   - If the boat is turning too quickly, a TURN RATE TOO HIGH message is displayed. Immediately reduce the rate of turn.
   - If you have to stop the compass swing before completion, press any button. If you do this, the message SWING ABORTED is displayed and the procedure will have to be restarted.
6. When the procedure is complete, the SWING COMPLETE screen is displayed, and the amount of deviation is shown.

Note: *If the deviation figure exceeds 15° or the display shows no deviation value, the compass is being affected by ferrous objects on your boat and you should move the compass to a better location. Higher deviation figures are acceptable on steel boats but you must verify the compass accuracy with an independent reference.*

7. Press the button to proceed to the ALIGN HEADING page.

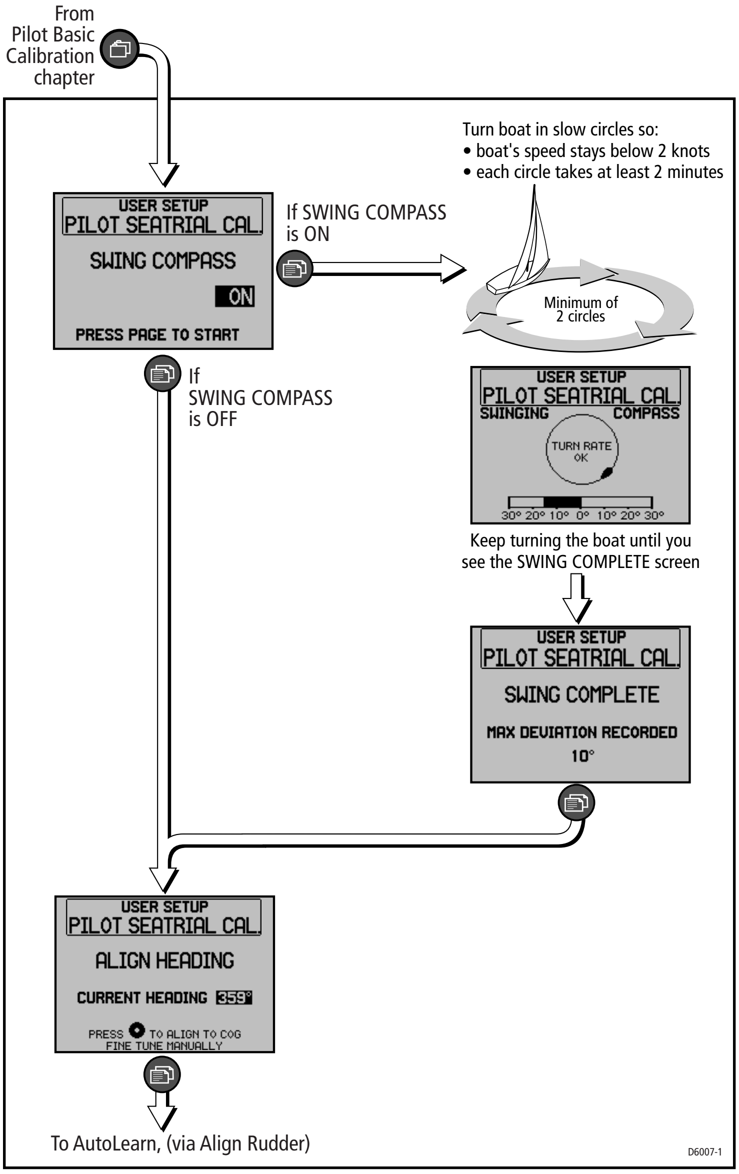


Figure 4-7: Autopilot compass calibration

Setting compass alignment

To carry out compass alignment, enter Seatrial Calibration, then:

1. Use the button to scroll to the ALIGN HEADING page.
2. Either:

   - Steer your boat on a steady course at a speed that enables you to hold that course, then use the ∧ or ∨ button to manually set the correct heading value,
     or
   - If you have GPS system installed, keep a steady course and to a speed above 3 knots for 30 seconds to allow the COG and SOG values to stabilize, then at the Graphic Display, press the ⊙ button for 1 second to set the COG value as the heading value.

Heading alignment tips

You can check the compass alignment after completing the deviation correction procedure (swinging the compass). After completing the initial compass calibration, you can make further adjustments to the alignment without swinging the compass again.

Although the compass calibration removes most of the alignment error, small errors, of the order of a few degrees, may remain. These will vary depending on the heading.

Check the heading reading against a number of known headings, plot a deviation curve, and determine the heading alignment value that will give the lowest **average** alignment error. You can then enter this value on the Heading Alignment screen, as described above.

If the average heading error is more than 5°, you should perform the compass deviation correction procedure again, circling more slowly and in more favorable conditions.

Step 2: Adjusting autopilot settings

The next stage of the seatrial is to set important parameters that affect the autopilot's steering characteristics, i.e. rudder gain, counter rudder and rudder trim. The manner in which you adjust these depends on the type of autopilot system you are using:

- 150G and 400G autopilot systems have an AutoLearn facility that automatically adjusts these parameters, to suit your boat.
- If you are using a T150 or T400 (non-GyroPlus) autopilot, you will need to adjust these parameters manually.

Note: *For a full explanation of the parameters set during the AutoLearn, and how to adjust them manually, refer to Manual setup on page 8-4-17.*

Using AutoLearn to adjust settings

WARNING:
The AutoLearn process requires a significant amount of CLEAR SEA SPACE in front of the boat. The autopilot will take the boat through a number of zig-zag maneuvers until it has acquired enough data. If you need to cancel the AutoLearn at any time, press the STANDBY button to gain manual control of the boat.

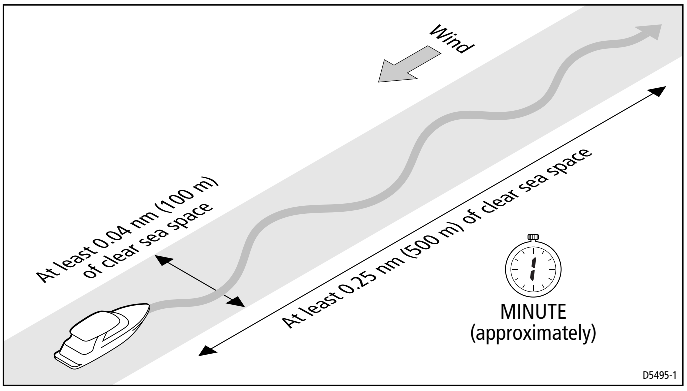


Figure 4-8: AutoLearn maneuvers

If you are using a 150G or 400G autopilot system, use AutoLearn to set rudder gain, counter rudder and rudder trim. Before commencing AutoLearn, ensure that you have at least the amount of clear sea space shown in *Figure 4-8* .

To carry out AutoLearn, enter Seatrial Calibration, then:

1. Use the button to scroll to the PILOT AUTOLEARN screen in Seatrial Calibration (*Figure 4-9*).
2. Use the ∧ or ∨ buttons to select ON.

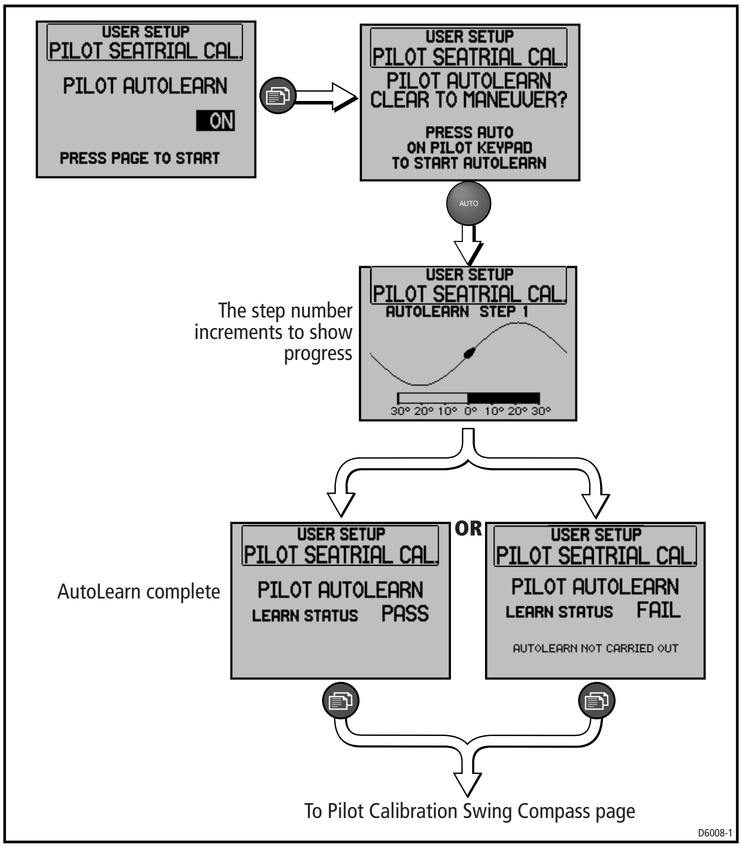


Figure 4-9: Using AutoLearn

3. Steer straight ahead, with the rudder centered and prepare to start the AutoLearn process:
   - **Power boats:** set the boat's speed between 8 and 15 knots. Planing boats should be **OFF** the plane.
   - **Sail boats:** with sails down, motor the boat at typical cruising speed.
   - If conditions are not calm, head **into** the wind and waves.
4. When you are ready to start the AutoLearn, press the button.

5. The screen will then show the CLEAR TO MANEUVER? message. Check that you have enough sea room to carry out the AutoLearn, and if so, press the Pilot Keypad **AUTO** button to start the AutoLearn process:
   - The boat will start the AutoLearn process.
   - The Graphic Display will show a learning progress screen. Progress is indicated by a number that increments as each AutoLearn step is completed.
   - A typical AutoLearn is completed in 7 to 27 steps, depending on boat characteristics and sea conditions.

Note: *If you need to cancel the AutoLearn for any reason, press the Pilot Keypad* **STANDBY** *button.*

6. When the autopilot has finished learning, the control unit will beep and a PILOT AUTOLEARN STATUS page is displayed. This shows:
   - PASS if the AutoLearn completed successfully.
   - FAIL if the AutoLearn was not successful. In this case, the AutoLearn should be repeated again.
     Common failure codes are:
     LRN FAIL 1 = AutoLearn has not been carried out.
     LRN FAIL 2 = AutoLearn failed, due to manual interruption.
     LRN FAIL 4 = AutoLearn failed, probably due to drive or compass failure.

   This completes the commissioning for 150G and 400G autopilot systems. The only setting you may now need to adjust is the response level (see *Section 8, Chapter 2*).

Manual set-up

The T150 or T400 (non-GyroPlus) autopilot systems do not support AutoLearn. If you have one of these systems, you need to manually adjust the rudder gain, counter rudder and AutoTrim settings, based on your observations of the boat's performance under autopilot control.

Adjust these settings when motoring your boat at cruising speed. On sail boats, repeat if necessary under sail to optimize the pilot.

Checking autopilot operation

Before manually adjusting any of these settings, familiarize yourself with basic autopilot operation:

1. Steer onto a compass heading and hold the course steady. If necessary, control the boat manually for a while to check how the boat steers.
2. At the Pilot Keypad, press the **AUTO** button, to lock onto the current heading. The autopilot should hold a constant heading in calm sea conditions.
3. Use the Pilot Keypad **-1**, **+1**, **-10** and **+10** buttons to check how the autopilot alters the course to port and starboard in multiples of 1° and 10°.
4. Press the Pilot Keypad **STANDBY** button, to return to hand steering.

Adjusting the rudder gain

Boats can vary widely in their response to helm, and by adjusting the rudder gain you can change the autopilot's steering characteristics. RUDDER GAIN is a measure of how much helm the autopilot applies to correct course errors – higher settings mean more rudder is applied.

You will find it easiest to recognize the steering response in calm sea conditions where wave action does not mask basic steering performance.

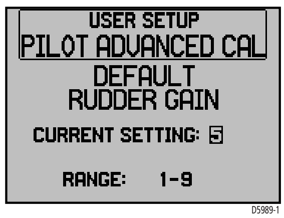
Complete the following test to determine whether the rudder gain is set correctly:

1. Set RESPONSE to level 2. To do this:
   i. At the Pilot Keypad, press the **RESP** button.
   ii. Use the **-1** or **+1** button to adjust the setting
   iii. Press the Pilot Keypad **DISP** button or wait for 10 seconds.
2. Sail your boat at cruising speed in clear water.
3. Press the Pilot Keypad **AUTO** button, to enter Auto mode, then using the **-10** or **+10** buttons, alter course by 40°:

- If the rudder gain is adjusted **correctly**, the 40° course change should result in a crisp turn followed by an overshoot of no more than 5°.
- If the rudder gain setting is **too high**, the 40° course change will result in a distinct overshoot of more than 5° and there may be a distinct 'S' in the course (see **A** in *Figure 4-10*).
  Correct this oversteer by **reducing** the rudder gain setting.
- If the rudder gain is **too low**, the boat's performance will be sluggish. It will take a long time to make the 40° turn and there will be no overshoot (see **B** in *Figure 4-10*).
  Correct this understeer by **increasing** the rudder gain setting.

If you need to adjust the rudder gain:

1. Access Pilot Advanced Calibration and use the button to scroll to the RUDDER GAIN screen.
2. Use the ∧ or ∨ button to adjust the rudder gain.
3. To save the setting change, press the button.



4. Press **AUTO** to check the autopilot performance in Auto mode.

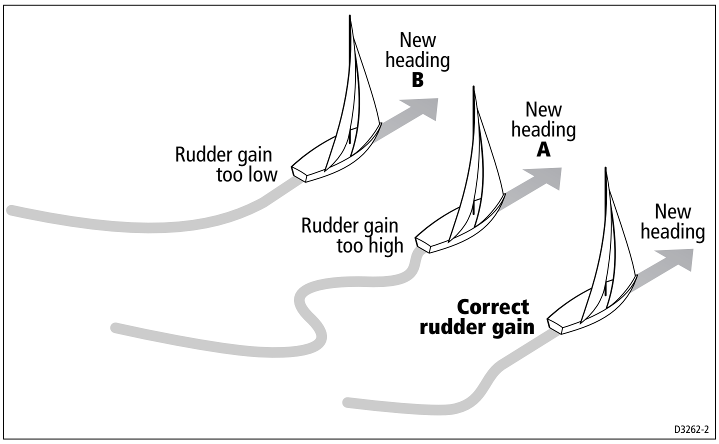


Figure 4-10:Rudder gain settings

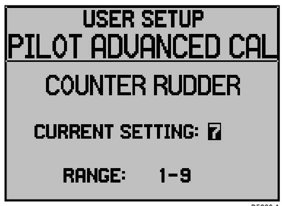
Adjusting the counter rudder

If you intend to use RESPONSE level 3 on a T150 or T400 (non-GyroPlus) autopilot system, you will need to adjust the COUNTER RUDDER. Counter rudder is the amount of rudder the autopilot applies to control the yaw of the boat. Higher counter rudder settings result in more rudder being applied. The adjustment range is from 1 to 9.

To check the counter rudder setting:

1. Set RESPONSE to level 3. To do this:
   i. At the Pilot Keypad, press the **RESP** button.
   ii. Use the **-1** or **+1** button to adjust the setting.
   iii. Press the Pilot Keypad **DISP** button or wait for 10 seconds.
2. Sail your boat at cruising speed in clear water.
3. At the Pilot Keypad, press **AUTO** to switch the autopilot to Auto mode, then use the **-10** and **+10** buttons to make a 90° course change:
   - When gain and counter rudder are both set correctly, the boat performs a smooth continuous turn with minimal overshoot.
   - If the counter rudder is too low, the boat will still overshoot.
   - If counter rudder is too high, the boat will 'fight' the turn and make a series of short, sharp turns: this results in a very 'mechanical' feel as the boat changes course.

To adjust the counter rudder:



1. Access Pilot Advanced Calibration and use the button to scroll to the COUNTER RUDDER screen.
2. Use the ∧ or ∨ button to adjust the rudder level. The adjustment can be made from 1 to 9.
3. To save the setting change, press the button.
4. Press **AUTO** to check the autopilot performance in Auto mode.

This completes the commissioning for T150 and T400 autopilot systems, although over time it may be necessary to repeat the adjustments for T150 or T400 (non-GyroPlus) autopilot systems, for a range of sea conditions and headings, to maintain good overall performance (see *Further adjustments* below).

Further adjustments

You may also need to adjust the RUDDER TRIM setting. Rudder trim determines how quickly the autopilot applies 'standing helm' to correct for trim changes, caused for example, by changes in the wind load on the sails or superstructure, or an imbalance of engines.

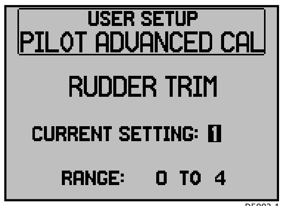
Before attempting to adjust the rudder trim setting, use your autopilot for a period of time, to gain experience. On sail boats you can only evaluate the effect of rudder trim while under sail.

Although an increase in rudder trim level reduces the time the autopilot takes to get back onto the correct course, it also makes the boat less stable. Therefore:

- If the autopilot gives unstable course keeping and the boat snakes around the desired course, **decrease** the rudder trim level.
- If the autopilot hangs off course for excessive periods of time, **increase** the rudder trim level.

If necessary, use the RUDDER TRIM screen to change the setting. The possible settings range from OFF (no trim correction) to 4 (fastest trim correction). Always adjust in single steps and use the **lowest** acceptable value.

To adjust the Rudder Trim:



D5992-1

1. Access Pilot Advanced Calibration and use the button to scroll to the RUDDER TRIM screen.
2. Use the ∧ or ∨ button to adjust the rudder trim level.
3. To save the setting change, press the button.
4. Press **AUTO** to check the autopilot performance in Auto mode.

Note: *150G and 400G autopilots have a 'FastTrim' feature within Rudder Trim. Select* RUDDER TRIM OFF *to disable both FastTrim and Rudder Trim.*

Chapter 5: Adjusting Autopilot Settings

5.1 Introduction

This chapter is intended primarily as reference material to provide an overall picture of the autopilot calibration settings you can adjust to best suit your operating requirements, and to give details of the autopilot factory default settings. You will have adjusted many of these settings when commissioning the system, and they should not require further adjustment.

Note: *Before adjusting any calibration settings, complete the commissioning procedures described in Section 8, Chapter 4.*

Calibration groups

There are three pilot calibration groups, namely Pilot Basic, Pilot Seatrial and Pilot Advanced Calibration.

Each calibration group uses a series of screens to set calibration values. The exact structure of each group is dependent on which Vessel Type is selected in Pilot Advanced Calibration. For example, if POWER BOAT is selected, some options relating to wind settings will not be available.

Pilot Basic Calibration

The Pilot Basic Calibration settings are those you may need to change on a regular basis, to optimize performance in changing conditions.

Pilot Seatrial Calibration

As Pilot Seatrial Calibration is specifically designed for use during the initial autopilot seatrial (see *Section 8, Chapter 4*), you should not need to change these settings during normal autopilot operation.

Pilot Advanced Calibration

Pilot Advanced Calibration has a significant impact on autopilot operation and can affect your boat's safety. You should not normally need to alter the Pilot Advanced Calibration values, once you have completed the initial installation and seatrial.

Pilot Advanced Calibration should be carried out only by suitably-qualified personnel. **DO NOT** attempt to use these procedures if you do not have an in-depth knowledge of setting up Raymarine autopilots

5.2 Accessing Pilot Calibration

To carry out Pilot calibration procedures, use an ST290 Graphic Display, with PILOT CAL enabled, as follows:

1. Enter the ST290 User Setup mode (see *Section 7, System Setup*).
2. Use the button to move to the required Pilot setup chapter, either, PILOT BASIC CAL, PILOT SEATRIAL CAL or PILOT ADVANCED CAL.
3. Adjust the required settings.

General instructions

Throughout this chapter, all button presses are made at the Graphical Display unless otherwise stated.

When you enter a pilot calibration screen, press the button to move between the individual calibration pages, or hold down the button to move backwards through the calibration pages. Use the ∧ or ∨ buttons to alter calibration values.

To move to the next setting press the button or to leave the current calibration chapter and save all setting changes, press the button.

Note: *You must leave the calibration chapter by using the button to save all calibration changes. If the system loses power or is powered off before this stage then all configuration changes made will be lost.*

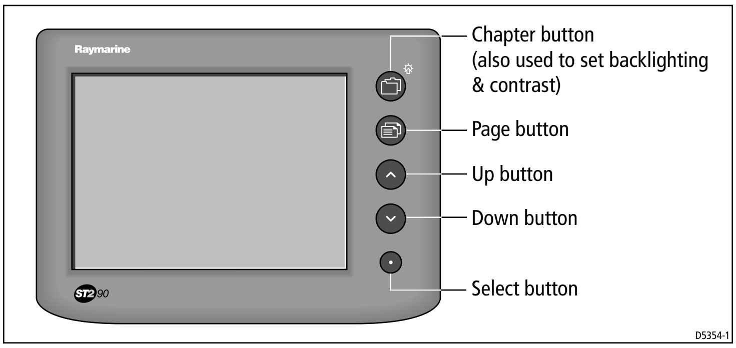


Figure 5-1: The ST290 Graphic Display

5.3 Pilot Basic Calibration

With the PILOT BASIC CAL chapter selected at an ST290 Graphic Display, use the button to move to the required setup screen. Typical PILOT BASIC CAL screens are shown in *Figure 5-2* .

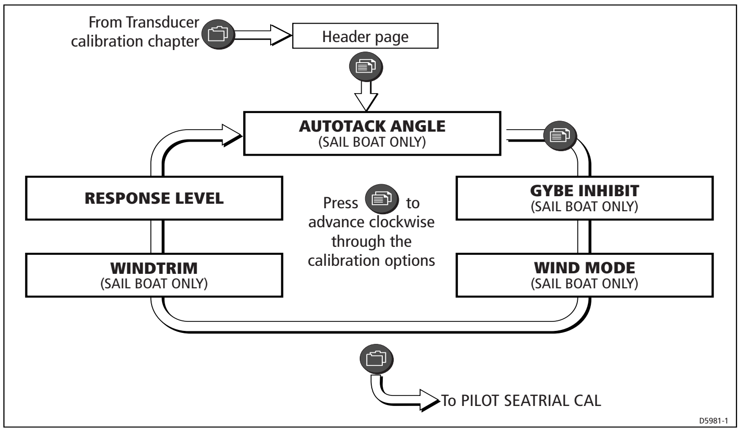


Figure 5-2: Pilot Basic calibration

AutoTack angle

Note: The AUTOTACK ANGLE *function is only active if the vessel type is set as* SAIL BOAT.

The AutoTack angle is the angle through which the boat will turn when you select an automatic tack.

Relative (Mirror) tacks

You can also set the AUTOTACK ANGLE function to perform relative tacks.

When a relative tack is executed, the boat turns so that the angle to the wind is mirrored.

If you wish to use relative tacking, set the AUTOTACK ANGLE parameter to RELATIVE.

Note: *When using AutoTack in wind vane mode, your system will automatically trim to the mirrored angle having turned through the set angle first.*

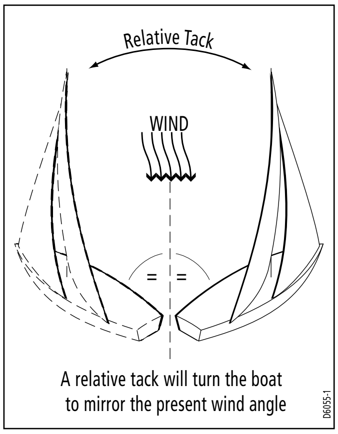
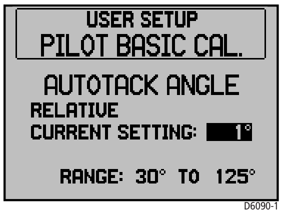


Figure 5-3: Relative Tacks

To configure AUTOTACK ANGLE:



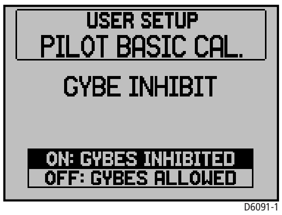
1. Use the button to scroll to the AUTOTACK ANGLE page.
2. Use the ∧ or ∨ button to adjust the Auto Tack angle. The adjustment can be made from 40° to 125°, in 1° steps. To set a relative tack, press the ∨ button when the value reads 40° and the value RELATIVE will be displayed.
3. To move to the next setting press the button, or to leave the current calibration chapter and save all setting changes, press the button.

Gybe inhibit

Note: The GYBE INHIBIT *function is only active if the vessel type is set as* SAIL BOAT.

The gybe inhibit feature can prevent accidental gybes by not allowing AutoTacks away from the wind.

To configure GYBE INHIBIT:



1. Use the button to scroll to the GYBE INHIBIT page.
2. Use the ∧ or ∨ button to select or deselect Gybe Inhibit.

   With GYBE INHIBIT ON, you can only perform an AutoTack into the wind.

   With GYBE INHIBIT OFF, you can perform an AUTO TACK into or away from the wind
3. To move to the next setting press the button, or to leave the current calibration chapter and save all setting changes, press the button.

Wind mode

Note: The WIND MODE *function is only active if the vessel type is set as* SAIL BOAT *and appropriate wind data is present.*

Use the WIND MODE screen to determine whether the boat steers to the APPARENT or TRUE wind angle in WIND VANE mode.

To configure WIND MODE:

1. Use the button to scroll to the WIND MODE page.
2. Use the ∧ or ∨ button to select true or apparent wind mode.
3. To move to the next setting press the button, or to leave the current calibration chapter and save all setting changes, press the button.

D6092-1

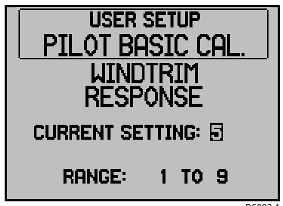
WindTrim response

Note: The WINDTRIM RESPONSE *function is only active if the vessel type is set as* SAIL BOAT.

Use the WINDTRIM RESPONSE screen to determine how quickly the autopilot responds to changes in the wind direction.

To configure WINDTRIM RESPONSE:

1. Use the button to scroll to the WINDTRIM RESPONSE page.
2. Use the ∧ or ∨ button to select the response level. The adjustment can be made from 1 to 9 and typical settings are between 4 and 6.



D6093-1

3. To move to the next setting press the button, or to leave the current calibration chapter and save all setting changes, press the button.

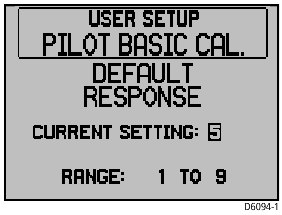
If a lower value (1 to 3) is used, the autopilot responds to longer term changes in wind resulting in less autopilot activity.

If a higher value (7 to 9) is used, the autopilot responds to shorter term changes in wind resulting in more autopilot activity.

Response level

The autopilot response level controls the relationship between course keeping accuracy and the amount of helm/drive activity. Although you can make temporary changes to response during normal operation, the DEFAULT RESPONSE value you set here is the response level at power up.

To configure DEFAULT RESPONSE:



1. Use the button to scroll to the DEFAULT RESPONSE page.
2. Use the ∧ or ∨ button to select the response level. The adjustment can be made from 1 to 9 *(1 to 3 for T150 & T400 systems - see below)*
3. To move to the next setting press the button, or to leave the current calibration chapter and save all setting changes, press the button.

150G & 400G autopilot systems

150G and 400G autopilot systems have nine response level options:

Level 1 gives the least pilot activity to conserve power, but may compromise short-term course-keeping accuracy

Levels 4 to 6 should give good course keeping with crisp, well-controlled turns under normal operating conditions

Level 9 gives the tightest course keeping and greatest rudder activity, but may lead to a rough passage in open waters as the autopilot may ‘fight’ the sea

T150 & T400 autopilot systems

T150 and T400 (non-GyroPlus) autopilot systems have three response level options:

Level 1 - AutoSeastate on (Automatic deadband)

- Autopilot gradually ignores repetitive boat movements and only reacts to true variations in course
- Provides the best compromise between power consumption and course keeping accuracy

Level 2 - AutoSeastate off (minimum deadband)

- Provides tighter course keeping
- Increased power consumption and drive unit activity

Level 3 - AutoSeastate off and counter rudder yaw damping.

- Provides tightest possible course keeping by introducing counter rudder yaw damping

5.4 Pilot Seatrial Calibration

The Seatrial Calibration group is specifically intended for use during the initial seatrial when commissioning your autopilot. Refer to *Section 8, Chapter 4*, for details.

You should not need to access Seatrial Calibration to adjust settings during normal autopilot operation.

5.5 Pilot Advanced Calibration

WARNING:
Many of the Pilot Advanced Calibration procedures affect your boat's safety, and should therefore be carried out only by suitably-qualified personnel. Do not attempt any of these procedures if you do not have an in-depth knowledge of the requirement for setting up Raymarine autopilots.

The Pilot Advanced Calibration group includes items that have a significant impact on autopilot operation, and is therefore intended for use only by autopilot engineers.

If you have successfully carried out the Pilot Basic Calibration procedures earlier in this chapter and have commissioned the autopilot using the procedures in *Section 8, Chapter 4*, you should not normally need to alter the Pilot Advanced Calibration values.

The items in Pilot Advanced Calibration vary according to the vessel type you have selected. See the table on *page 8-5-23* for default values.

Calibration structure

The structure of the Pilot Advanced Calibration procedures, is shown in *Figure 5-4*

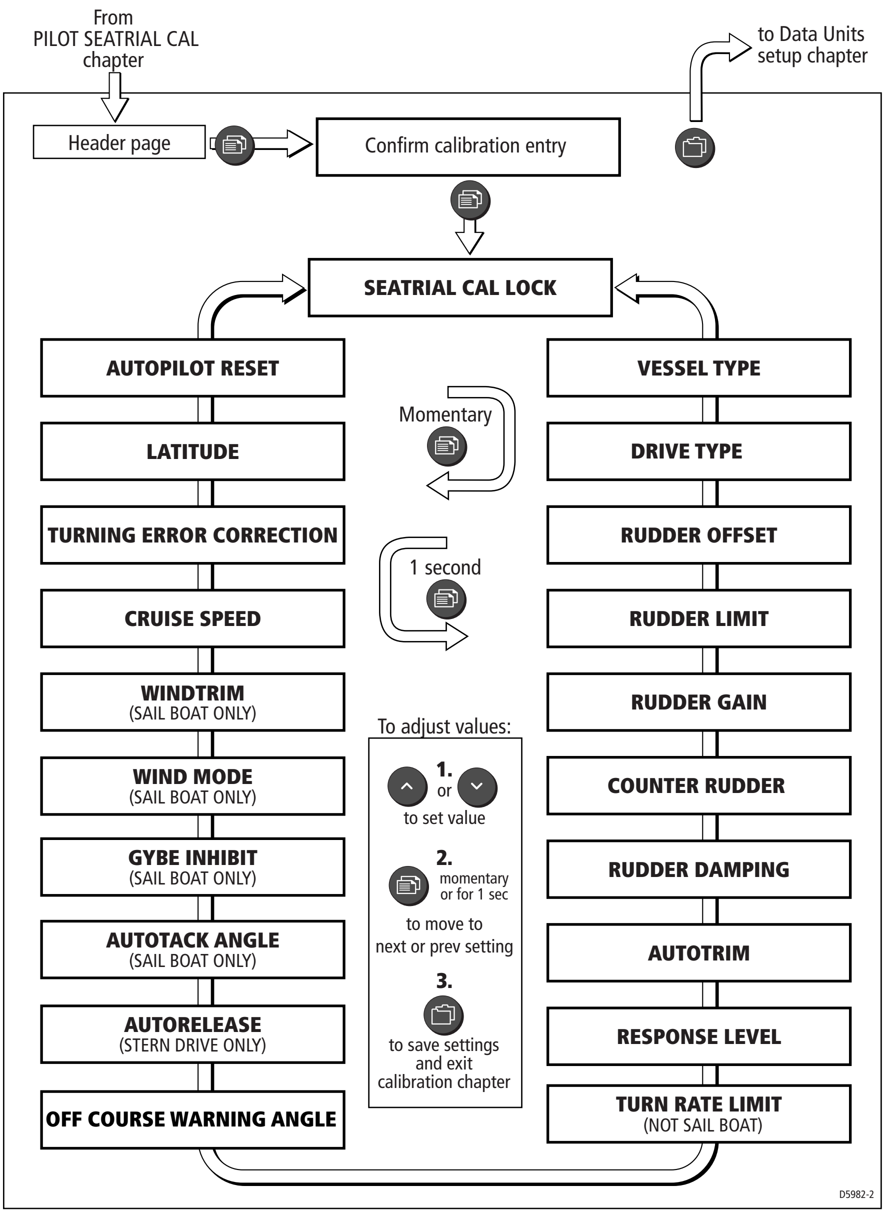


Figure 5-4: Pilot Advanced Calibration

SeaTrial Calibration lock

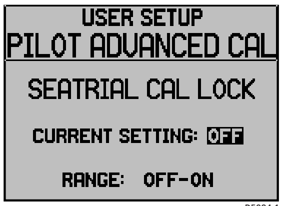
This SEATRIAL CAL LOCK screen enables you to lock and unlock access to the Seatrial Calibration screens.

To configure SEATRIAL CAL LOCK:

1. Use the button to scroll to the SEATRIAL CAL LOCK page.
2. Use the ∧ or ∨ button to select:

   OFF - to give access to the Seatrial calibration routines.

   ON - to prevent access to the Seatrial calibration routines.



D5984-1

3. To move to the next setting press the button, or to leave the current calibration chapter and save all setting changes, press the button.

Vessel type

This should be set when commissioning the autopilot (see *Section 8, Chapter 4*). To configure VESSEL TYPE:

1. Use the button to scroll to the VESSEL TYPE page.
2. Use the ∧ or ∨ button to select the appropriate vessel type. The options are:

   SAIL BOAT

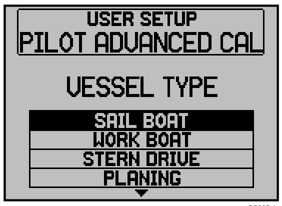
   WORK BOAT

   STERN DRIVE- Planing powerboat with I/O drive (stern drive).

   PLANING - Planing powerboat.

   SEMI-DISPLACEMENT - Semi-displacement powerboat.

   DISPLACEMENT - Displacement powerboat.



D5985-1

3. To move to the next setting press the button, or to leave the current calibration chapter and save all setting changes, press the button.

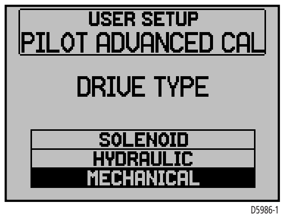
Note: *When you choose the vessel type, the autopilot will set appropriate defaults for the other calibration settings. Refer to the table at the end of this section for default values.*

Drive type

Use the DRIVE TYPE screen to set the appropriate autopilot drive type for your vessel. This should be set when commissioning the autopilot (see *Section 8, Chapter 4*).

To configure DRIVE TYPE:

1. Use the button to scroll to the DRIVE TYPE page.
2. Use the ∧ or ∨ button to highlight the appropriate drive type. The options are:
   SOLENOID - for solenoid valve, spool valve or constant running pump drive systems.
   HYDRAULIC - for hydraulic drives.
   MECHANICAL - for mechanical drives.

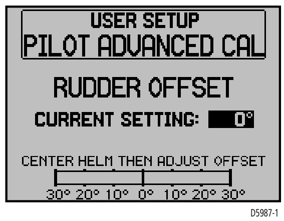


3. To move to the next setting press the button, or to leave the current calibration chapter and save all setting changes, press the button.

Rudder offset

Use the RUDDER OFFSET screen to center the rudder bar display after installing the autopilot system. To configure RUDDER OFFSET:

1. Use the button to scroll to the RUDDER OFFSET page.
2. Use the wheel to manually center the rudder.
3. Use the ∧ or ∨ button to adjust the bar graph to zero. The adjustment can be made from -7°to +7°, in 1°steps.
4. To move to the next setting press the button, or to leave the current calibration chapter and save all setting changes, press the button.



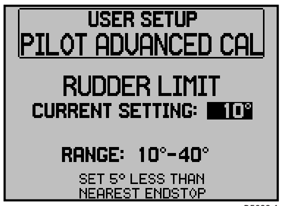
Note: *You can also zero the rudder bar with the boat underway during the initial seatrial, by manually steering a straight course then accessing the* RUDDER OFFSET *screen in Seatrial Calibration, to adjust the offset.*

Rudder limit

Use the RUDDER LIMIT screen to set the limits of autopilot rudder control just inside the mechanical end stop, to avoid putting the steering system under unnecessary load.

To configure RUDDER LIMIT:

1. Use the button to scroll to the RUDDER LIMIT page.
2. Use the ∧ or ∨ button to adjust the limit value. The adjustment can be made from 10° to 40°, in 1° steps
3. To move to the next setting press the button, or to leave the current calibration chapter and save all setting changes, press the button.



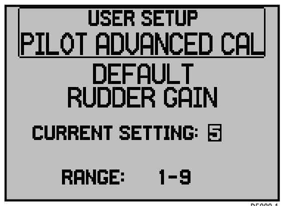
D5988-1

Rudder gain

Use the RUDDER GAIN screen to set the default rudder gain setting. Rudder gain is a measure of how much helm the autopilot will apply to correct course errors. The higher the setting the more rudder will be applied. You can make temporary changes to the rudder gain value during normal operation (see *Section 8, Chapter 2*).The default rudder gain is usually set during the initial seatrial.

If you need to adjust the rudder gain:

1. Use the button to scroll to the DEFAULT RUDDER GAIN screen.
2. Use the ∧ or ∨ button to adjust the rudder gain.
3. To move to the next setting press the button, or to leave the current calibration chapter and save all setting changes, press the button.



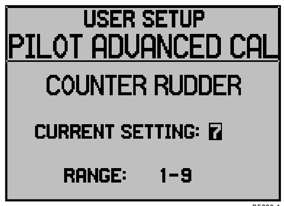
D5989-1

Note: *The rudder gain on 150G and 400G autopilots is adjusted automatically during the AutoLearn process. Manual adjustment of Rudder gain is required for T150 and T400 autopilots (see Section 8, Chapter 4).*

Counter rudder

Use the COUNTER RUDDER screen to set the required counter rudder value. Counter rudder is the amount of rudder the autopilot applies, to control the yaw of the boat. Higher counter rudder settings result in more rudder being applied. The default rudder gain is set during the initial seatrial.

To adjust the counter rudder:



D5990-1

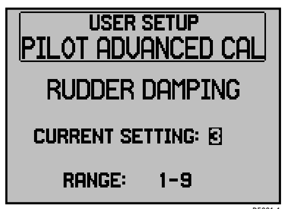
1. Use the button to scroll to the COUNTER RUDDER screen.
2. Use the ∧ or ∨ button to adjust the counter rudder level The adjustment can be made from 1 to 9.
3. To move to the next setting press the button, or to leave the current calibration chapter and save all setting changes, press the button.

Note: *Counter rudder on 150G and 400G autopilots is adjusted automatically during the AutoLearn process. Manual adjustment of Counter rudder is required for T150 and T400 autopilots (see Section 8, Chapter 4).*

Rudder damping

If the autopilot 'hunts' when trying to position the rudder (see *Section 8, Chapter 4*), adjust the rudder damping value by using the RUDDER DAMPING screen to set a different value. Increasing the rudder damping value reduces hunting.

To adjust the rudder damping:



D5991-1

1. Use the button to scroll to the RUDDER DAMPING page.
2. Use the ∧ or ∨ button to select the required value. The adjustment can be made from 1 to 9.
3. To move to the next setting press the button, or to leave the current calibration chapter and save all setting changes, press the button.

Rudder trim

The RUDDER TRIM setting determines the rate at which the autopilot applies ‘standing helm’ to correct for trim changes caused by varying wind loads on the sails or superstructure or an imbalance of engines.

The default rudder trim is set when commissioning the autopilot:

- 150G and 400G autopilots will adjust the AutoTrim setting automatically during the AutoLearn (see *Section 8, Chapter 4*).
- T150 and T400 require manual adjustment of Rudder Trim (see *Section 8, Chapter 4*) after the initial seatrial.

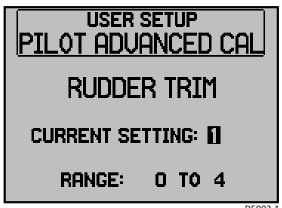
Before attempting to adjust the rudder trim setting, use your autopilot for a period of time, to gain experience. On sail boats you can only evaluate the effect of rudder trim while under sail.

Although an increase in rudder trim level reduces the time the autopilot takes to get back onto the correct course, it also makes the boat less stable. Therefore:

- If the autopilot gives unstable course keeping and the boat snakes around the desired course, **decrease** the rudder trim level.
- If the autopilot hangs off course for excessive periods of time, **increase** the rudder trim level.

If necessary, use the RUDDER TRIM screen to change the setting. The possible settings range from OFF (no trim correction) to 4 (fastest trim correction). Always adjust in single steps and use the **lowest** acceptable value.

To adjust the Rudder Trim:



1. Use the button to scroll to the RUDDER TRIM screen.
2. Use the ∧ or ∨ button to adjust the rudder trim level.
3. To move to the next setting press the button, or to leave the current calibration chapter and save all setting changes, press the button.

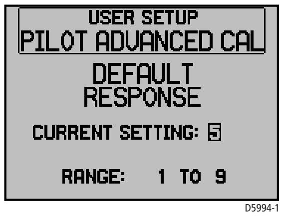
Note: *150G and 400G autopilots have a ‘FastTrim’ feature within Rudder Trim. Select* RUDDER TRIM OFF *to disable both FastTrim and Rudder Trim.*

Response level

Use the DEFAULT RESPONSE screen to set the autopilot response. The autopilot response level controls the relationship between course keeping accuracy and the amount of helm/drive activity. Although you can make temporary changes to response during normal operation, the value you set here is the response level at power up.

To configure the default response:

1. Use the button to scroll to the DEFAULT RESPONSE page.
2. Use the ∧ or ∨ button to select the response level. The adjustment can be made from 1 to 9 *(1 to 3 for T150 & T400 systems - see below).*
3. To move to the next setting press the button, or to leave the current calibration chapter and save all setting changes, press the button.



150G & 400G autopilot systems

150G and 400G autopilot systems have nine response level options:

Level 1 gives the least pilot activity to conserve power, but may compromise short-term course-keeping accuracy

Levels 4 to 6 should give good course keeping with crisp, well-controlled turns under normal operating conditions

Level 9 gives the tightest course keeping and greatest rudder activity, but may lead to a rough passage in open waters as the autopilot may ‘fight’ the sea

T150 & T400 autopilot systems

T150 and T400 (non-GyroPlus) autopilot systems have three response level options:

Level 1 - AutoSeastate on (Automatic deadband)

- Autopilot gradually ignores repetitive boat movements and only reacts to true variations in course
- Provides the best compromise between power consumption and course keeping accuracy

Level 2 - AutoSeastate off (minimum deadband)

- Provides tighter course keeping
- Increased power consumption and drive unit activity

Level 3 - AutoSeastate off and counter rudder yaw damping.

- Provides tightest possible course keeping by introducing counter rudder yaw damping

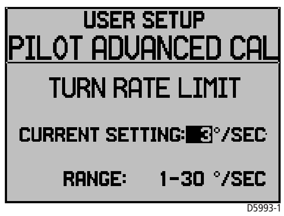
Turn rate limit

Note: *Not available if the vessel type is set to* SAIL BOAT.

Use the TURN RATE LIMIT screen to set the maximum turn rate allowable under autopilot control.

To adjust the turn rate limit:

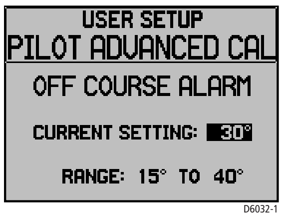
1. Use the button to scroll to the TURN RATE LIMIT page.
2. Use the ∧ or ∨ button to select the required value. The adjustment can be made from 1°per second to 30°per second in 1°steps.
3. To move to the next setting press the button, or to leave the current calibration chapter and save all setting changes, press the button.



Off course warning angle

Use the OFF COURSE ALARM screen to set the angle which will activate the Off Course warning. This sounds if the pilot strays off course by more than the specified angle for more than 20 seconds.

To adjust the off course alarm:



1. Use the button to scroll to the OFF COURSE ALARM page.
2. Use the ∧ or ∨ button to select the required value. The adjustment can be made from 15° to 40° in 1° steps.
3. To move to the next setting press the button, or to leave the current calibration chapter and save all setting changes, press the button.

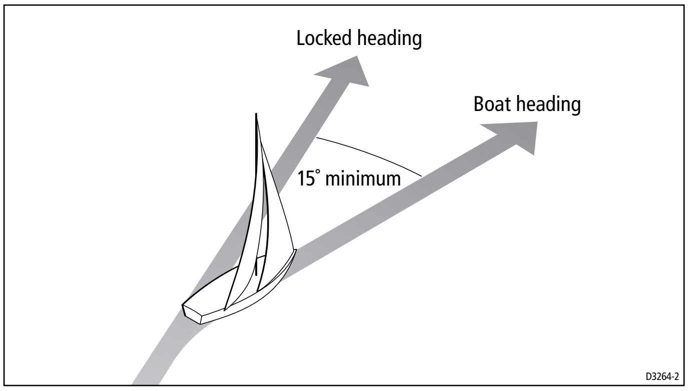


Figure 5-5: Off course warning angle

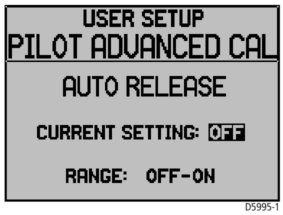
AutoRelease (I/O drives only)

Note: *AutoRelease is only available if the vessel type is set to* STERN-DRIVE.

AutoRelease provides emergency manual over-ride in situations when you need to avoid an obstacle at the last moment. If the vessel type is set to STERN DRIVE (I/O or stern drive), the default setting is AutoRelease ON.

To adjust the AutoRelease setting:

1. Use the button to scroll to the AUTO RELEASE page.
2. Use the ∧ or ∨ button to select ON or OFF.
3. To move to the next setting press the button or to leave the current calibration chapter and save all setting. changes, press the button.



AutoTack angle

Note: *The autotack angle function is active only if the vessel type is set as* SAIL BOAT.

The AutoTack angle is the angle through which the boat will turn when you select an automatic tack.

Relative (Mirror) tacks

You can also set the AUTOTACK ANGLE function to perform relative tacks.

When a relative tack is executed, the boat turns so that the angle to the wind is mirrored.

If you want to use relative tacking, set the AUTOTACK ANGLE parameter to RELATIVE.

Note: *When using AutoTack in wind vane mode, your system will automatically trim to the mirrored angle having turned through the set angle first.*

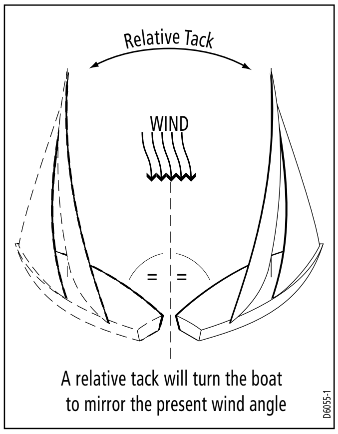
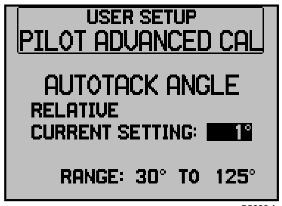


Figure 5-6: Relative Tacks

To configure the AutoTack angle:

1. Use the button to scroll to the AUTOTACK ANGLE page.
2. Use the ∧ or ∨ button to adjust the Auto Tack angle. The adjustment can be made from 40° to 125°, in 1° steps. To set a relative tack, press the ∨ button when the value reads 40° and the value RELATIVE will be displayed.



D5996-1

3. To move to the next setting press the button, or to leave the current calibration chapter and save all setting changes, press the button.

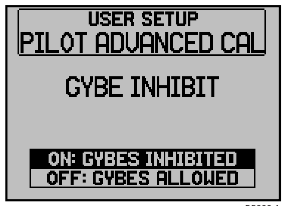
Gybe inhibit

Note: *The gybe inhibit function is active only if the vessel type is set as* SAIL BOAT.

The gybe inhibit function can prevent accidental gybes by not allowing AutoTacks away from the wind.

To configure the gybe inhibit function:

1. Use the button to scroll to the GYBE INHIBIT page.
2. Use the ∧ or ∨ button to make the required selection:
   - ON GYBES INHIBITED, you can only perform an AutoTack into the wind.
   - OFF GYBES ALLOWED, you can perform an AutoTack into or away from the wind



D5999-1

3. To move to the next setting press the button, or to leave the current calibration chapter and save all setting changes, press the button.

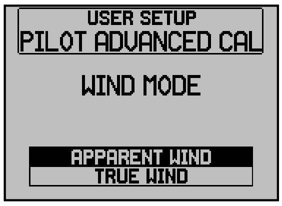
Wind mode

Note: The *Wind mode function is active only if the vessel type is set as SAIL BOAT and appropriate wind data is present.*

Use the WIND MODE screen to determine whether the boat steers to the APPARENT or TRUE wind angle in Wind Vane mode.

To configure the Wind mode:

1. Use the button to scroll to the WIND MODE page.
2. Use the ∧ or ∨ button to select APPARENT WIND or TRUE WIND.
3. To move to the next setting press the button, or to leave the current calibration chapter and save all setting changes, press the button.



D5997-1

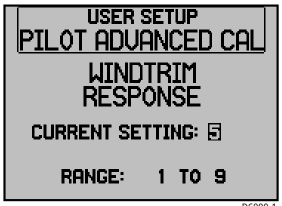
WindTrim response

Note: *The WindTrim response function is active only if the vessel type is set as* SAIL BOAT.

Use the WINDTRIM RESPONSE screen to determine how quickly the autopilot responds to changes in the wind direction.

To configure the WindTrim response:

1. Use the button to scroll to the WINDTRIM RESPONSE page.
2. Use the ∧ or ∨ button to select the response level. The adjustment can be made from 1 to 9 and typical settings are between 4 and 6.
3. To move to the next setting press the button, or to leave the current calibration chapter and save all setting changes, press the button.



D6000-1

If a lower value (1 to 3) is used, the autopilot responds to longer term changes in wind resulting in less autopilot activity.

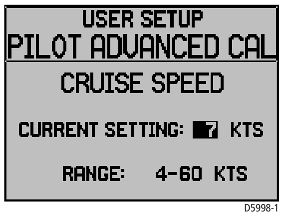
If a higher value (7 to 9) is used, the autopilot responds to shorter term changes in wind resulting in more autopilot activity.

Cruise speed

Use the CRUISE SPEED screen to define the boat's typical cruising speed.This is the speed the autopilot will use to compute course changes, if both the boat's speed through the water and speed over ground readings are unavailable.

To adjust the cruise speed:

1. Use the button to scroll to the CRUISE SPEED page.
2. Use the ∧ or ∨ button to adjust the Cruise Speed. The adjustment can be made from 4 to 60 knots.
3. To move to the next setting press the button, or to leave the current calibration chapter and save all setting changes, press the button.



Turning error correction (T150 and T400 systems only)

Turning error correction allows the autopilot to compensate for heading errors, which are caused by the increasing dip of the earth's magnetic field at higher latitudes. The increased dip has the effect of amplifying rudder response on northerly headings in the northern hemisphere, and on southerly headings in the southern hemisphere.

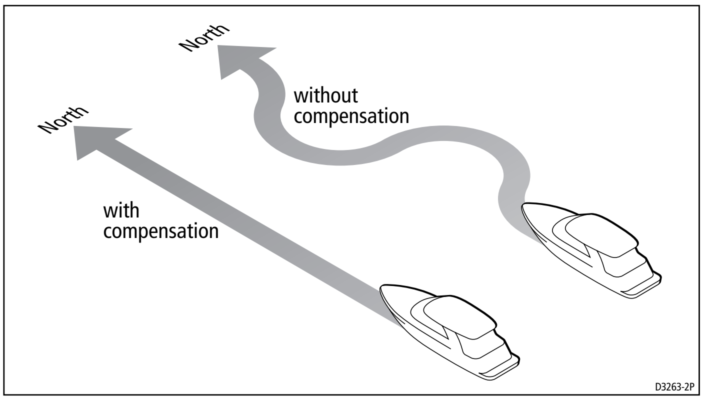
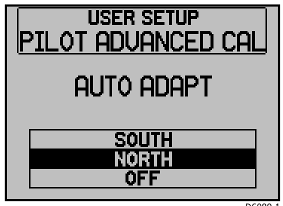


Figure 5-7: Turning error correction

To set the required correction:

1. Use the button to scroll to the AUTO ADAPT page.
2. Use the ∧ or ∨ button to select the required setting. The options are:
   - OFF - no correction.
   - NORTH - correction for northern hemisphere.
   - SOUTH - correction for southern hemisphere.



D6089-1

To move to the next setting press the button, or to leave the current calibration chapter and save all setting changes, press the button.

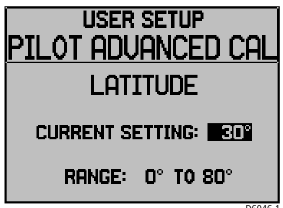
If you select either NORTH or SOUTH, you must then use the LATITUDE screen to enter your current latitude, so that the autopilot can provide accurate course keeping by automatically adjusting the rudder gain depending on the heading.

Latitude

Note: *The* LATITUDE *screen is available only if you have set Turning Error Correction to* NORTH *or* SOUTH.

To set the latitude:

1. Use the button to scroll to the LATITUDE page.
2. Use the ∧ or ∨ button to select the latitude. The adjustment can be made from 0° to 80° in 1° steps.
3. To move to the next setting press the button, or to leave the current calibration chapter and save all setting changes, press the button.



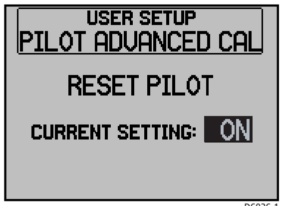
D6046-1

Autopilot reset

WARNING:
Do NOT use this feature unless advised to do so by a Raymarine dealer. If you complete a reset you will lose ALL autopilot calibration settings. You will then need to repeat the autopilot commissioning process.

Selecting an autopilot reset will reset all of the settings in Basic Calibration, Seatrial Calibration and Advanced Calibration to the factory default values.

To reset the autopilot:

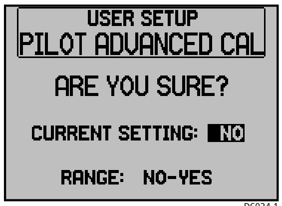


D6036-1

1. Use the button to scroll to the RESET PILOT page.
2. Use the ∧ button to set the CURRENT SETTING ON.
3. Press the button. You will then see an ARE YOU SURE? message. Either:
   - Press the ∧ button again to select YES and reset the autopilot.

   OR

   - If you want to cancel, ensure that NO is selected and press the button to leave Pilot calibration.



D6034-1

4. To save the setting change, turn the course computer power off and back on.

Pilot Advanced Calibration defaults

Calibration setting	Vessel type						
	Factory default	Displacement	Semi Displacement	Planing	Stern drive (I/O)	Work boat	Sail boat
Calibration lock	OFF	OFF	OFF	OFF	OFF	OFF	OFF
Vessel type	0	DISPLACE	SEMI DISPLACE	PLANING	STERN DRIVE	WORK BOAT	SAIL BOAT
Drive type	MECHAN ICAL	HYDRA ULIC	HYDRA ULIC	HYDRA ULIC	MECHAN ICAL	SOLENOID	MECHAN ICAL
Rudder offset	0	0	0	0	0	0	0
Rudder limit	30	30	30	20	20	30	30
Rudder gain	4	5	4	4	4	5	2
Counter rudder	4	3	5	5	5	2	2
Rudder damping	2	2	2	2	2	3	2
Rudder trim	2	2	3	3	3	2	1
Response: with G non-G	5 2	5 2	5 2	5 2	5 2	5 2	5 2
Turn rate limit	5	5	5	5	5	5	---
Off course angle	20	20	20	20	20	20	20
AutoRelease	OFF	---	---	---	ON	---	---
AutoTack angle	100	---	---	---	---	---	100
Gybe inhibit	ON	---	---	---	---	---	ON
Wind mode	APPARENT	---	---	---	---	---	APPARENT
WindTrim response	5	---	---	---	---	---	5
Cruise speed	8	8	8	8	20	8	8
Turning error corr.	NORTH	NORTH	NORTH	NORTH	NORTH	NORTH	NORTH
Latitude	0	0	0	0	0	0	0
Autopilot reset	OFF	OFF	OFF	OFF	OFF	OFF	OFF

Advanced Calibration options

Calibration setting	Options	Your settings
Calibration lock	OFF, ON	
Vessel type	DISPLACEMENT, SEMI DISPLACEMENT, PLANING, STERN DRIVE, WORK BOAT, SAIL BOAT	
Drive type	MECHANICAL, HYDRAULIC, SOLENOID, UNIVERSAL I/O, STANDARD I/O	
Rudder offset	-7 to +7	
Rudder limit	10 to 40	
Rudder gain	1 to 9	
Counter rudder	1 to 9	
Rudder damping	1 to 9	
Rudder trim	0 to 4	
Response	1 to 9 (150G/400G) 1 to 3 (T150/T400)	
Turn rate limit	1 to 30 (NOT Sailboat)	
Off course angle	15 to 40	
AutoRelease	OFF, ON (Sterndrive only)	
AutoTack angle	30 to 125 (Sailboat only)	
Gybe inhibit	OFF, ON (Sailboat only)	
Wind mode	APPARENT, TRUE (Sailboat only)	
WindTrim response	1 to 9 (Sailboat only)	
Cruise speed	4 to 60	
Turning error corr.	OFF, NORTH, SOUTH	
Latitude	0 to 80	
Autopilot reset	OFF, ON	

Section 9: Glossary

Glossary

AST	Advanced Steering Technology. Inputs from a wide variety of sensors are used to tune autopilot operation and provide superior control of the boat in any condition.
AutoLearn	Autopilot self-learning calibration feature. Available on 150G and 400G autopilot systems.
AutoTrim	AutoTrim determines the rate at which the autopilot applies 'standing helm' to correct for trim changes caused by varying wind loads on the sails or superstructure.
AVE	Average
AWA	Apparent Wind Angle (relative to the vessel)
AWS	Apparent Wind Speed
BTW	Bearing To Waypoint
CAN	Control Area Network
COG	Course Over Ground. Available from GPS.
Counter rudder	The amount of rudder an autopilot applies to try to prevent the boat from yawing off course. Higher settings result in more rudder being applied.
CTS	Course To Steer
DMG	Distance Made Good
DTW	Distance To Waypoint
ETA	Estimated Time of Arrival
GAL	Gallon(s)
GPS	Global Positioning System
G/H	Gallons per hour

GTO	Great Circle
GyroPlus	An autopilot yaw sensor that measures the boat's rate of turn. It is built into the 150G and 400G course computers, and is an option for T150 and T400 course computers.
KM	Kilometer(s)
KM/H	Kilometers per hour
KTS	Knots
L/H	Liters per hour
LTR	Liter(s)
MPH	Miles per hour
NM	Nautical mile(s)
NMEA	National Maritime Electronics Association. The NMEA provides protocols which define an internationally accepted serial communication interface standards for sharing data between electronic equipment. The ST290 system can share information with non-SeaTalk equipment using the NMEA 0183 and NMEA 2000 protocols.
Profile	A group of instrument chapters and pages to suit a specific purpose, e.g. Sail or Power.
Response	The sensitivity of an instrument, to data changes.
SeaTalk & **SeaTALK^2**	Raymarine proprietary communication systems, each of which links products to provide a single, integrated system sharing power and data.
SM	Statute mile(s)
Smart Heading Sensor	Source of ST290 heading information
SOG	Speed Over Ground

TTG	Time To Go
TWA	True Wind Angle relative to the vessel, taking into account the speed of the vessel.
TWD	True Wind Direction. Wind direction as a compass bearing. What the wind direction reading would be if the vessel were stationary.
TWS	True Wind Speed relative to the vessel, taking into account the speed of the vessel.
Update rate	The rate at which an instrument refreshes the displayed data.
VMG	Velocity Made Good. The component of the vessel speed through the water in the direction of true wind.
WindTrim	Determines how quickly an autopilot responds to changes in wind direction. Higher wind trim settings give a greater responsiveness to wind changes.
WP	Waypoint
XTE	Cross Track Error

Section 10: Index

Index

D

E

F

V

W

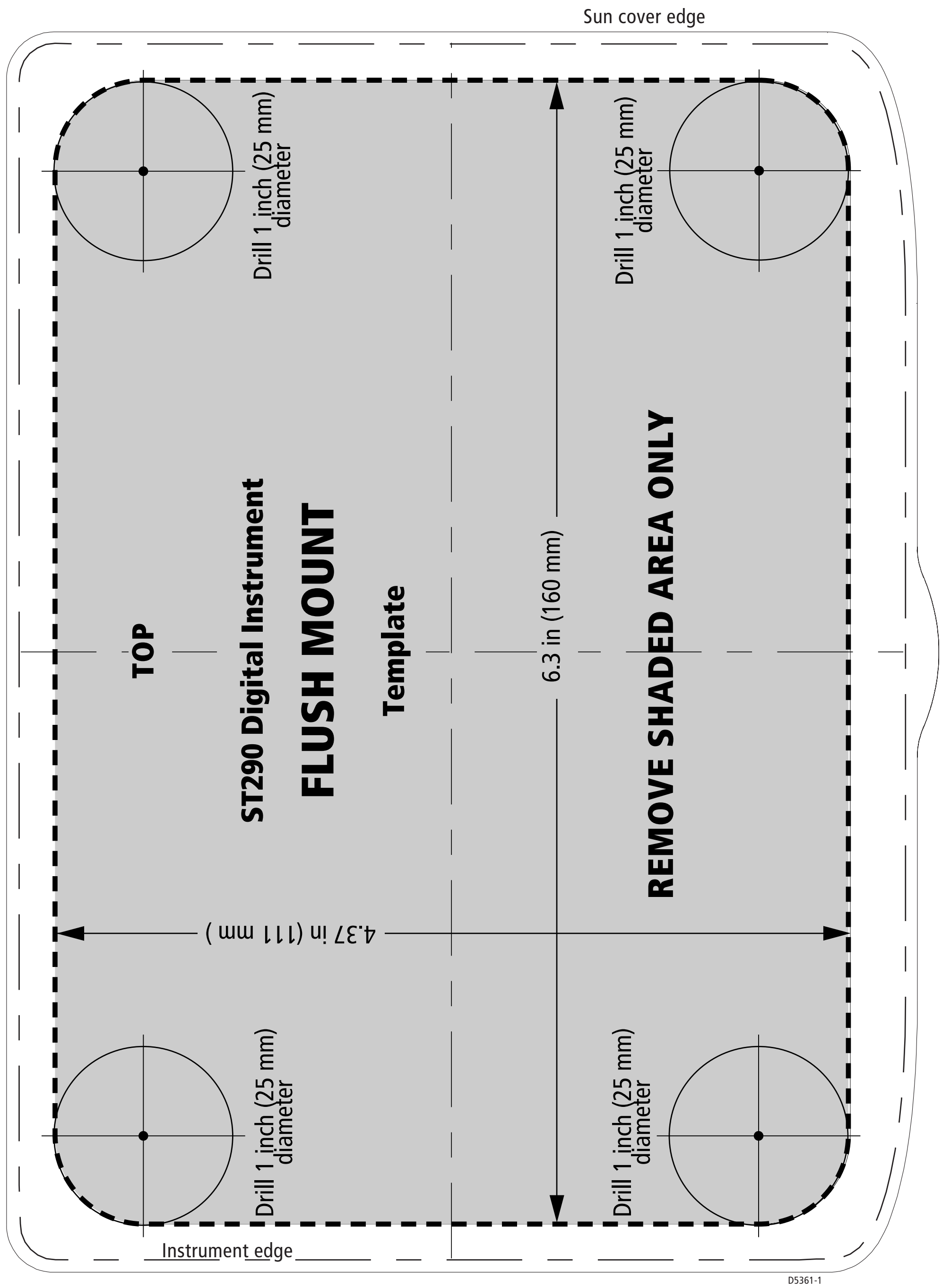
Section 11: Templates

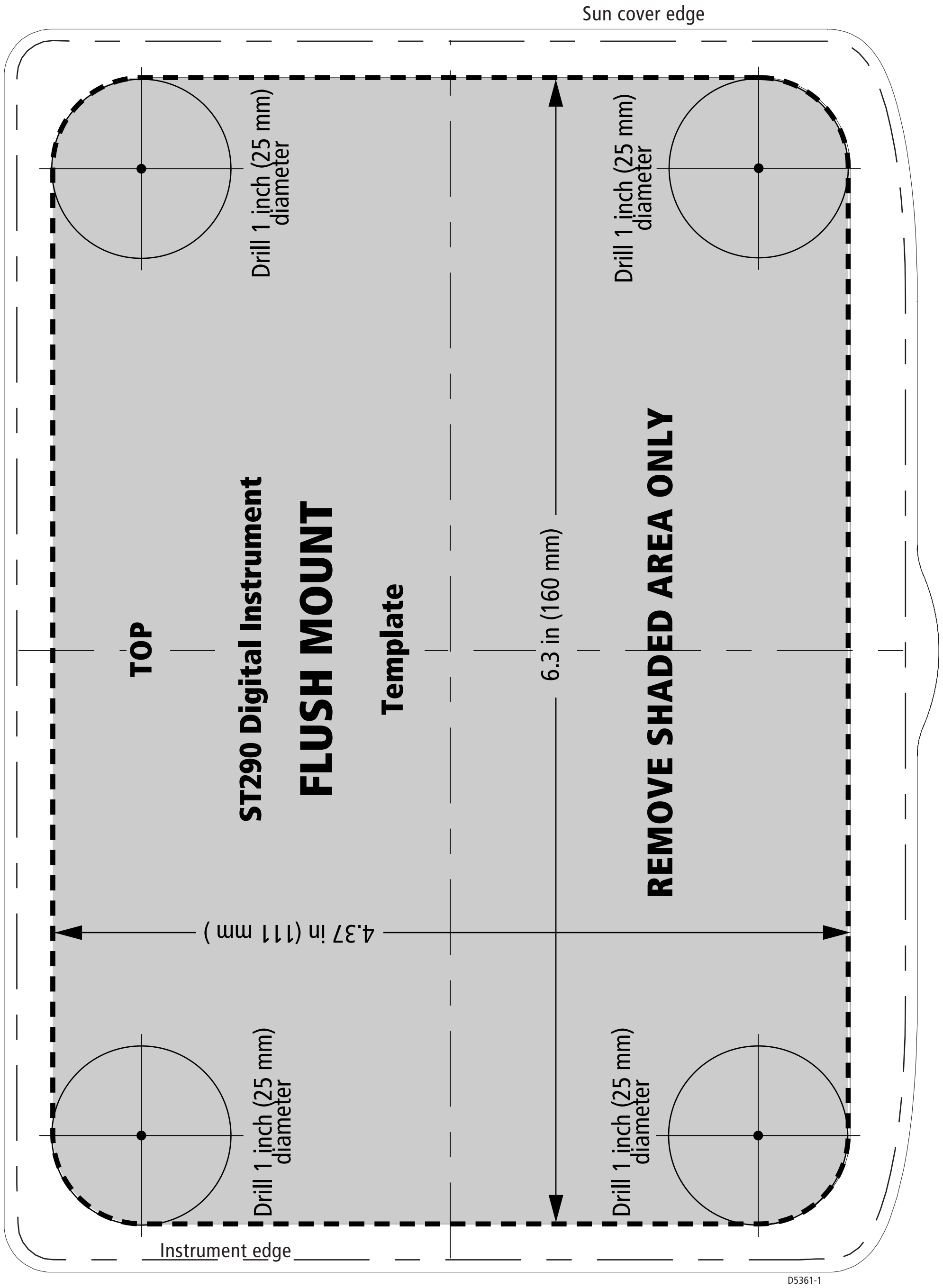
Contents

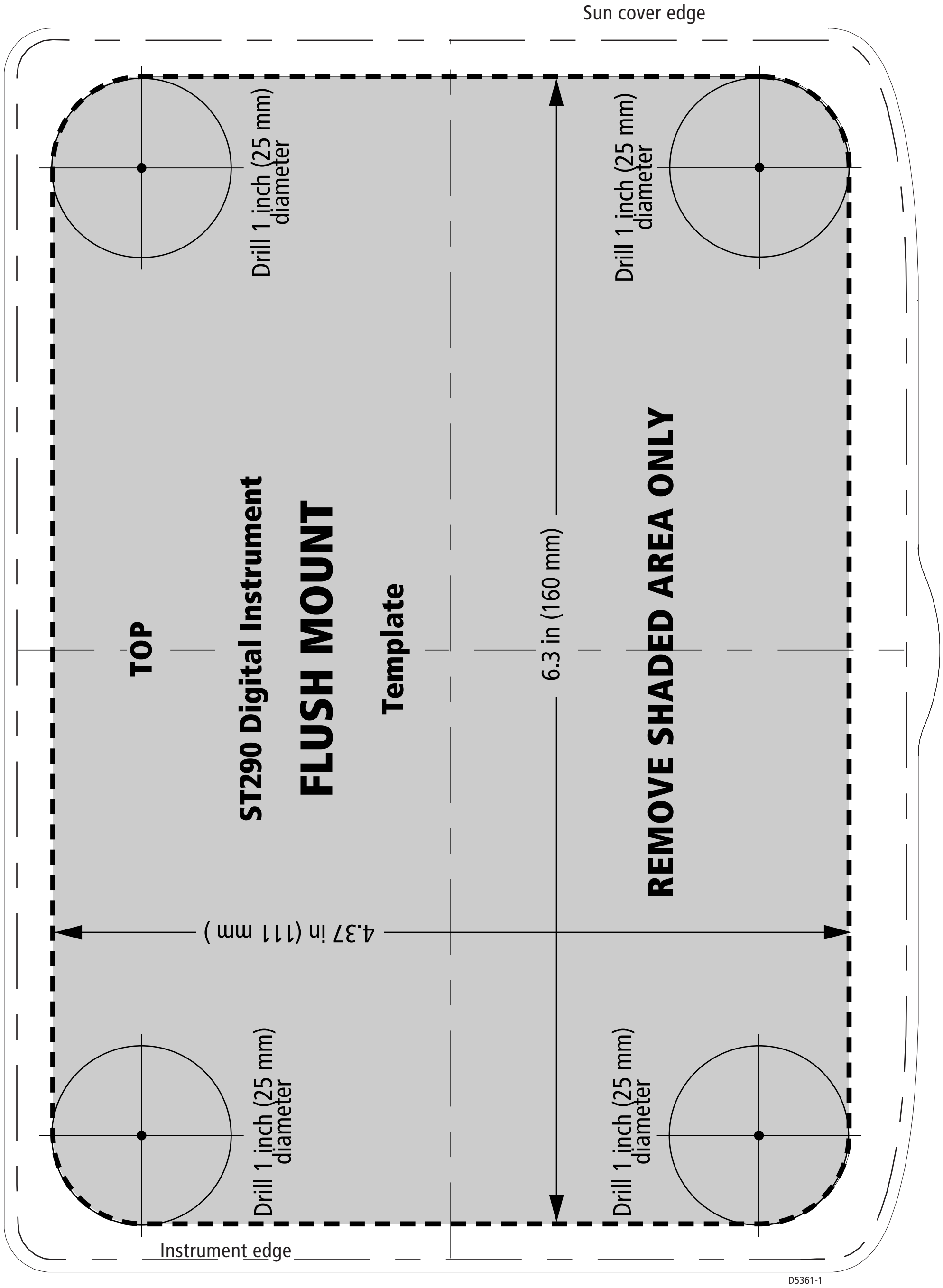
Using the templates

Although the best efforts are made to ensure each template is produced at the correct physical size, variables in the printing process may lead to slight inaccuracies in the printed templates.

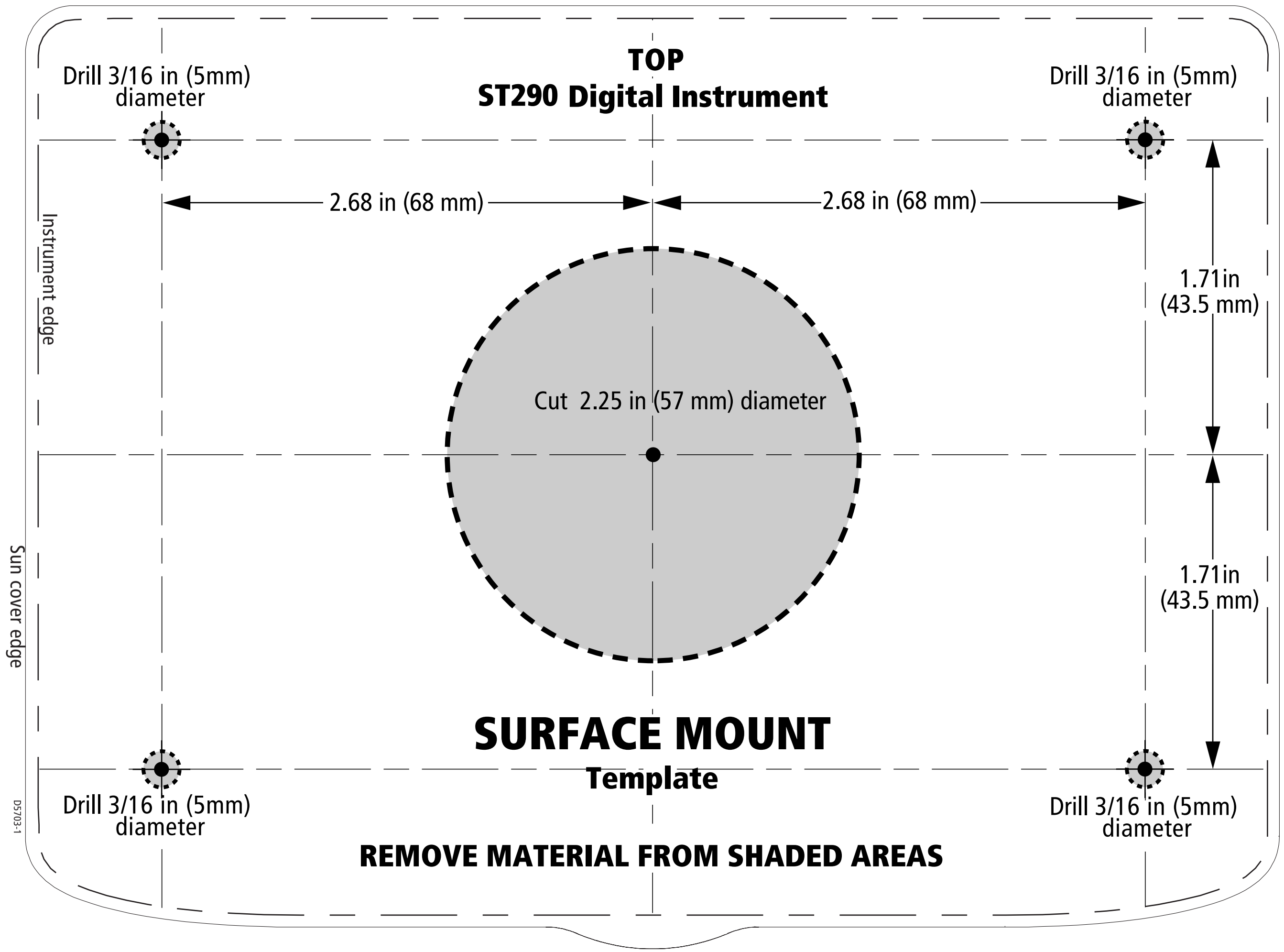
Always check the template dimensions before use.

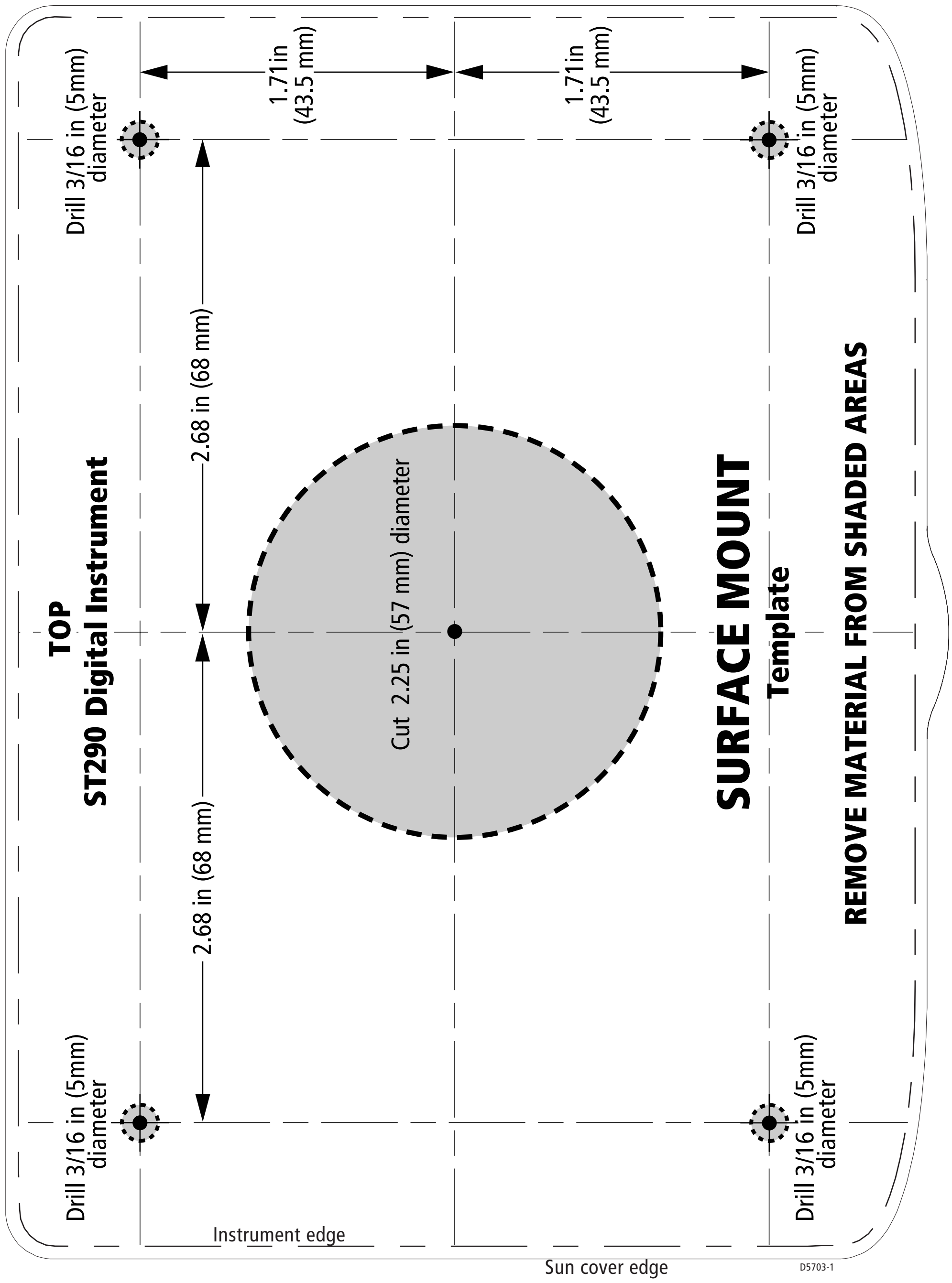

Sun cover edge
TOP
ST290 Digital Instrument
FLUSH MOUNT
Template
6.3 in (160 mm)
REMOVE SHADED AREA ONLY
4.37 in (111 mm)
Drill 1 inch (25 mm) diameter
Drill 1 inch (25 mm) diameter
Drill 1 inch (25 mm) diameter
Drill 1 inch (25 mm) diameter
Instrument edge
D5361-1

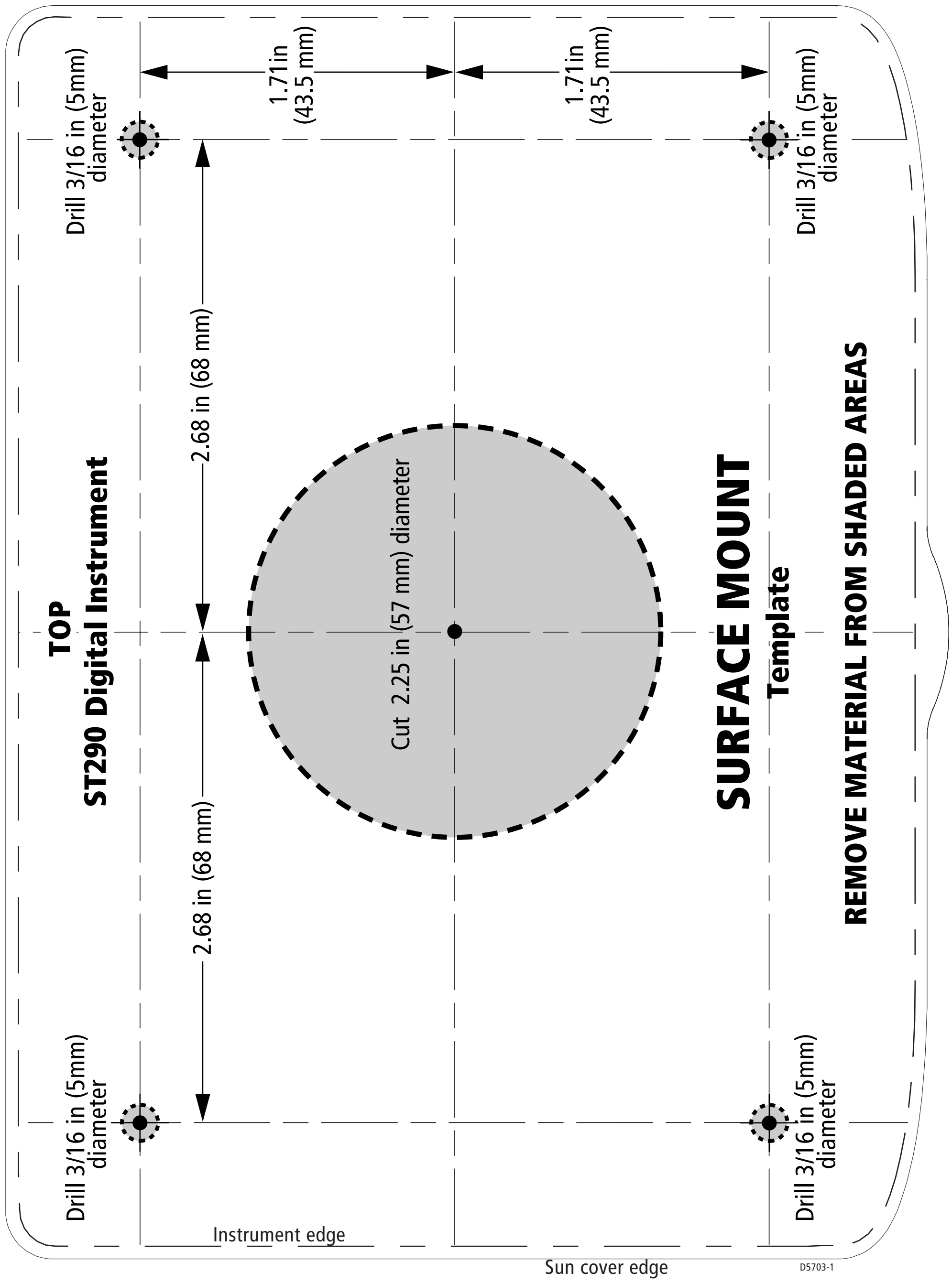

Sun cover edge
TOP
ST290 Digital Instrument
FLUSH MOUNT
Template
REMOVE SHADED AREA ONLY
Drill 1 inch (25 mm) diameter
Drill 1 inch (25 mm) diameter
Drill 1 inch (25 mm) diameter
Drill 1 inch (25 mm) diameter
6.3 in (160 mm)
4.37 in (111 mm)
Instrument edge
D5361-1

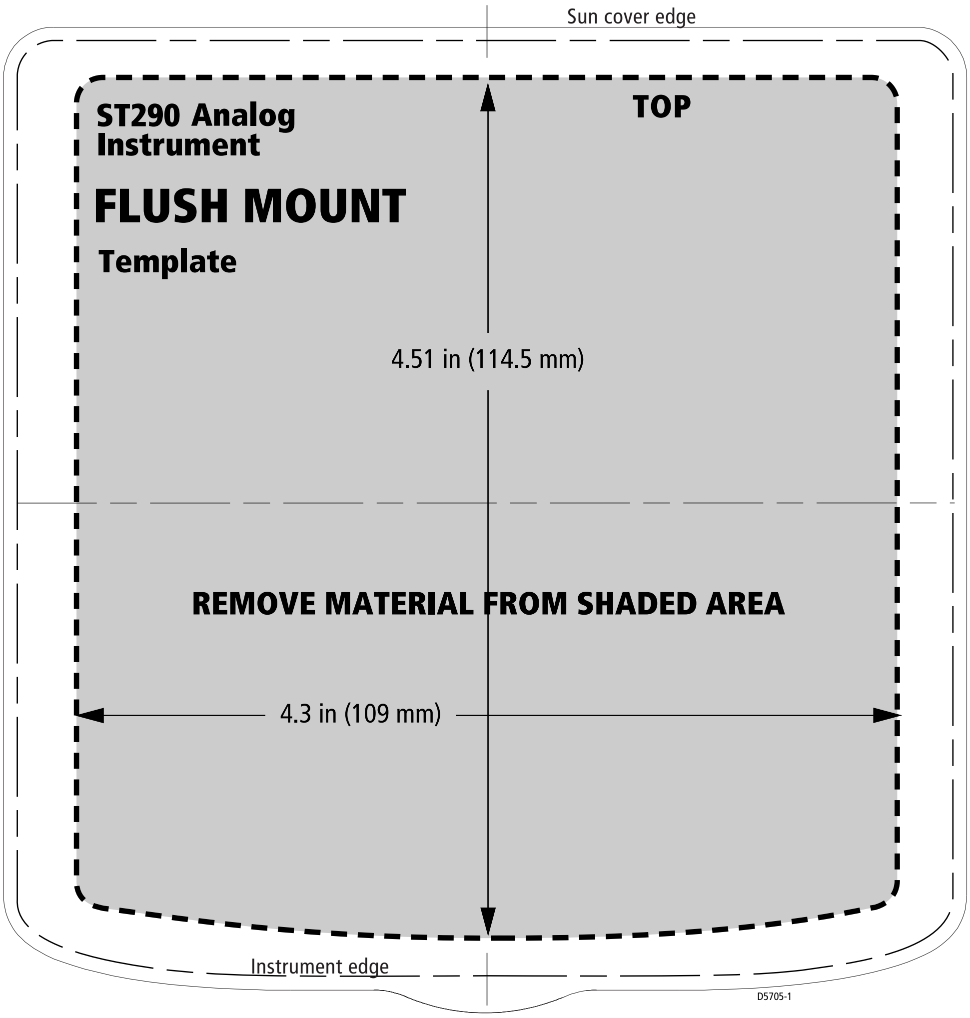


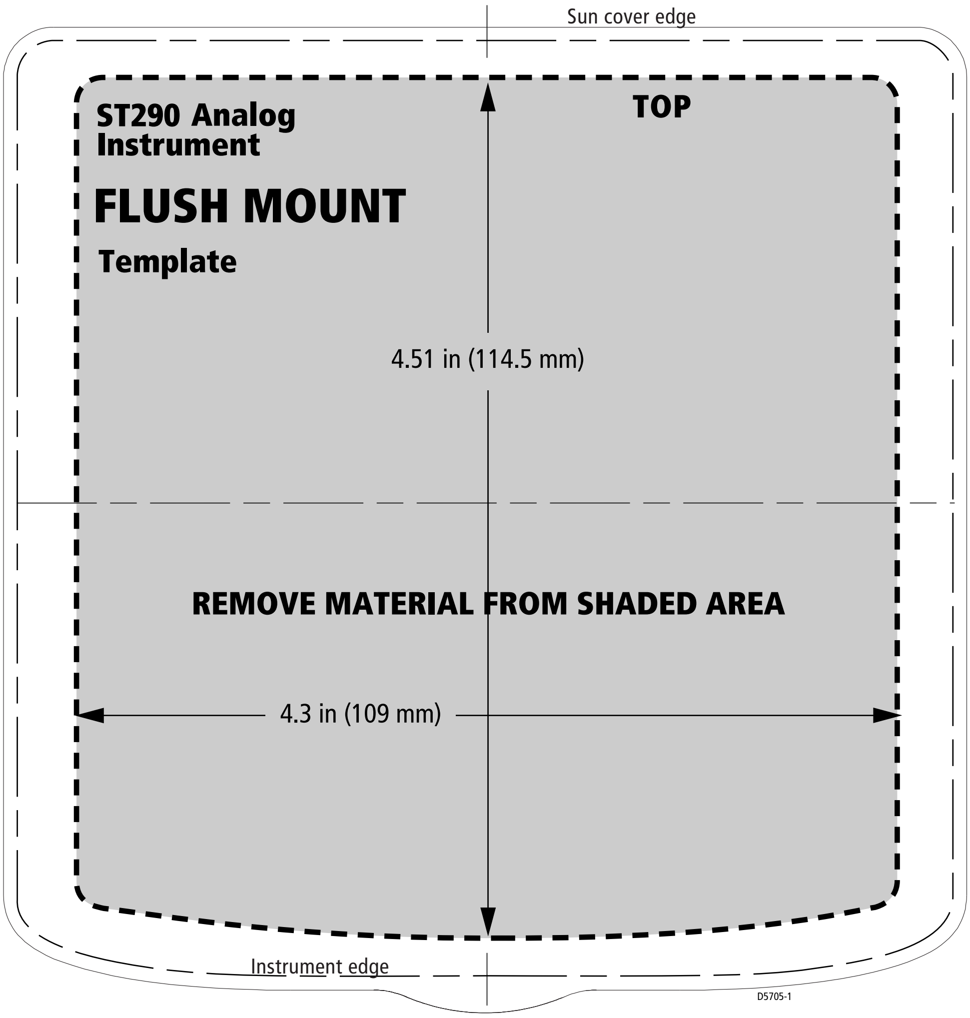
Sun cover edge
TOP
ST290 Digital Instrument
FLUSH MOUNT
Template
6.3 in (160 mm)
REMOVE SHADED AREA ONLY
4.37 in (111 mm)
Drill 1 inch (25 mm) diameter
Drill 1 inch (25 mm) diameter
Drill 1 inch (25 mm) diameter
Drill 1 inch (25 mm) diameter
Instrument edge
D5361-1

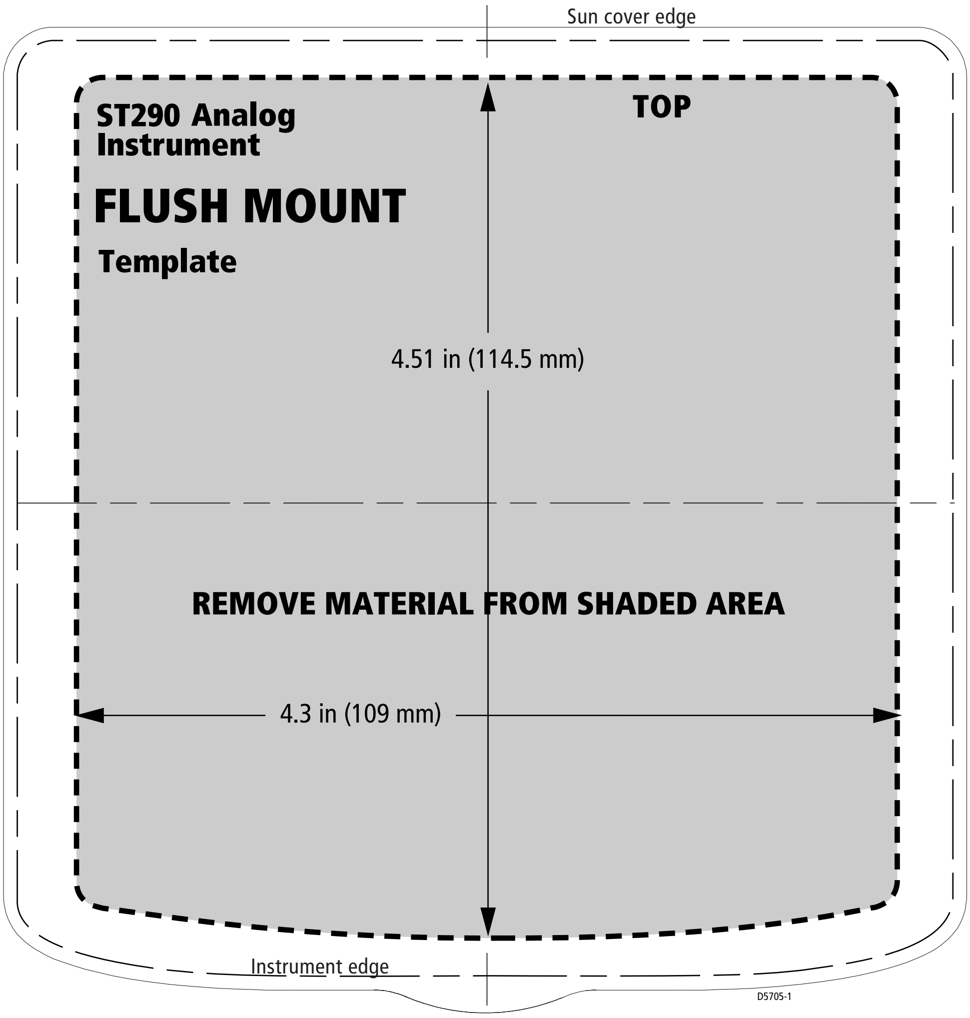

TOP
ST290 Digital Instrument
Drill 3/16 in (5mm) diameter
Drill 3/16 in (5mm) diameter
2.68 in (68 mm)
2.68 in (68 mm)
Instrument edge
1.71in (43.5 mm)
Cut 2.25 in (57 mm) diameter
Sun cover edge
1.71in (43.5 mm)
SURFACE MOUNT
Template
Drill 3/16 in (5mm) diameter
Drill 3/16 in (5mm) diameter
D5703-1
REMOVE MATERIAL FROM SHADED AREAS

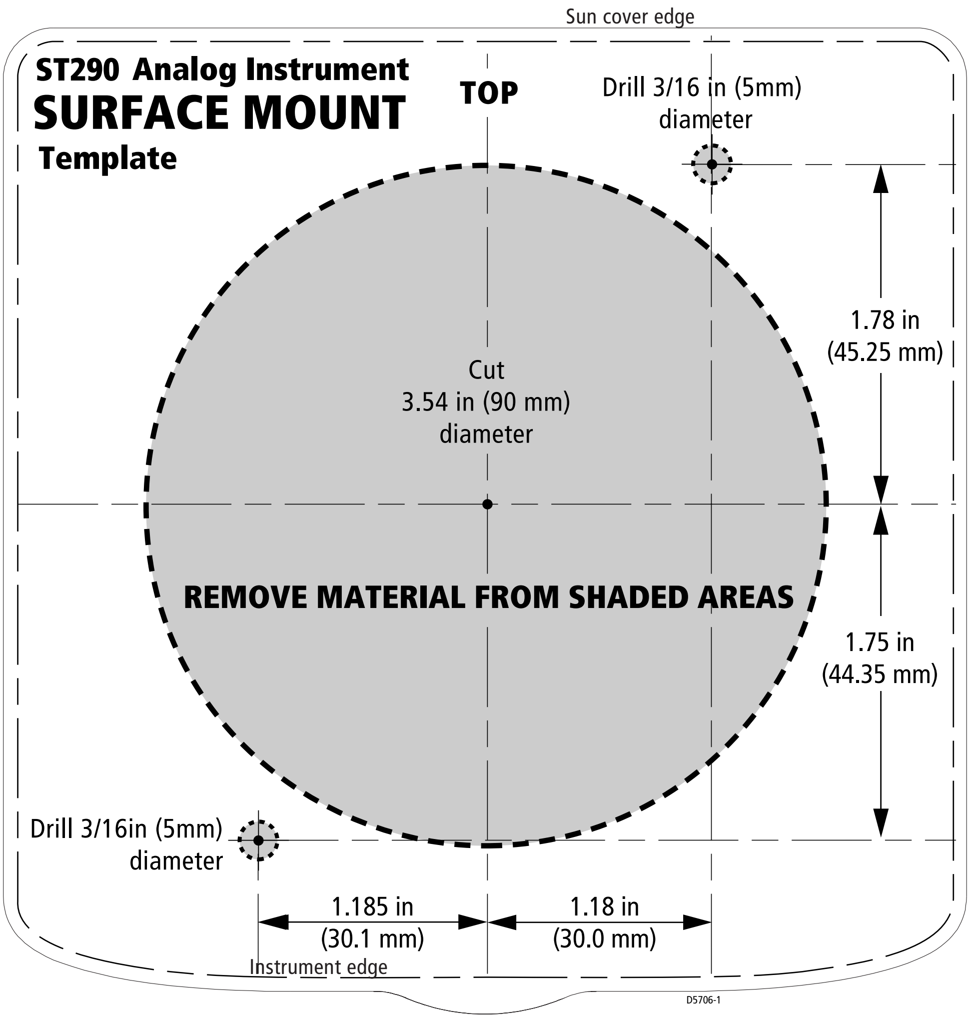

TOP
ST290 Digital Instrument
SURFACE MOUNT
Template
REMOVE MATERIAL FROM SHADED AREAS
Cut 2.25 in (57 mm) diameter
Drill 3/16 in (5mm) diameter
Drill 3/16 in (5mm) diameter
Drill 3/16 in (5mm) diameter
Drill 3/16 in (5mm) diameter
1.71in (43.5 mm)
1.71in (43.5 mm)
2.68 in (68 mm)
2.68 in (68 mm)
Instrument edge
Sun cover edge
D5703-1

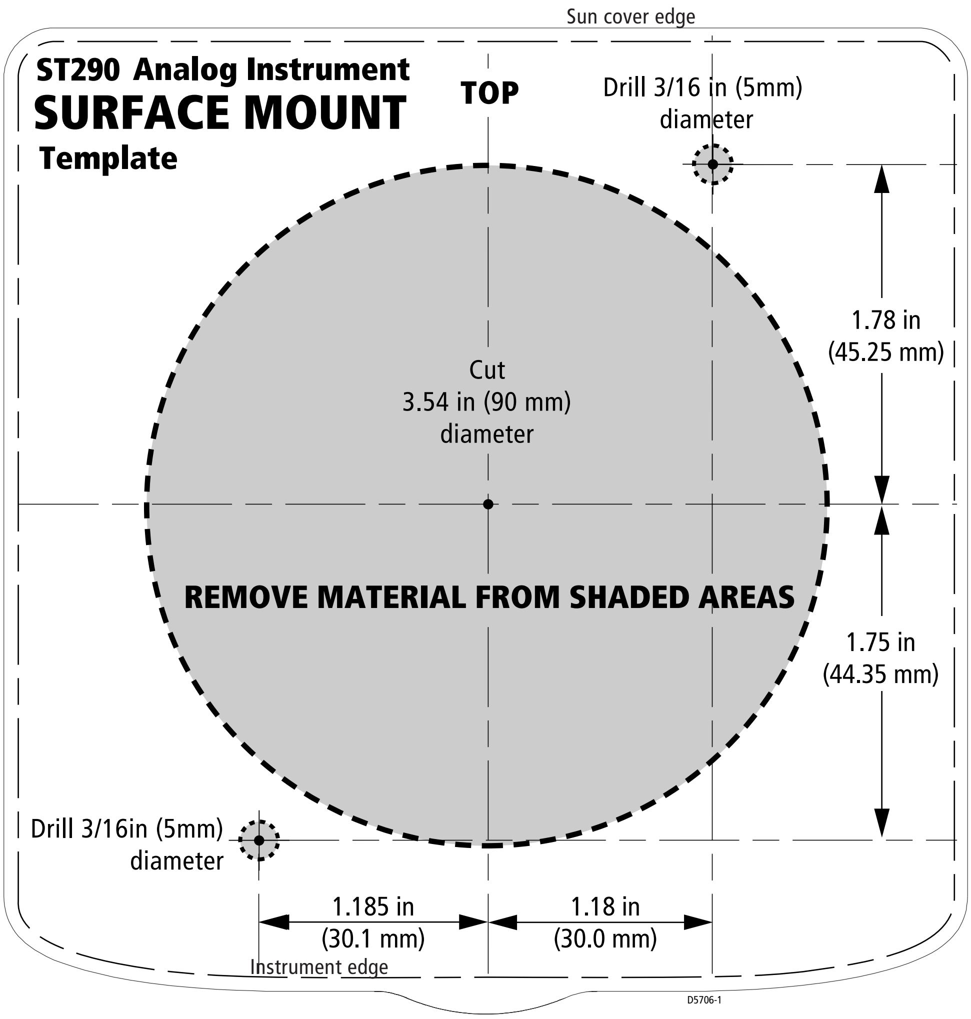

TOP
ST290 Digital Instrument
SURFACE MOUNT
Template
REMOVE MATERIAL FROM SHADED AREAS
1.71in
(43.5 mm)
1.71in
(43.5 mm)
2.68 in (68 mm)
2.68 in (68 mm)
Cut 2.25 in (57 mm) diameter
Drill 3/16 in (5mm)
diameter
Drill 3/16 in (5mm)
diameter
Drill 3/16 in (5mm)
diameter
Drill 3/16 in (5mm)
diameter
Instrument edge
Sun cover edge
D5703-1

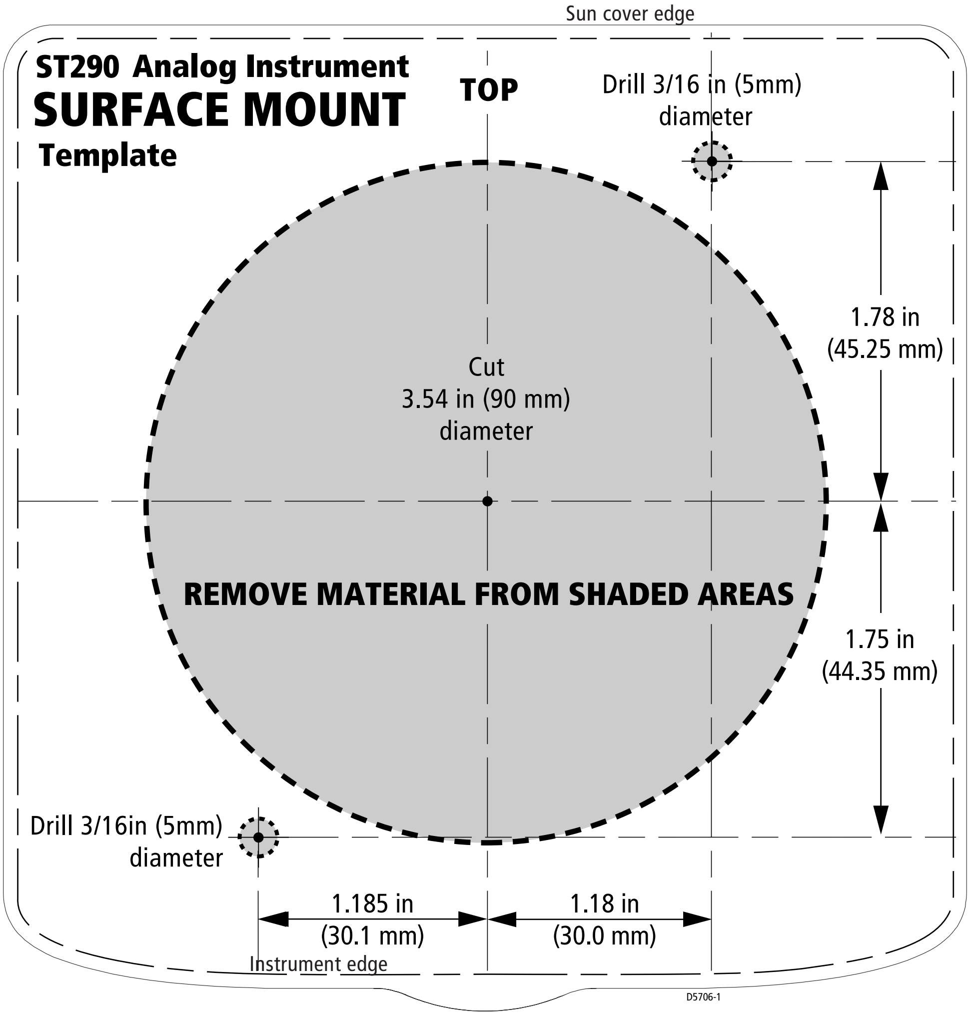

Sun cover edge
ST290 Analog Instrument
FLUSH MOUNT
Template
TOP
4.51 in (114.5 mm)
REMOVE MATERIAL FROM SHADED AREA
4.3 in (109 mm)
Instrument edge
D5705-1

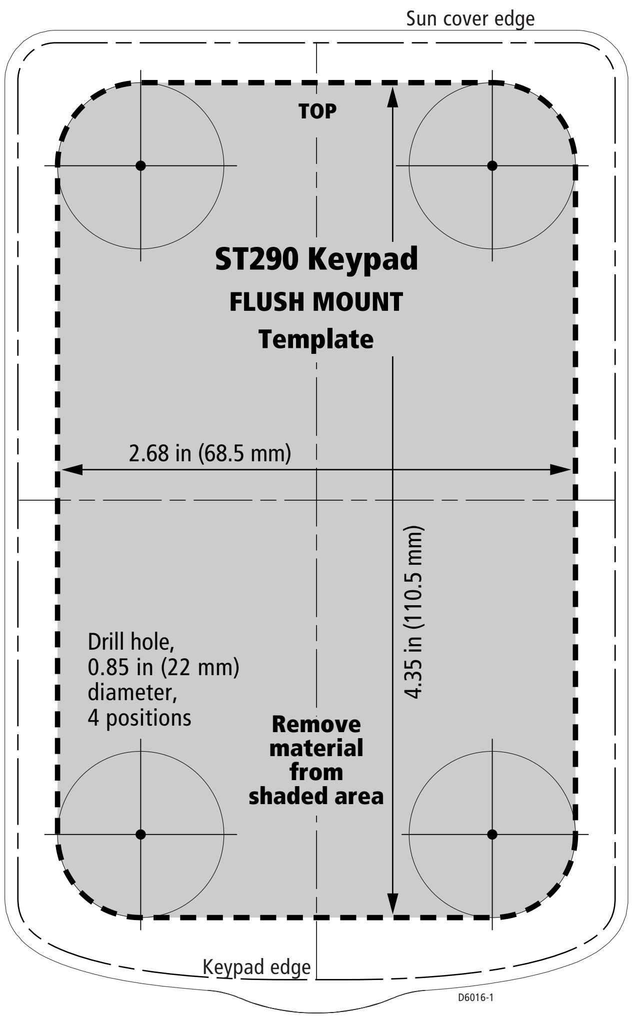

Sun cover edge
ST290 Analog
Instrument
FLUSH MOUNT
Template
TOP
4.51 in (114.5 mm)
REMOVE MATERIAL FROM SHADED AREA
4.3 in (109 mm)
Instrument edge
D5705-1

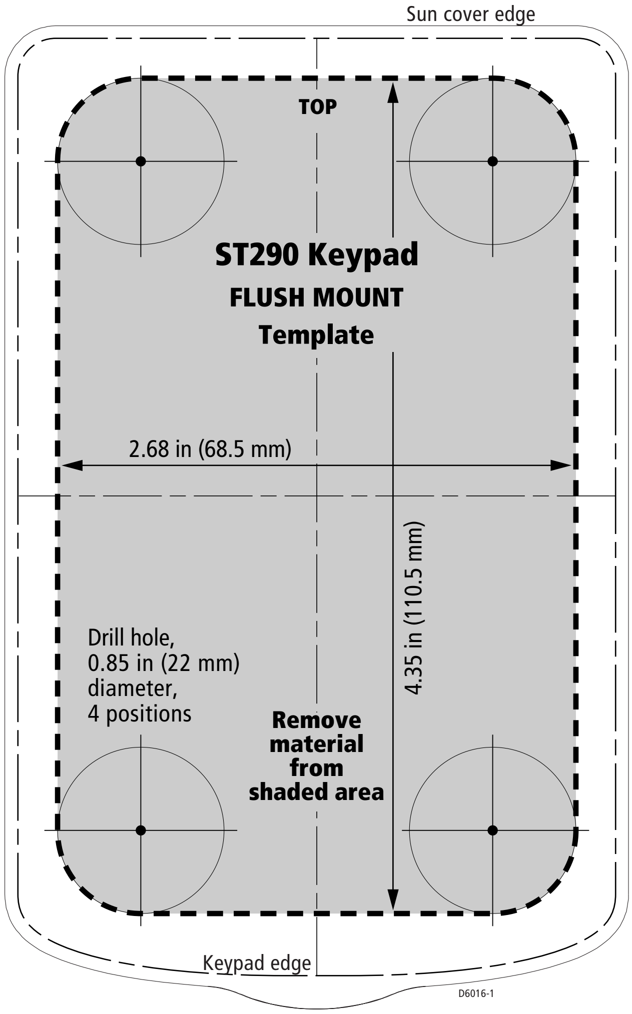

Sun cover edge
ST290 Analog
Instrument
FLUSH MOUNT
Template
TOP
4.51 in (114.5 mm)
REMOVE MATERIAL FROM SHADED AREA
4.3 in (109 mm)
Instrument edge
D5705-1

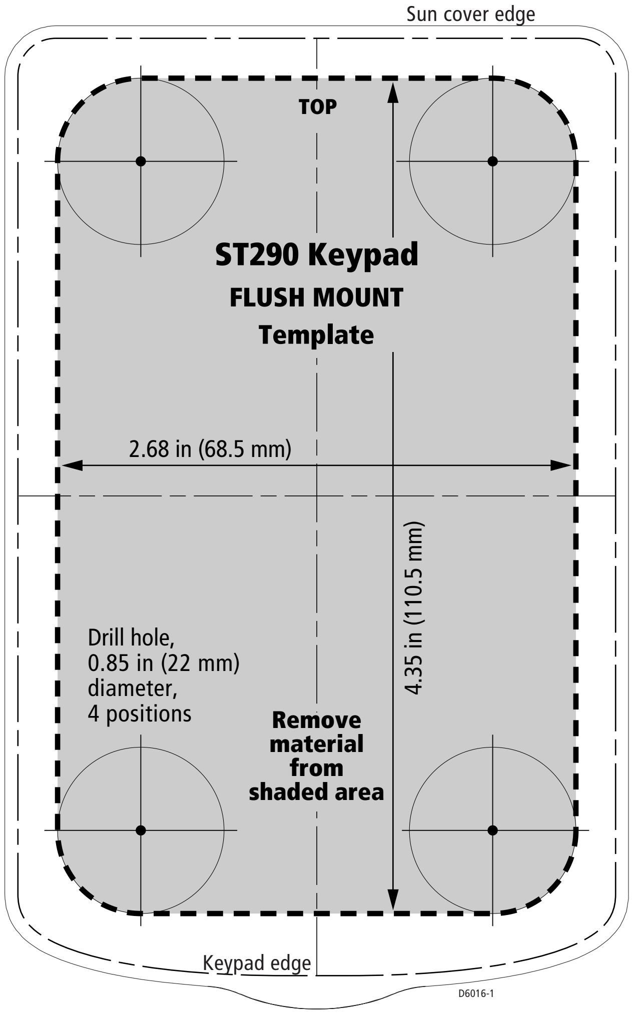

Sun cover edge
ST290 Analog Instrument
SURFACE MOUNT
Template
TOP
Drill 3/16 in (5mm) diameter
1.78 in (45.25 mm)
Cut 3.54 in (90 mm) diameter
REMOVE MATERIAL FROM SHADED AREAS
1.75 in (44.35 mm)
Drill 3/16in (5mm) diameter
1.185 in (30.1 mm)
1.18 in (30.0 mm)
Instrument edge
D5706-1

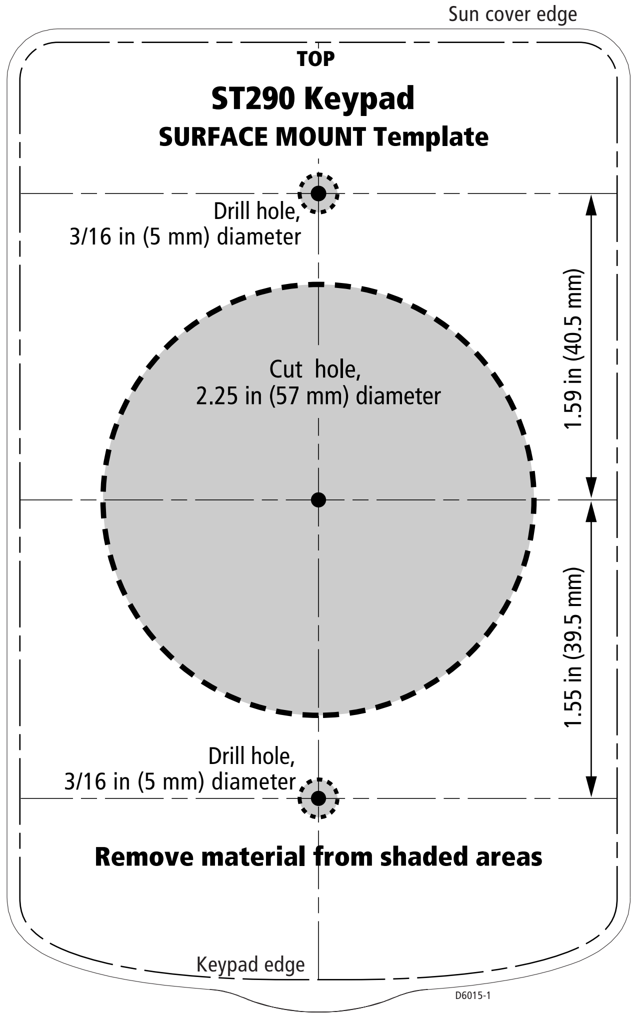

Sun cover edge
ST290 Analog Instrument
SURFACE MOUNT
Template
TOP
Drill 3/16 in (5mm)
diameter
1.78 in
(45.25 mm)
Cut
3.54 in (90 mm)
diameter
REMOVE MATERIAL FROM SHADED AREAS
1.75 in
(44.35 mm)
Drill 3/16in (5mm)
diameter
1.185 in
(30.1 mm)
1.18 in
(30.0 mm)
Instrument edge
D5706-1

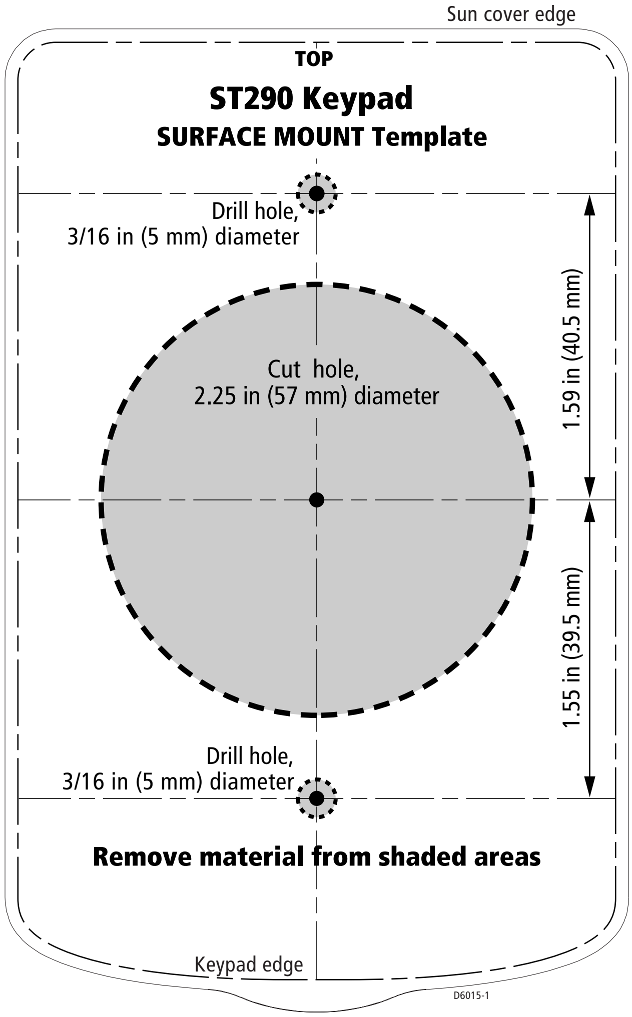

Sun cover edge
ST290 Analog Instrument
SURFACE MOUNT
Template
TOP
Drill 3/16 in (5mm)
diameter
1.78 in
(45.25 mm)
Cut
3.54 in (90 mm)
diameter
REMOVE MATERIAL FROM SHADED AREAS
1.75 in
(44.35 mm)
Drill 3/16in (5mm)
diameter
1.185 in
(30.1 mm)
1.18 in
(30.0 mm)
Instrument edge
D5706-1

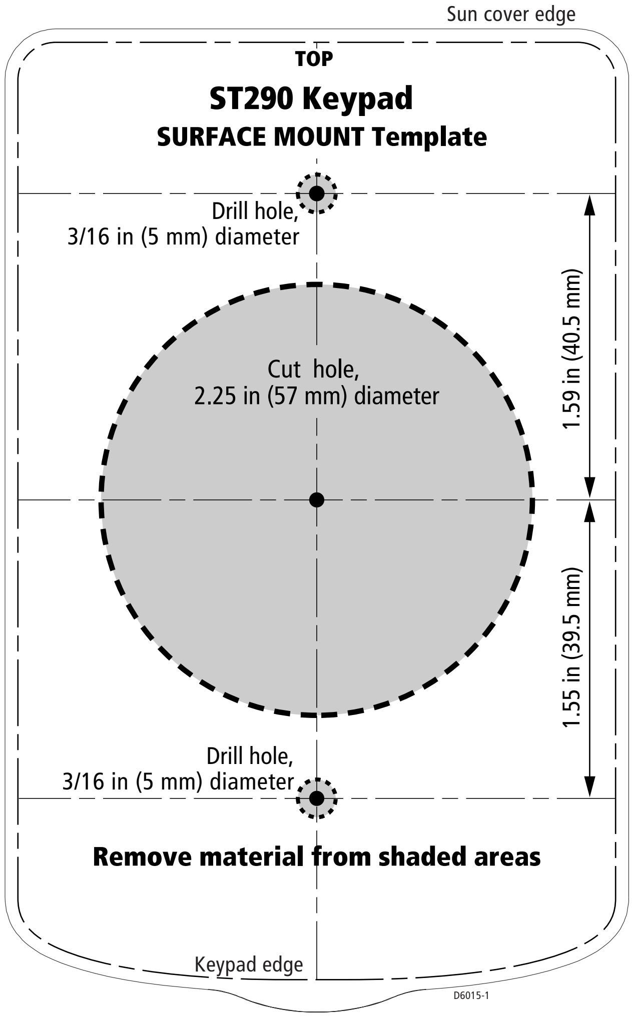

Sun cover edge
TOP
ST290 Keypad
FLUSH MOUNT
Template
2.68 in (68.5 mm)
4.35 in (110.5 mm)
Drill hole,
0.85 in (22 mm)
diameter,
4 positions
Remove
material
from
shaded area
Keypad edge
D6016-1


Sun cover edge
TOP
ST290 Keypad
FLUSH MOUNT
Template
2.68 in (68.5 mm)
4.35 in (110.5 mm)
Drill hole,
0.85 in (22 mm)
diameter,
4 positions
Remove
material
from
shaded area
Keypad edge
D6016-1


Sun cover edge
TOP
ST290 Keypad
FLUSH MOUNT
Template
2.68 in (68.5 mm)
4.35 in (110.5 mm)
Drill hole,
0.85 in (22 mm)
diameter,
4 positions
Remove
material
from
shaded area
Keypad edge
D6016-1


Sun cover edge
TOP
ST290 Keypad
SURFACE MOUNT Template
Drill hole,
3/16 in (5 mm) diameter
Cut hole,
2.25 in (57 mm) diameter
1.59 in (40.5 mm)
1.55 in (39.5 mm)
Drill hole,
3/16 in (5 mm) diameter
Remove material from shaded areas
Keypad edge
D6015-1


Sun cover edge
TOP
ST290 Keypad
SURFACE MOUNT Template
Drill hole,
3/16 in (5 mm) diameter
Cut hole,
2.25 in (57 mm) diameter
1.59 in (40.5 mm)
1.55 in (39.5 mm)
Drill hole,
3/16 in (5 mm) diameter
Remove material from shaded areas
Keypad edge
D6015-1



Sun cover edge
TOP
ST290 Keypad
SURFACE MOUNT Template
Drill hole,
3/16 in (5 mm) diameter
Cut hole,
2.25 in (57 mm) diameter
1.59 in (40.5 mm)
1.55 in (39.5 mm)
Drill hole,
3/16 in (5 mm) diameter
Remove material from shaded areas
Keypad edge
D6015-1