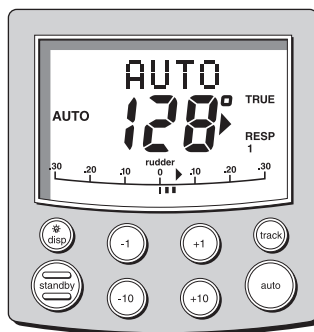


# ST5000+ Sterndrive & Hydraulic Autopilots



## Owner's handbook

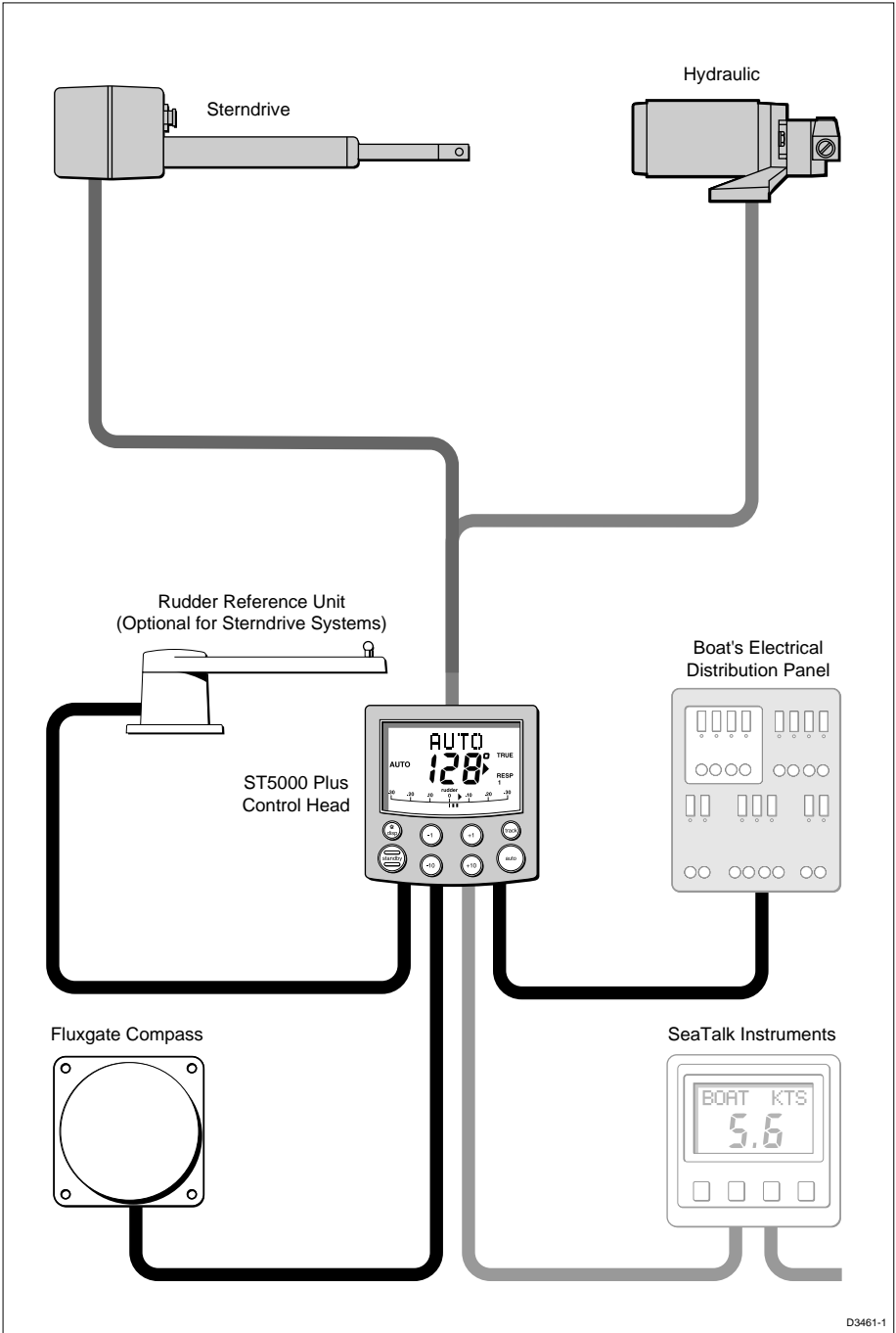
### English

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# Preface

This handbook contains information on the operation and installation of your new equipment. In order to obtain the best performance from your autopilot, please read this handbook thoroughly.

## How this handbook is organised

This handbook is divided into the following chapters:

**Chapter 1:** Introduces the autopilot, its features and its use.

**Chapter 2:** Covers basic autopilot operation.

**Chapter 3:** Explains how to use Track mode and adjust autopilot performance, and summarises the ST5000 Plus alarms.

**Chapter 4:** Provides details on how to make adjustments to customise the autopilot to your particular vessel.

**Chapter 5:** Explains how to install your autopilot and its components.

**Chapter 6:** Covers functional testing and dockside procedures after installation, and initial sea trials.

**Chapter 7:** Provides general maintenance procedures.

**Chapter 8:** Provides information to help you resolve any problems you may encounter with your autopilot.

An index is included at the end of this handbook, followed by templates for the installation of the control head, SeaTalk deck connector and rudder reference transducer.

## Warranty

To verify the ownership of your new autopilot, please take a few minutes to complete the warranty card. It is important that you complete the owner information and return the card to the factory to receive full warranty benefits.

## Safety information

Passage making under autopilot control is an enjoyable experience that can, if you are not careful, lead to the relaxation of the permanent watch. A permanent watch **MUST** be maintained no matter how clear the sea may appear to be.

Remember, a large ship can travel two miles in five minutes – just the time it takes to make a cup of coffee.

The following rules should always be observed:

- Maintain a permanent watch and regularly check all around for other vessels and obstacles to navigation – no matter how clear the sea may appear a dangerous situation can develop rapidly.
- Maintain an accurate record of the vessel's position either by use of a radio navigation receiver or visual bearings.
- Maintain a continuous plot of position on a current chart. Ensure the locked autopilot heading steers you 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 radio navigation receiver, always maintain a log and make regular positional plots. Radio navigation signals can produce significant errors under some circumstances and the autopilot cannot detect this situation.
- Make sure that all members of crew are familiar with the procedures to disengage the autopilot.

Your Raymarine autopilot will add a new dimension to your boating enjoyment. However, it is the responsibility of the skipper to ensure the safety of the vessel at all times by careful observance of these basic rules.

## EMC conformance

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

Their design and manufacture conforms to the appropriate Electromagnetic Compatibility (EMC) standards, but good installation is required to ensure that performance is not compromised.

# Chapter 1: Introduction

## 1.1 Overview

The ST5000 Plus is a SeaTalk<sup>®</sup> compatible autopilot, available for sterndrive or hydraulic steering systems, which can also repeat instrument data in a programmable selection of Data Pages.

The ST5000 Plus can share all data transmitted from other Raymarine SeaTalk instruments:

- Track information, from a navigation instrument, provides waypoint control from the autopilot.
- Boat speed from the Speed instrument provides optimum track-keeping performance.

The ST5000 Plus autopilot can also be used with any navigator (GPS, Decca, Loran) transmitting NMEA 0183 data.

There are three operating modes:

**Standby:** Autopilot disengaged

**Auto:** Autopilot engaged and locked onto a heading

**Track:** Autopilot maintains a track between two waypoints created using a navigation system

When the ST5000 Plus is being used to repeat instrument data, “pop-up pilot” pages are displayed for 5 seconds whenever a change in autopilot control is made.

The ST5000 Plus also provides the following:

- Automatic compass deviation correction
- Northerly/Southerly heading compensation
- Automatic heading deadband – seastate control
- Waypoint advance feature
- Setup and calibration options to suit each installation, giving maximum performance with many types of boat, with three calibration menus (user, intermediate and dealer)

## 1.2 Extended systems

The ST5000 Plus is compatible with other Raymarine SeaTalk instruments. Additional fixed and hand-held SeaTalk autopilot control units can be connected at secondary steering and control positions.

A rudder reference unit can be fitted as an optional extra to the ST5000 Plus Sterndrive system, and will improve performance. It is especially recommended if there is significant backlash in the steering system, or optimum performance is required from a mechanical or cable steering system.

## 1.3 Specification

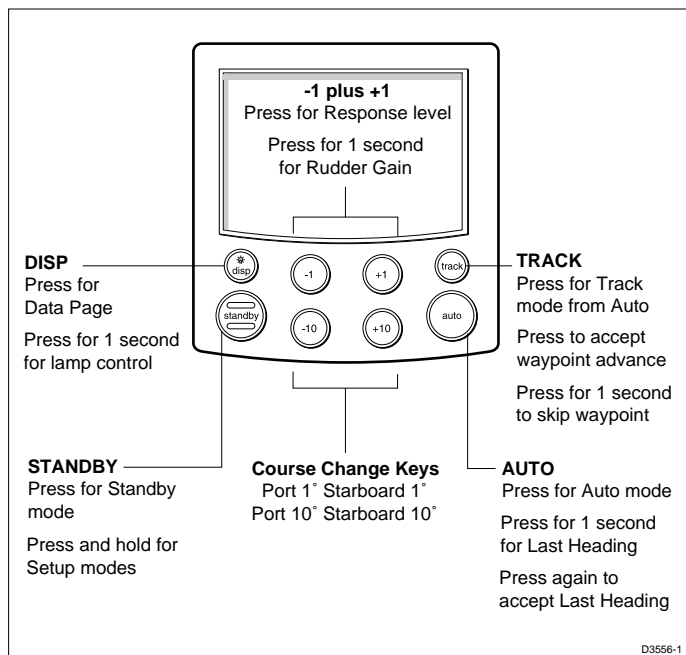
- Power Supply: 10 V to 15 V dc
- Drive mechanism: Sterndrive actuator or hydraulic pump, high current FET drive
- Current consumption:  
Standby: 60 mA (less than 200 mA with full lighting)  
Auto: between 0.5 A and 1.5 A depending on drive type, boat trim, helm load and sailing conditions
- Operating temperature: 0°C to +70°C (32°F to 158°F)
- Eight button illuminated digital keypad
- LCD display of heading, locked course and navigational data, with three levels of illumination
- Input connections for: SeaTalk, power, fluxgate compass, rudder reference unit and NMEA
- Output connections for: SeaTalk, clutch drive and motor drive
- Clutch current limit: 2 A

# Chapter 2: Basic Operation

This chapter first provides summary diagrams of the key functions and screen layout. It then gives operating instructions for engaging the autopilot and using Auto mode, changing the lighting, and displaying Data Pages.

## 2.1 Key functions

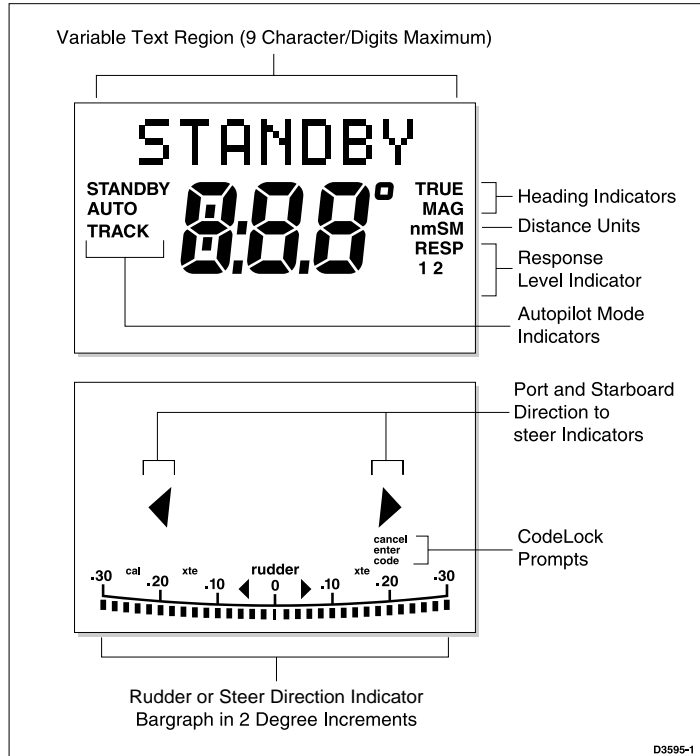
The autopilot is controlled using simple push-button operations, all of which are confirmed with a beep. In addition to the main single key functions, there are several dual key functions.



- The autopilot always powers up in Standby mode.
- Course changes can be made at any time using the **-1**, **+1**, **-10** and **+10** keys.
- You can return to manual steering at any time by pressing **standby**.

## 2.2 Display layout

The following illustration shows all the elements, together with a brief description, that make up the ST5000 Plus autopilot LCD display.



- The bar graph at the bottom of the display is normally a rudder bar for ST5000 Plus Hydraulic systems. For ST5000 Plus Sterndrive systems (or if the bar graph has been set as a direction-to-steer indicator) the display depends on the current mode, as follows:

| Mode    | Bar   |
|---------|---|
| Standby | Rudder bar for systems with a rudder reference transducer |
| Auto    | Heading error bar   |
| Track   | Cross track error (XTE) bar, in 0.02 nm increments        |

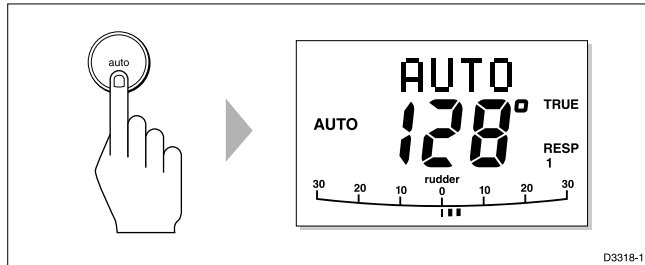
- If neither distance units (nm or SM) are displayed, the distance is in Km.



## 2.3 Using Auto mode

### Engaging the Autopilot (Auto)

1. Steady the vessel on the required heading.
2. Press **auto**.



- In Auto mode, the display shows the locked autopilot heading.

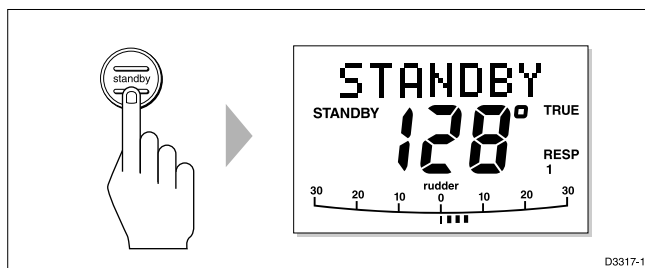
### CAUTION:

Passage making under autopilot control is an enjoyable experience that can, if you are not careful, lead to the relaxation of the permanent watch. A permanent watch **MUST** be maintained no matter how clear the sea may appear to be.

Remember, a large ship can travel two miles in five minutes – just the time it takes to make a cup of coffee.

### Disengaging the autopilot (Standby) to return to hand steering

- Press **standby**.

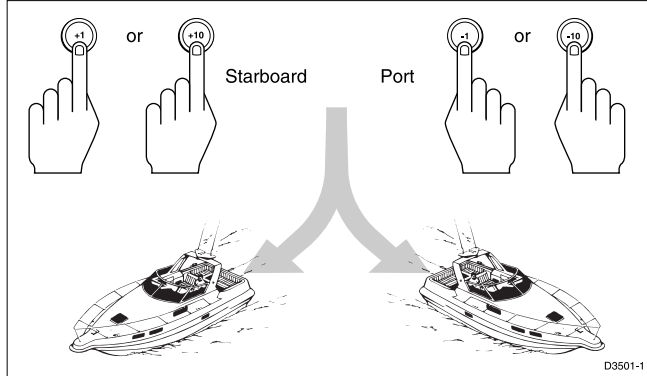


- In Standby mode, the display shows the vessel's current compass heading.
- The previous autopilot heading is memorised and can be recalled.

## Changing course in Auto mode

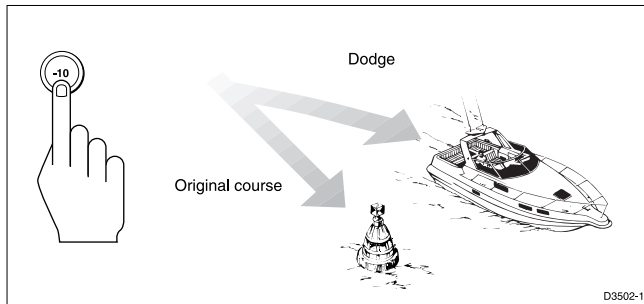
- The **+1** and **+10** (starboard) and **-1** and **-10** (port) keys are used to change the locked heading, in increments of  $1^\circ$  and  $10^\circ$ , when the autopilot has control.

Example: a  $30^\circ$  course change to port = press **-10** three times.



## Dodging obstacles in Auto mode

In order to avoid an obstacle when your vessel is under autopilot control, select a course change in the appropriate direction (for example, port  $30^\circ$  = press **-10** three times).

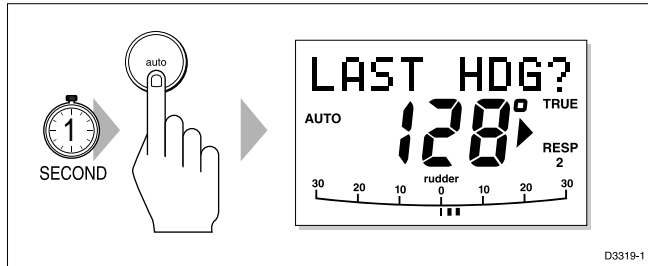


- When safely clear of the obstacle, you can reverse the previous course change (for example, press **+10** three times), or return to the previous locked heading (LAST HDG).

## Returning to the previous locked heading (LAST HDG)

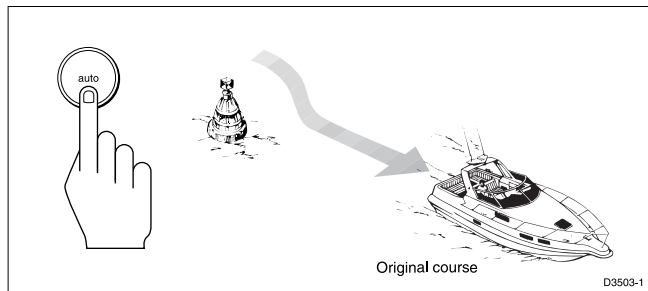
If for any reason the vessel is steered away from the selected locked heading (for example, executing a dodge manoeuvre or selecting Standby) you can return to the previous locked heading:

1. Press **auto** for 1 second. The previous locked heading (LAST HDG) is displayed for 7 seconds.



**Note:** A direction-to-steer indicator is displayed to show you the direction the vessel will turn.

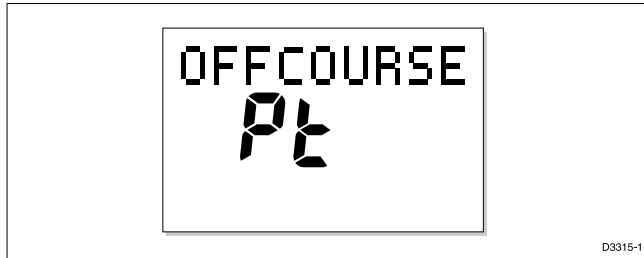
2. To accept this heading, and resume the original course, press **AUTO** once within this 7 second period.



If you do not press **auto** while the display is flashing, the current heading will be maintained.

## Off course alarm

The off course alarm will sound if the locked autopilot heading and the vessel's current heading differ for more than 20 seconds, by more than the alarm angle set in calibration (the factory default is 20°).



- To cancel the off course alarm, press **standby** to return to hand steering.

## Operating hints

### Making major course changes

- It is sound seamanship to make major course changes only when steering manually.
- Manual course changes ensure that obstructions or other vessels can be cleared properly, and due account taken of the changed wind and sea conditions on the new heading prior to engaging the autopilot.

### Course changes under autopilot control

It is important to understand the effect of sudden trim changes on steering performance. When a sudden trim change occurs, due, for example, to weather helm, there will be a delay before the automatic trim applies rudder to restore the locked heading. This correction can take up to one minute.

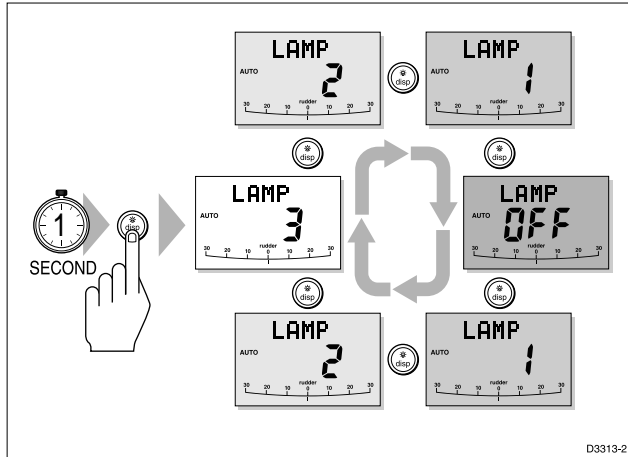
Large course changes which change the apparent wind direction can produce large trim changes. In these situations, the autopilot will not immediately assume the new automatic heading, and will only settle onto course when the automatic trim has been fully established.

To eliminate this problem, the following procedure can be adopted for large course changes:

1. Note the required new heading.
2. Select **standby** and steer manually.
3. Bring the vessel onto the new heading.
4. Select **auto** and let the vessel settle onto course.
5. Bring the vessel to the final course with 1° increments.

## 2.4 Display and keypad illumination

Press **disp** for 1 second, from any mode, to enter illumination adjustment mode and turn the lights on.



Subsequent presses of the **disp** key cycles the possible illumination settings: L3, L2, L1, OFF, L1, L2, L3 etc. where L3 is the brightest setting.

The display times out to normal operation after 7 seconds of keypad inactivity.

Pressing any other key before the 7 second time-out will select the mode assigned to that key (for example, **auto** selects Auto mode, **standby** selects Standby mode).

**Note:** *If other SeaTalk instruments or autopilot control units are connected to SeaTalk, the illumination can be adjusted from these units.*

Any adjustments to the illumination are lost when the unit is switched off.

The keys are still lit at a courtesy level when the display lighting is off.

## 2.5 Data pages

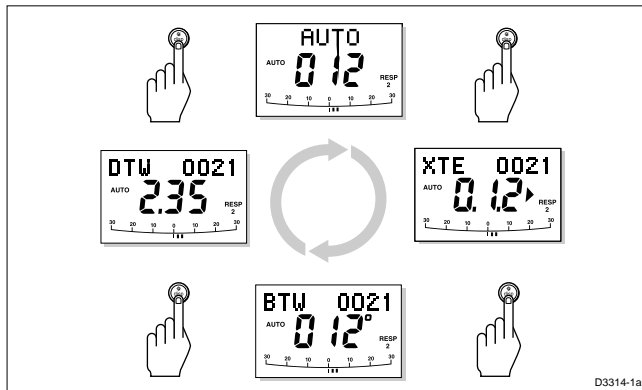
The **disp** key is used to cycle “pages” of SeaTalk or NMEA data. Once a Data Page is selected, this page becomes the principle autopilot display. The autopilot mode displays (Standby, Auto, Track and Vane)

then become “pop-ups”, and are displayed for 5 seconds when the autopilot mode is changed or a course change is made.

- Press **disp** to display each Data Page in turn.
- When the last Data Page is cycled, the display returns to the current autopilot mode display (for example, Standby).
- To return to a previous Data Page, press **disp** for 1 second within 2 seconds of displaying a page. You can continue to move backwards through the Data Page sequence in this way.

Up to 7 Data Pages are available using the **disp** key. The number of pages, and the information displayed on each page, depends on the selections made in User Setup (see section 4.1).

The following illustration shows the default settings for the Data Pages.



- If the required data for a page is not available, dashes are displayed instead of a value.
- Most displays are repeated data, and cannot be adjusted. The exceptions are the Response and Rudder Gain pages (if selected for display), which can be adjusted using the **+1** and **-1** keys.
- The current autopilot mode is shown at the left of the display, and the autopilot bar graph remains in use.
- The “direction-to-steer” arrows relate to the Data Page information.

# Chapter 3: Advanced Operation

This chapter provides information on:

- Operation in Track mode
- Adjusting the response level and rudder gain
- Alarms

## 3.1 Operation in Track mode

Track mode is used to maintain a track between two waypoints created on a GPS, Decca, or Loran navigation system. The ST5000 Plus will then compute any course changes to keep your boat on track, automatically compensating for tidal streams and leeway.

The ST5000 Plus can receive cross track error (the distance your vessel is from a planned track) from:

- (a) A SeaTalk navigation instrument or chartplotter  
or
- (b) A non-SeaTalk navigation system transmitting data in the NMEA 0183 format – this can be connected directly to the ST5000 Plus NMEA input, as described in the Installation Chapter.

Track mode is selected by pressing the **track** key, but can only be selected from Auto mode. You can return to either Auto or Standby mode from Track mode, as follows:

- Press **auto** to leave Track mode and return to Auto mode.
- Press **standby** to leave Track mode and return to manual steering.

### Initiating Track mode

When initiating Track mode, the track can be acquired in one of two ways:

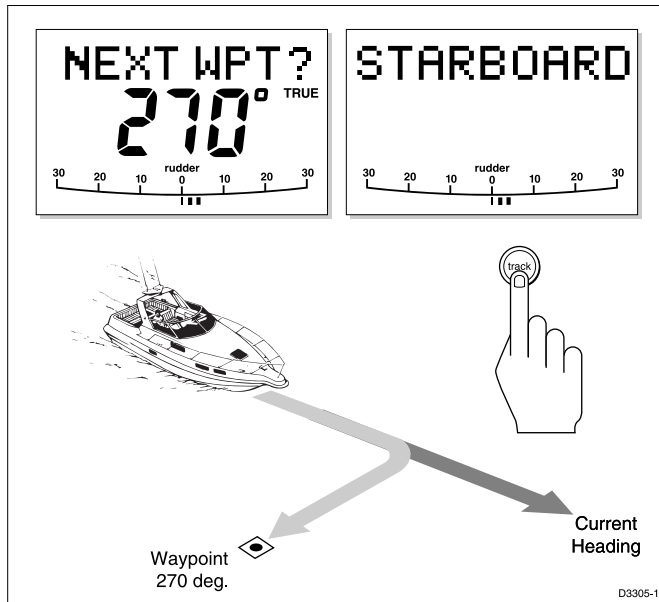
- Automatic acquisition, when cross track error and bearing to waypoint data are available
- Manual acquisition, when cross track error is the only available data

## Automatic acquisition

Automatic acquisition can only be achieved if the pilot is receiving cross track error and bearing to waypoint information (via SeaTalk or NMEA 0183). It is initiated as follows:

1. Bring the vessel to within 0.1 nm of track.
2. Press **auto**.
3. Press **track** to enter Track mode, with the current locked heading displayed.

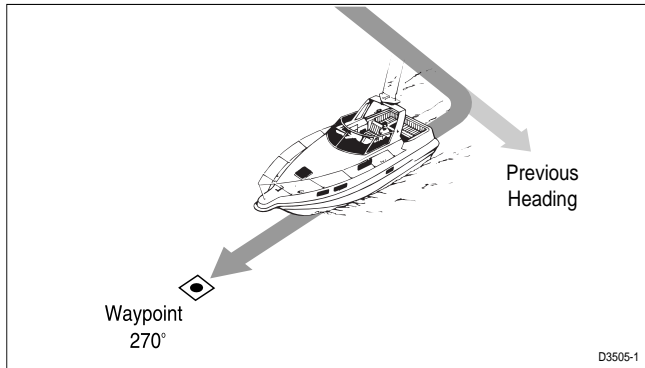
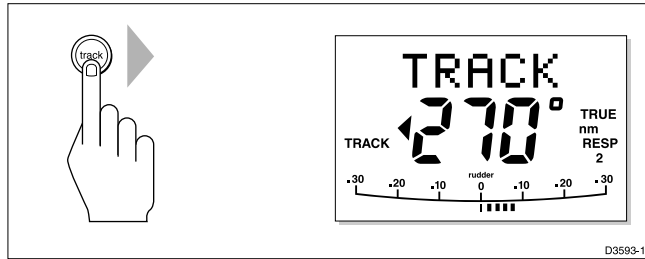
After a short delay for data acquisition, the Waypoint Advance alarm will sound, and the display will show the planned bearing to waypoint alternating with the direction in which the boat will turn.



**Note:** If the vessel is further than 0.3 nm from the track, the Large Cross Track Error alarm will sound. Press **standby** to cancel the alarm, hand steer closer to the track, and press **auto** and **track** again.

4. Check that it is safe to turn onto the new course.
5. Press the **track** key. The boat will turn onto the new course and the alarm will be cancelled.





The display shows the new bearing to waypoint.

## Manual acquisition

For manual track acquisition, when only cross track error data is available:

1. Steer the vessel to within 0.1 nm of track.
2. Bring the heading to within 5° of the bearing to the next waypoint.
3. Press **auto**.
4. Press **track** to enter Track mode.

The display shows the locked pilot heading.

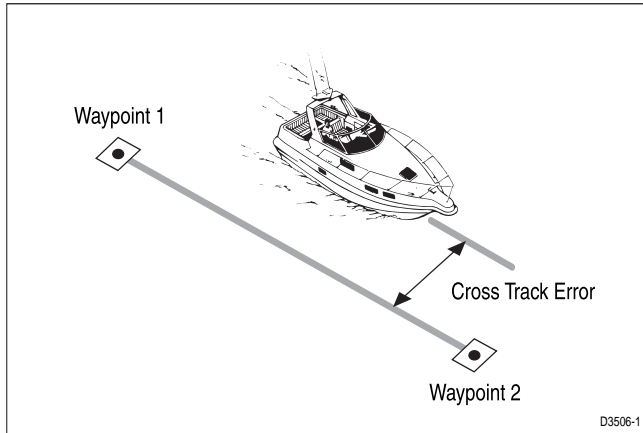
Note that at low speeds, the effect of tidal streams is far more significant than it is at higher speeds. Provided the tidal flow is less than 35% of the vessel's speed, no noticeable difference should occur in the performance of Track mode. However, extra care should be taken during manual acquisition, as follows:

- Ensure that the vessel is as close as possible to track, and the direction made good over the ground is as close as possible to the direction of the next waypoint, before selecting Track mode.

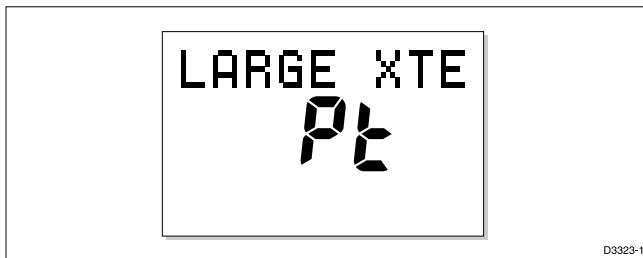
- Make positive positional checks at regular intervals, especially if navigational hazards are close by.

## Cross track error

Cross track error (XTE) is the distance between the current position and a planned route. This is displayed in nautical miles (nm), statute miles (SM) or kilometres, and is taken directly from your navigator.



The Large XTE alarm sounds if the XTE exceeds 0.3 nm



The direction of the error is identified as port (Pt) or starboard (Stb).

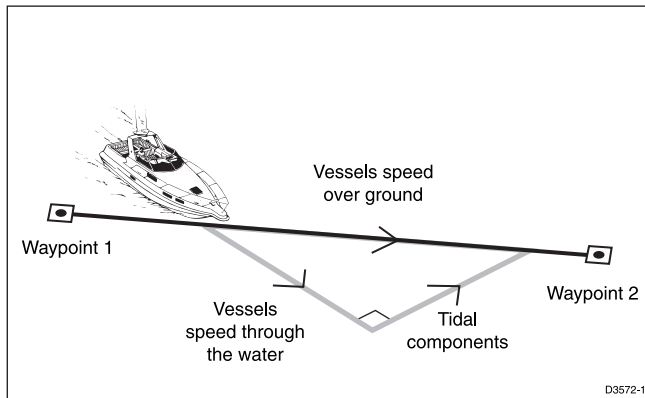
To cancel the alarm and leave track mode, press **standby** to return to hand steering, or **auto** to return to Auto mode and retain the current heading.

**Note:** *If the Large XTE alarm sounds, it is usually an indication that the cross tide is too great for the vessel's current speed.*

## Tidal stream compensation

Under most conditions, Track mode will hold the selected track to within  $\pm 0.05$  nm (300 ft) or better.

The autopilot takes account of vessel speed when computing course changes to ensure optimum performance over a wide range of vessel speeds. If speed data is available, the ST5000 Plus uses the measured vessel speed. Otherwise, the Speed Over Ground (SOG) or specified cruise speed is used, depending on the calibration setting (see *Dealer Setup* in Chapter 4).

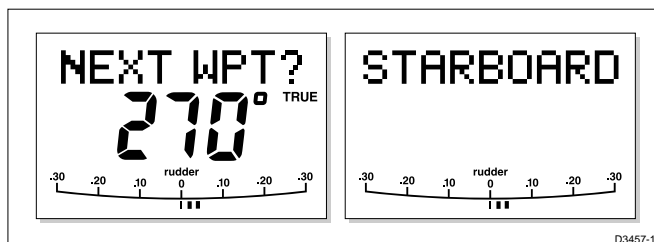


## Waypoint arrival and advance

### Arrival

As the vessel arrives at the target waypoint, the navigation receiver should select (manually or automatically) the next target waypoint.

The ST5000 Plus detects the new target waypoint number, sounds the Waypoint Advance alarm and displays the Waypoint Advance information. This display shows the new bearing to waypoint and the direction the boat will turn to acquire the new track.



To accept the new target waypoint, press **track**.

**Note:** *When you reach the last waypoint in the track, the NO DATA alarm will sound to indicate that there is no further waypoint information. Press **auto** to continue on the same heading, or **standby** to return to hand steering.*

### **Skipping a Waypoint – SeaTalk Navigators Only**

If you wish to advance to the next waypoint before you have arrived at the target waypoint, press **track** for 1 second. The Waypoint Advance information for the next waypoint is displayed.

### **Advance**

While the Waypoint Advance alarm is sounding, Track mode is suspended and the ST5000 Plus maintains the current boat heading.

1. Check that it is safe to turn onto the new track.
2. Press the **track** key. This will cancel the Waypoint Advance alarm and turn the boat towards the next waypoint.

**Note:** *Unless the Waypoint Advance is accepted in the above manner, the alarm will continue to sound and the current heading will be maintained.*

## **Dodges**

Full control is still available from the keypad when the autopilot is in Track mode.

### **Initiating a dodge manoeuvre**

In Track mode, dodge manoeuvres are accomplished by simply selecting the desired course change using the course change keys (**-1**, **+1**, **-10** or **+10**).

### **Cancelling a dodge manoeuvre**

Once the hazard has been avoided, the course change selected for the dodge manoeuvre should be cancelled by selecting an equal course change in the opposite direction.

**Note:** *Provided the vessel remains within 0.1 nm of track, there is no need to steer back towards the track.*

## Safety

Passage making in Track mode removes the chores of compensating for wind and tidal drift, and will aid precise navigation. However, it is important to maintain an accurate log with regular plots.

### Position confirmation at the start of a passage

At the start of a passage you must always confirm the fix given by the position transducer, using an easily identifiable fixed object. Check for fixed positional errors and compensate for them.

### Verifying computed positions

Verify the computed position with a dead reckoned position, calculated from the average course steered and the distance logged.

### Plot frequency

In open water, plots should be at least hourly.

In confined waters, or when potential hazards are near, plots should be more frequent.

Local variations in radio signal quality, and changes in the tidal stream, will produce deviations from the desired track.

### Setting waypoints

When setting waypoints, remember that deviations will occur.

Thoroughly check along each track.

Check up to 0.5 nm each side of the track to ensure that there are no hazards within the zone.

**Note:** *In order for the waypoint advance function to work successfully, the last four characters of adjacent waypoint names must be different.*

### General

The use of Track mode will enable accurate track keeping even in complex navigational situations. However, it cannot remove the responsibility of the skipper to ensure the safety of his vessel at all times by careful navigation and frequent position checks.

## 3.2 Adjusting autopilot performance

The response level and rudder gain can be adjusted during normal operation using a combined key-press. Alternatively, you can set up these two control displays as default Data Pages (see *Section 2.5*).

The default calibration settings for response level and rudder gain, as specified in Dealer Setup, are restored whenever the system is powered on.

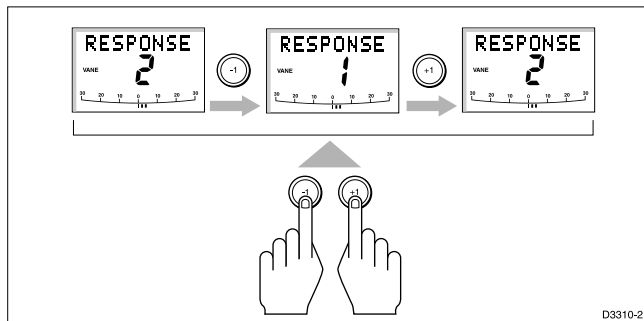
### Changing the response level (AutoSeastate)

The response level controls the relationship between the autopilot's course keeping accuracy and the amount of helm/drive activity.

- **Response Level 1**, AutoSeastate (Automatic Deadband), causes the autopilot to gradually ignore repetitive movements of the vessel and only react to true variations in course. This provides the best compromise between power consumption and course keeping accuracy, and is the default calibration setting.
- **Response Level 2** (Minimum Deadband) provides the tightest course keeping possible. However, tighter course keeping results in increased power consumption and drive unit activity.

The response can be changed at any time. To do so:

1. Press the **+1** and **-1** keys together momentarily to display the Response screen.
2. Press **+1** or **-1** to change the response level.
3. Wait for 5 seconds, or press **disp**, to return to the previous display.



## Changing the rudder gain

Press the **+1** and **-1** keys together for 1 second to display the Rudder Gain screen, and adjust the setting in the same way as for the response level. Refer to *Chapter 6, Post installation procedures*, for instructions on how to check that the rudder gain is set correctly.

### **WARNING:**

**It is important that the rudder gain is correctly set on planing craft. Incorrect adjustment will lead to poor steering performance and is dangerous at high speeds.**

## 3.3 Alarms

This section summarises the alarms (in order of priority) that are reported by the ST5000 Plus.

Press **standby** to clear an alarm and return to hand steering, unless indicated otherwise.

### **SeaTalk failure**

STLK FAIL

This silent alarm indicates that there is a wiring fault in the SeaTalk connection.

### **Auto release**

AUTO RELSE

This alarm is only reported for ST5000 Plus Sterndrive systems, and indicates that autopilot control has been released following manual movement of the helm. The alarm is cancelled automatically after 10 seconds.

### **Off course**

OFFCOURSE

This alarm is activated when the vessel has been off course from the locked heading by more than the specified angle for more than 20 seconds (see section 2.3, *Using Auto mode*).

The alarm is cleared if the heading recovers or the course is changed, or if the operating mode is changed.

## Large cross track error

### LARGE XTE

This alarm is activated when the cross track error exceeds 0.3 nm (see *Section 3.1, Operation in Track mode*).

The alarm is cleared if the heading recovers or the course is changed, or if the operating mode is changed.

## Drive stopped

### DRIVESTOP

This alarm is activated if:

- the rudder reference transducer fails.
- the autopilot is unable to turn the rudder. This occurs if the weather load on helm is too high, or if the rudder position is past the preset rudder limits or the rudder end-stops.

## Data not received

### NO DATA

This alarm is displayed in the following circumstances:

- Compass not connected
- Track mode is engaged and the vessel arrives at the last waypoint in the track
- Track mode is engaged and the autopilot is not receiving SeaTalk navigation data.
- Track mode is engaged and the position transducer (GPS, Loran, Decca) is receiving a low strength signal – this will clear as soon as the signal strength improves.

The autopilot stops adjusting the heading as soon as data is lost.

## Waypoint advance

### NEXT WPT?

The Waypoint Advance alarm sounds whenever the target waypoint number changes, which occurs in the following circumstances:

- Automatic acquisition is selected by pressing **track** from Auto mode
- When the vessel arrives at the target waypoint and the navigator accepts the next waypoint.



- Waypoint advance is requested by pressing **track** for 1 second in Track mode (SeaTalk Navigators only).
- When the Man Overboard (MOB) function is activated in Track mode.

When the alarm sounds, the pilot continues on its current heading, but displays the bearing to the next waypoint and the direction in which the boat will turn to take up that bearing.

Check that it is safe to turn onto the new track, and press **track** to accept the waypoint advance.

Alternatively, to cancel the alarm without accepting the waypoint advance, press **standby** to return to hand steering, or **auto** to return to Auto mode.

***Note:** The waypoint advance will only operate on pilots receiving valid bearing to waypoint and waypoint number information.*

## Low battery

### LOW BATT

The Low Battery alarm sounds when the supply voltage drops below 10 V ( $\pm 0.5$  V).

Press **STANDBY** to clear the alarm and return to hand steering.

Start the engine to recharge the battery.

## Watch alarm

### WATCH

The Watch alarm is activated in Watch mode when the timer reaches 4 minutes. It is not available from Standby mode.

If you wish to set the Watch mode, the WATCH screen must be configured as one of the Data Pages for display, as described in section 4.1.

To set and control the Watch alarm:

1. Select Auto, Track or Vane mode.
2. Press the **disp** key until the WATCH Data Page is displayed.

- The watch timer starts counting.
  - When the timer reaches 3 minutes, the text on the display starts flashing to indicate the last minute of Watch alarm.
  - When the timer reaches 4 minutes, the audible Watch alarm is activated.
3. Press **auto** at any time to silence the alarm and reset the timer to 4 minutes. (Pressing any other key resets the timer and performs the key's normal function.)
  4. To clear Watch mode, press **disp** to display a different page, or press **standby**.

**Note:** *You cannot engage Auto mode from Watch mode – pressing **auto** only resets the Watch timer.*

## **Shallow alarm**

### SHALLOW

The Shallow alarm is activated on the ST5000 Plus if a shallow depth alarm is received via SeaTalk.

Press **standby** or **disp** to cancel the alarm.

## **Man overboard (MOB)**

If a man overboard (MOB) message is received from another instrument on the SeaTalk system, the text MOB is shown instead of the waypoint number for the XTE, DTW and BTW Data Pages.

If the autopilot is operating in Track mode, the Waypoint Advance alarm will sound to notify the change in waypoint.

## Chapter 4: Customising the ST5000 Plus

The ST5000 Plus provides setup and configuration options that are used to adjust the settings for the ST5000 Plus itself, the compass, and the autopilot.

**Note:** *You should perform the post installation procedures described in Chapter 6 before adjusting any other calibration features.*

There are three setup levels:

- **User Setup**, which controls compass setup, rudder calibration and the ST5000 Plus display features
- **Intermediate Setup**, which displays version number information
- **Dealer Setup**, which controls the autopilot settings, and also the calibration lock which can be used to prevent accidental access to User and Intermediate Setup

The ST5000 Plus is calibrated at the factory to provide stable performance for most yachts. Although many of the setup and calibration features available in the ST5000 Plus can be fine tuned, it should not normally be necessary to adjust the Dealer Setup values once the initial installation and trials have been performed.

### 4.1 User setup

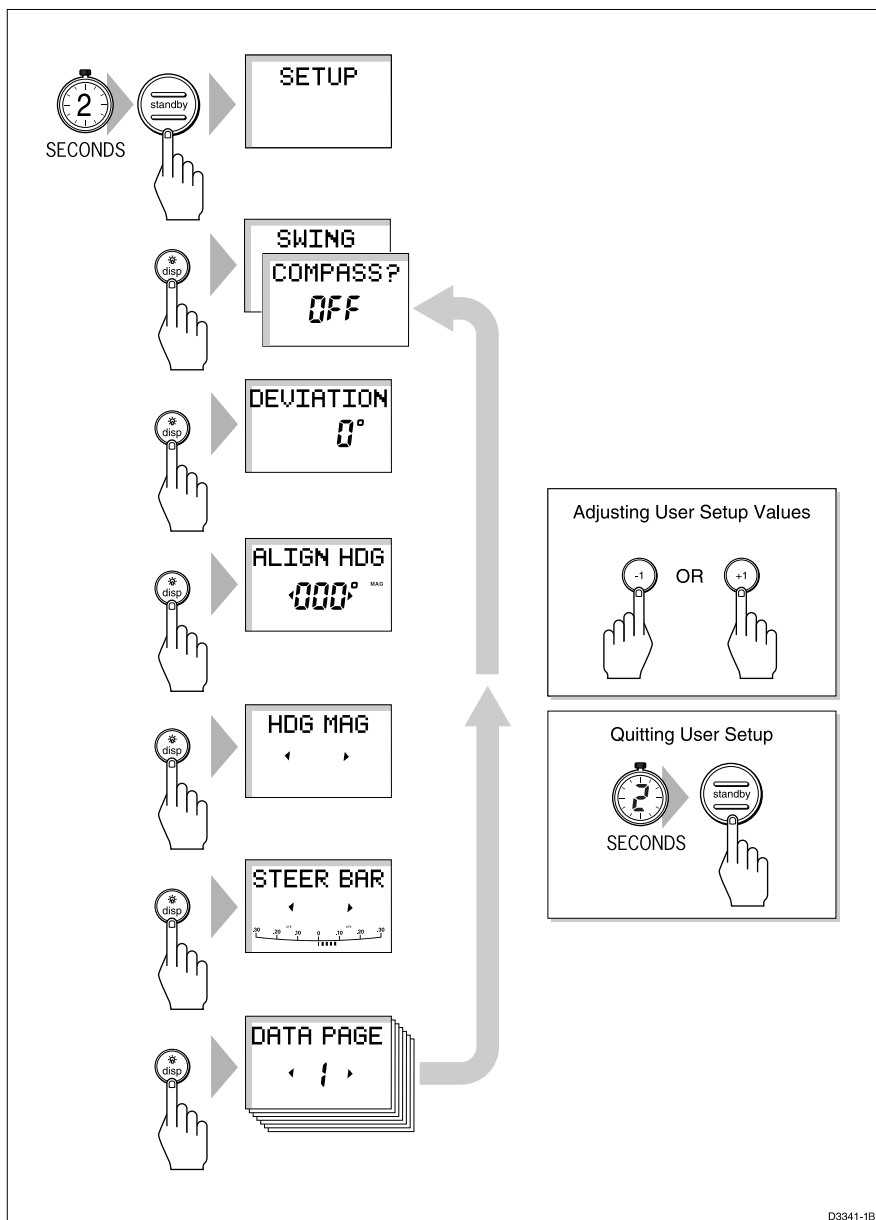
The flow chart on the following page shows the User Setup control procedure, and the setup screens with their default settings. Information on the functions of the different settings is given in the remainder of this section.

The following points should be considered:

- If the CAL LOCK screen is displayed instead of the initial page, you need to turn off the lock feature in *Dealer Setup*
- Setup options are always saved on exit

### Compass deviation correction (SWING COMPASS)

The compass deviation correction option allows you to correct the compass for deviating magnetic fields. The procedure must be performed as the first item in your initial sea trial, and is described in detail in *Chapter 6, Post Installation Procedures*.



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## Deviation display (DEVIATION)

The deviation screen shows the current deviation value, calculated from the correction procedure (Swing Compass). You cannot edit this value.

## Heading alignment (ALIGN HDG)

The heading alignment screen is used to align the autopilot compass with the ship's compass.

- Steer your vessel onto a known heading.
- Adjust the displayed heading using the **-1**, **+1**, **-10** and **+10** keys.
- Check the autopilot display on various headings and adjust as necessary.

## Heading mode (HDG MAG/TRUE)

Select either magnetic or true heading mode. When heading data is displayed in normal operation, the screen indicates whether true or magnetic mode has been selected.

## Bar selection (RUDD BAR/STEER BAR/NO BAR)

Select the type of bar graph that is shown at the bottom of the displays. The options are as follows:

**RUDD BAR:** This shows the rudder position, and is the default setting for Hydraulic systems. Note that a rudder reference transducer is required for accurate rudder position information.

**STEER BAR:** This is the default setting for Sterndrive systems. The bar graph is used as follows:

| Mode         | Bar   |
|--------------|---|
| Standby      | Rudder bar for systems with a rudder reference transducer |
| Auto compass | Heading error bar   |
| Track        | Cross Track Error (XTE) bar                               |

## Data pages (DATA PAGE)

The next 7 User Setup pages allow the settings for the Data Pages to be modified. These are the SeaTalk/NMEA data pages available during normal operation (see section 2.5).

Each setup page initially shows the title DATA PAGE. After 1 second, this changes to the title of the data currently set for that page.

The available pages are as follows:

| <b>Data</b>                  | <b>Displayed as</b> |
|------------------------------|---------------------|
| Speed Knots                  | SPEED KTS           |
| Log                          | LOG XXXX.X          |
| Trip                         | TRIP XXX.X          |
| Average Speed, Knots         | AV. SPD KTS         |
| Wind Direction               | E.g. WIND PORT      |
| Wind Speed                   | WIND KTS            |
| Depth Metres                 | DEPTH M             |
| Depth Feet                   | DEPTH FT            |
| Depth Fathoms                | DEPTH FA            |
| Heading                      | HEADING             |
| Water Temperature, Degrees C | WATER °C            |
| Water Temperature, Degrees F | WATER °F            |
| Course Over Ground           | COG                 |
| Speed Over Ground, Knots     | SOG KTS             |
| Cross Track Error            | XTE                 |
| Distance to Waypoint         | DTW                 |
| Bearing to Waypoint          | BTW                 |
| Rudder Gain                  | RUDD GAIN           |
| Response                     | RESPONSE            |
| Watch                        | WATCH               |
| Universal Time Constant      | UTC                 |

There are three depth pages and two water temperature pages. Data is displayed in the units defined by the selected page.

The default settings are:

| <b>Data Page</b> | <b>Default Setting</b>   | <b>New Setting</b> |
|------------------|--------------------------|--------------------|
| 1                | XTE Cross Track Error    |                    |
| 2                | BTW Bearing to Waypoint  |                    |
| 3                | DTW Distance to Waypoint |                    |
| 4                | NOT USED                 |                    |
| 5                | NOT USED                 |                    |
| 6                | NOT USED                 |                    |
| 7                | NOT USED                 |                    |

For each setup page, scroll forwards or backwards through the available data pages, using the **+1** or **-1** keys.

**Note:** *If you set a page to NOT USED, it is omitted from the display cycle during normal operation. For example, with the default page settings only three pages are displayed in the sequence.*

Press **disp** to move on to the next Data Page selection screen, and repeat the selection procedure.

**Note:** *If a man overboard (MOB) message is received by the autopilot, the BTW and DTW pages display the bearing and distance to the MOB location, so it is good practice to retain these pages for display.*

## 4.2 Dealer setup

Dealer Setup allows you to customise the autopilot to your boat. However, the factory default settings will provide safe performance for the initial sea trial, and fine tuning is not normally required.

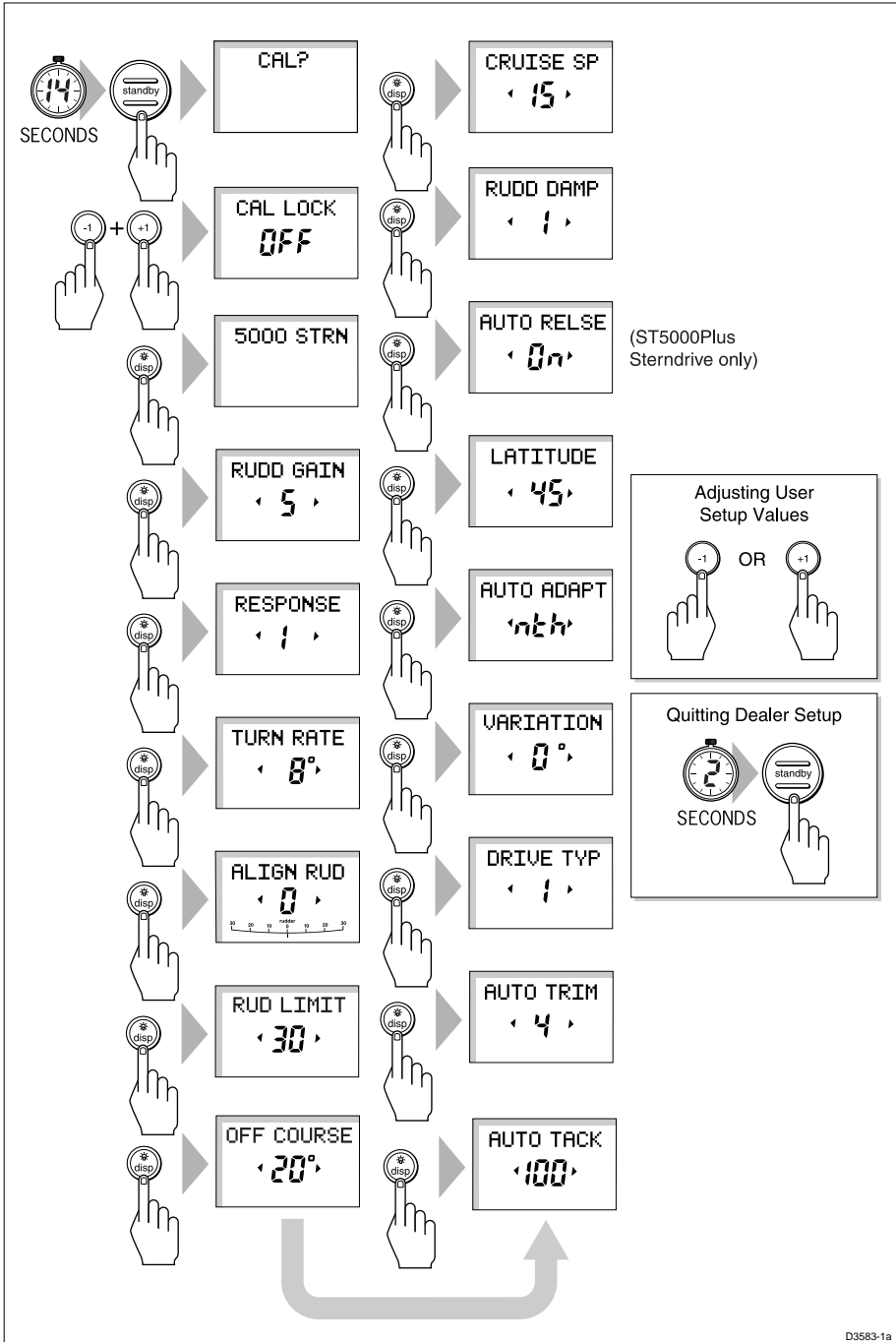
The flow chart on the next page shows you how to enter Dealer Setup, scroll through the setup displays, adjust the values and exit.

The features that can be adjusted are listed in the table following the flowchart. If you change any of the settings you can record them in the *New Setting* column for future reference.

Information on the functions of the different settings is given in the remainder of this section. The following points should be noted:

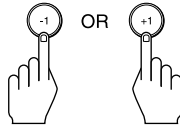
- Make sure that the autopilot is in Standby mode before you access Dealer Setup
- Setup options are always saved on exit



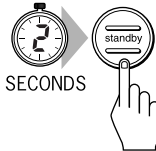


(ST5000Plus Sterndrive only)

Adjusting User Setup Values



Quitting Dealer Setup



| <b>Feature</b>   | <b>Options/<br/>Range</b>                  | <b>Default Setting<br/>Stern</b> | <b>Hydr</b> | <b>New<br/>Setting</b> |
|------------------|--|----------------------------------|-------------|------------------------|
| Calibration lock | ON or OFF                                  | OFF                              | OFF         |                        |
| Pilot type       | 5000 STRN, HYDR                            | 5000 STRN                        | 5000 HYDR   |                        |
| Rudder gain      | 1 to 9                                     | 5                                | 5           |                        |
| Response         | 1 (AutoSeastate) or<br>2 (no AutoSeastate) | 1                                | 1           |                        |
| Turn rate limit  | 5 to 20                                    | 8                                | 8           |                        |
| Align Rudder     | -7 to +7                                   | 0                                | 0           |                        |
| Rudder Limit     | 15 to 40                                   | 15                               | 30          |                        |
| Off course alarm | 15 to 40                                   | 20                               | 20          |                        |
| AutoTack         | 40 to 125                                  | 100                              |             |                        |
| AutoTrim         | OFF, 1 to 4                                | 4                                | 4           |                        |
| Drive type       | 1 (soft drive) or<br>2 (hard drive)        | 1                                | 2           |                        |
| Variation        | -30 +30                                    | 0°                               | 0°          |                        |
| AutoAdapt        | OFF, nth, Sth                              | nth                              | nth         |                        |
| Latitude         | 0 to 80                                    | 45°                              | 45°         |                        |
| AutoRelease      | ON or OFF                                  | ON                               | N/A         |                        |
| Rudder damping   | 1 to 9                                     | 1                                | 1           |                        |
| Cruise speed     | 4 to 60                                    | 15                               | 15          |                        |

## Calibration lock

Calibration lock controls whether User Setup and Intermediate Setup are available, and is intended for charter boat users.

## Pilot type

The default settings should be retained (5000 STRN for sterndrive systems, and 5000 HYDR for hydraulic systems).

## Rudder gain

This is the power-on rudder gain setting and should be adjusted to the setting that gives the best steering performance as described in *Chapter 6*.

## Response

This is the power-on response setting. The response level can be changed during normal operation (see *Section 3.2*) or via the Response Data Page, if this is set for display (see *Section 2.5*).

## Turn limit

This limits the rate of turn of your vessel when under autopilot control. The value must be within the range 5 to 20°. For sailboat applications it should be set to 20°.

## Align rudder (Rudder Offset)

Set this option if your system includes a rudder reference unit.

1. Manually centre the helm. The reported rudder angle is indicated on the rudder bar graphic at the bottom of the screen.
2. Adjust the offset, using the **+1** and **-1** keys, until the rudder position is shown as central on the rudder bar. The offset must be within -7° to +7°.
3. If required, move the rudder reference unit and repeat this procedure.

## Rudder limit

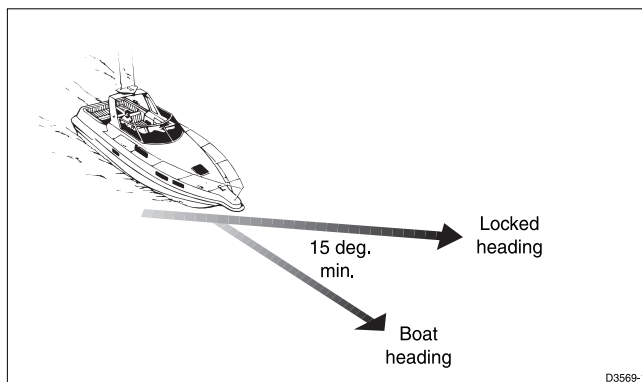
The rudder limit function enables you to set the limits of autopilot rudder control just inside the mechanical end stops, and thereby avoid putting the steering system under unnecessary load. The adjustment range is from 15° to 40° of rudder movement.

If your boat is fitted with a rudder reference transducer, set the autopilot rudder limit as follows:

1. Manually set the rudder to each end stop (port and starboard), and in each case use the rudder bar on the display, to determine the end-stop angle.
2. Access the rudder limit screen (RUD LIMIT).
3. Set the autopilot rudder limit so that it is  $5^\circ$  less than the smallest (port or starboard) mechanical end stop angle.

## Off course alarm

This feature controls the alarm that warns you if the autopilot is unable to maintain its set course. The alarm operates if the pilot strays off course by more than the alarm angle limit for more the 20 seconds. The value must be within  $15^\circ$  to  $40^\circ$ , and can be adjusted in  $1^\circ$  steps.



## AutoTack angle

The AutoTack angle is the angle through which the vessel will turn when automatic tack is selected (see *Chapter 2*). The value must be within the range  $40$  to  $125^\circ$ , and can be adjusted in  $1^\circ$  steps.

## AutoTrim

The AutoTrim level 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. The settings are:

| <b>Setting</b> | <b>Effect</b>          | <b>Recommended for:</b>                                       |
|----------------|------------------------|---|
| Off            | No trim correction     |   |
| 1              | Slow trim correction   | Heavy displacement vessels, with full keel or transom rudder. |
| 2              | Medium trim correction | Heavy displacement vessels.                                   |
| 3              | Fast trim correction   | Moderate to light displacement vessels.                       |
| 4              | Super fast correction  | Planing power vessels   |

The default settings should provide optimum performance with the ST5000 Plus autopilots. However, depending on the vessel's dynamic stability, an incorrect rate of trim application may result in poor course keeping due to autopilot instability. After gaining experience with the ST5000 Plus, you may wish to change the setting. The effect of the setting must be evaluated while under sail.

- Decrease the AutoTrim level if the autopilot gives unstable course keeping or excessive drive activity with a change in the heel angle.
- Increase the AutoTrim level if the autopilot reacts slowly to a heading change due to a change in the heel angle.

## Drive type

Drive type controls the way which the autopilot drives the steering system. The default settings (soft drive for mechanically driven vessels, and hard drive for hydraulic systems) should be retained.

## Variation

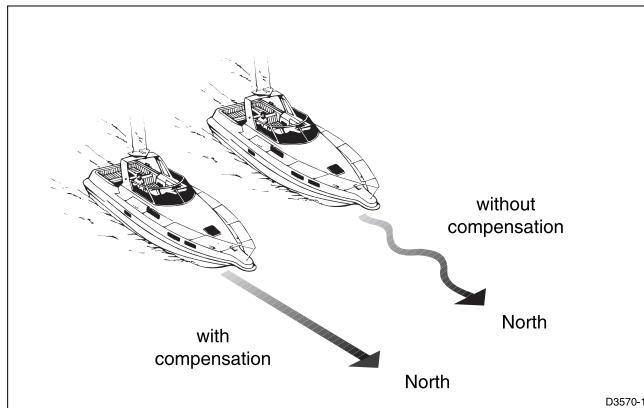
If required, set this to the level of magnetic variation present at your vessel's current position – indicated as East (E) or West (W). The variation setting is sent to other instruments on the SeaTalk system, and can be updated by other SeaTalk instruments.

## AutoAdapt

The patented AutoAdapt feature allows the ST5000 Plus to compensate for heading errors at higher latitudes, which are caused by the increasing dip of the earth's magnetic field. 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.

Set AutoAdapt to **nth** in the northern hemisphere, or **Sth** in the southern hemisphere. You then need to enter your current latitude in the next setup screen, so that the ST5000 Plus can provide accurate course keeping by automatically adjusting the rudder gain depending on the heading.



## Latitude

This screen is only displayed if AutoAdapt is set to **nth** or **Sth**.

Use the **+1** and **-1** keys to set the value to your vessel's current latitude, to the nearest degree.

**Note:** *If valid latitude data is available via SeaTalk or NMEA, it will be used instead of this calibration value.*

## AutoRelease

This is displayed on ST5000 Plus sterndrive systems and controls the emergency steering release. It should normally be set to **ON**.

## Rudder damping

Set this option if your system includes a rudder reference unit and the drive “hunts” when trying to position the rudder. Test this when your vessel is moored dockside, by pressing **auto** and then **+10**. If the helm overshoots and has to drive back or starts to hunt back and forth, you need to increase the damping level.

Adjust the damping one level at a time, and always use the lowest acceptable value.

## Cruise speed

If boat speed is not available via SeaTalk or NMEA, cruise speed should be set to the boats normal cruising speed.





# Chapter 5: Installation

## 5.1 Planning the installation

This chapter explains how to install and connect the following:

- Control head
- Fluxgate compass
- Rudder reference transducer (optional on sterndrive systems)
- Sterndrive actuator (sterndrive systems only)
- Hydraulic pump (hydraulic systems only)
- NMEA interface

Before starting the installation, decide how you will site the units and run the cables.

### EMC installation guidelines

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

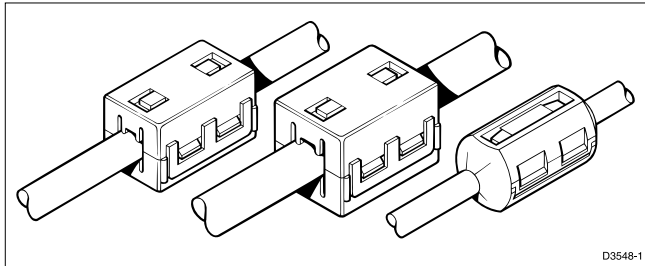
To minimise the risk of operating problems:

- All Raymarine equipment and cables connected to it should be:
  - At least 1 m (3 ft) 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 2 m (7 ft).
  - More than 2 m (7 ft). 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 should be supplied from a different battery than the one used for engine start. Voltage drops below 10 V in the power supply to our products can cause the equipment to reset. This will not damage the equipment, but will cause the loss of some information and can change the operating mode.

- Raymarine specified cables should be used at all times. Cutting and rejoining these cables can compromise EMC performance and so 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 has to be removed during installation it must be reassembled in the same position.

## Suppression Ferrites

The following illustration shows the typical range of suppression ferrites fitted to Raymarine equipment. Always use the ferrites specified by Raymarine.



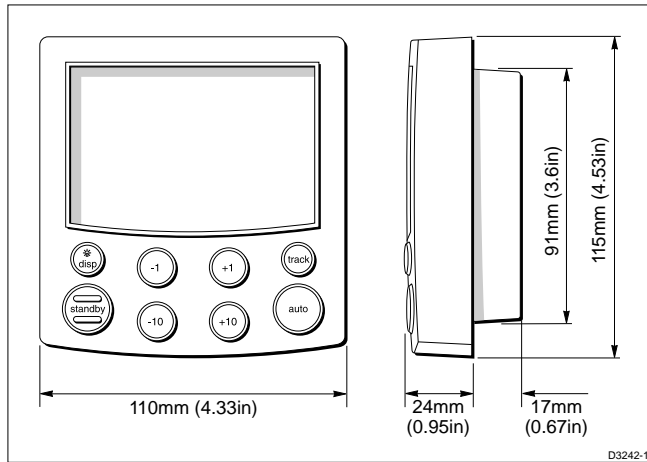
## Connections to Other Equipment

If your Raymarine equipment is going to be connected to other equipment using a cable not supplied by Raymarine, a suppression ferrite **MUST** always be fitted to the cable close to the Raymarine unit.

## Cabling

- Avoid running cables through bilges where possible
- Secure coiled lengths at regular intervals
- Avoid running cables close to fluorescent lights, engines, radio transmitting equipment etc.

## 5.2 Control head



### Siting

The control head is completely waterproof and should be sited where it is:

- Within easy reach of the steering position
- Viewed straight on, or with a maximum viewing angle of 30°
- Protected from physical damage
- At least 230 mm (9 in) from any compass
- At least 1 m (3 ft) from any radio/radar receiving/transmitting equipment
- Accessible from behind to secure and run cables

**Note:** *The back cover is designed to breath through the cable boss to prevent moisture accumulation. This must be protected from the weather by following the mounting procedure.*

### Mounting procedure

Control heads are available in surface mount and flush mount styles. Use the appropriate procedure to mount your instrument, but in each case, ensure that:

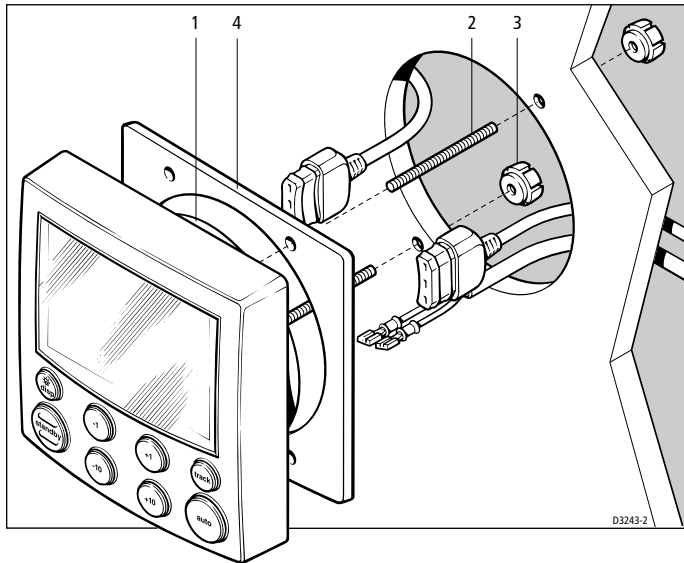
- The selected location is clean, smooth and flat.
- There is sufficient space behind the selected location to accommodate the rear of the control head and connectors.

**Note:** *Adjacent control heads, or instruments, must have a 6 mm (1/4 in) gap between them to allow sun covers to be fitted.*

## Surface mounting

To fit a surface mount control head:

1. Apply the surface mount template (supplied near the rear of this handbook) to the selected bulkhead.
2. Mark the centres of the two fixing holes and the cable boss.

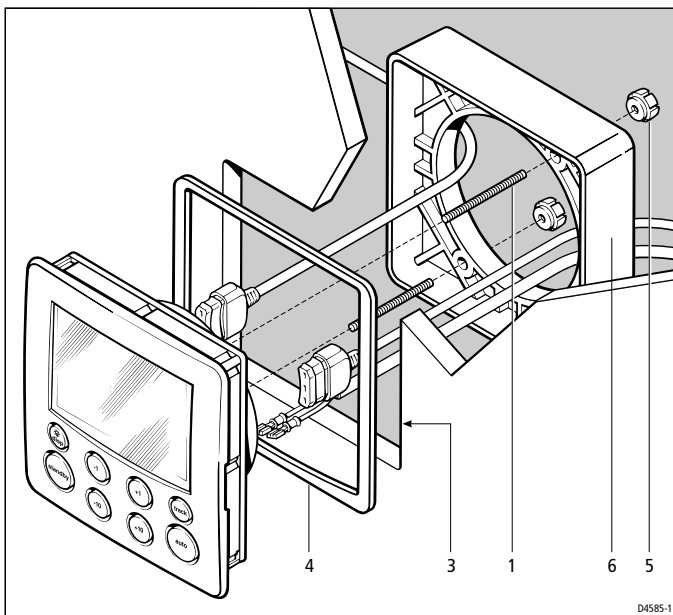


3. Drill two 4 mm (5/32 in) diameter holes for the fixing studs.
4. Use a 90 mm (3.5 in) diameter cutter to drill the hole for the cable boss (1).
5. Peel off the protective sheet from the self-adhesive gasket (4) then stick the gasket into position on the rear of the control head bezel.
6. Screw the fixing studs (2) into the display head.
7. Pass the cables (SeaTalk, power, compass etc.) through the bulkhead and connect them to the appropriate terminals (see relevant subsection for connection details).
8. Assemble the control head to the bulkhead.
9. Secure the control head with the thumb nuts (3) provided. Tighten the thumb nuts **BY HAND**. Do NOT use a wrench.

## Flush mounting

To fit a flush mount control head:

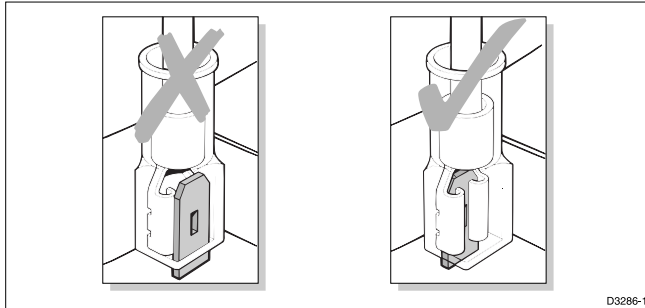
1. Ensure that the panel on which you intend to mount the control head is between 3 mm and 20 mm thickness.
2. Apply the flush mount template (supplied near the rear of this handbook) to the selected location and mark out the aperture into which the control head will sit.
3. Cut out the aperture (3) for the control head and remove the template.
4. Peel off the protective sheet from the self-adhesive gasket (4) then stick the gasket into position on the rear of the control head bezel.



5. Screw the two fixing studs (1) into the threaded sockets on the rear of the control head.
6. Pass the cables (SeaTalk, power, compass etc.) through the bulkhead and connect them to the appropriate terminals (see relevant subsection for connection details).
7. Mount the assembled control head, studs, and gasket into the panel.
8. Locate the bracket (6) onto the fixing studs and secure the assembly to the panel with the thumb-nuts (5). Tighten the thumb nuts **BY HAND**. Do **NOT** use a wrench.

## Cable connectors

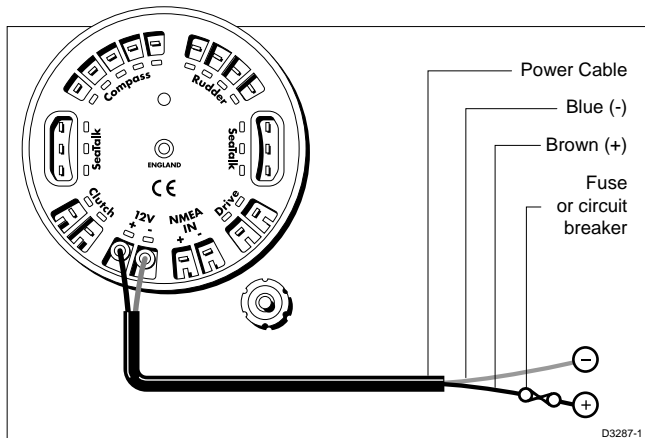
- All connections, except for the SeaTalk cables, are made via spade connectors.
- When fitting the spade connectors, make sure the connector fits securely over the blade and not between the connector and its plastic insulating boot – incorrect fitting will give intermittent contact which will lead to faulty autopilot operation.



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## Power supply connection

- The head unit requires its own dedicated power supply. It cannot source power from SeaTalk, and must supply the power to the rest of the SeaTalk system.
- The ST5000 Plus is supplied with a 2 m (6.5 ft) power lead terminated with 1/4 in (6 mm) spade connectors.
- A circuit breaker or fuse (12 A for sterndrives and 20 A for hydraulics) must be fitted to the +12 V supply.



D3287-1

- If the supplied power lead is too short, the lead can be extended if required. The table shows the minimum acceptable cable sizes:

### Hydraulic

| Cable Length        | Copper Area         | AWG |
|---------------------|---------------------|-----|
| Up to 2.5 m (8 ft). | 2.5 mm <sup>2</sup> | 14  |
| Up to 4 m (13 ft)   | 4 mm <sup>2</sup>   | 12  |

### Stern Drive

| Cable Length        | Copper Area         | AWG |
|---------------------|---------------------|-----|
| Up to 2.5 m (8 ft). | 1 mm <sup>2</sup>   | 18  |
| Up to 4 m (13 ft)   | 1.5 mm <sup>2</sup> | 16  |
| Up to 6 m (19.5 ft) | 2.5 mm <sup>2</sup> | 14  |

**Note:** *Correct cable size is critical for correct autopilot operation. If the cable is too small, a voltage drop will occur between the supply and the control head. This will reduce the power to the drive, causing slower response to course changes and corrections.*

## Connection to the SeaTalk bus

SeaTalk cables are not supplied with the equipment, as different installations have different cabling requirements.

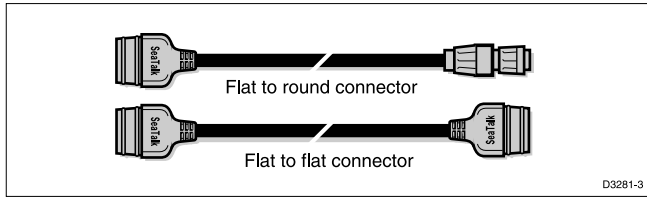
### SeaTalk cables

The following table lists the standard SeaTalk cables available from your Raymarine dealer:

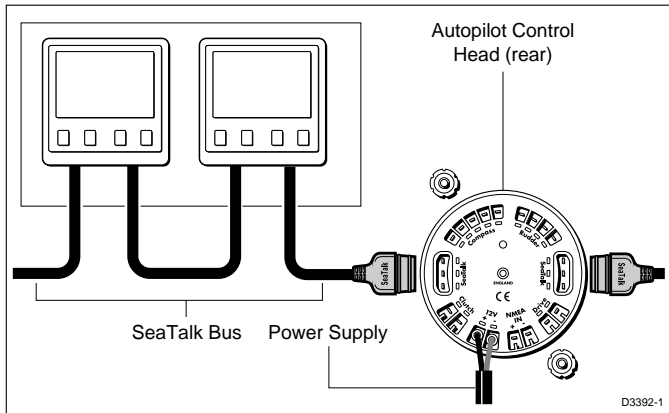
| Part No: | Description  |
|----------|--|
| D187     | Flat to a male round connector – 0.15 m (6 in) long    |
| D188     | Flat to a female round connector – 0.3 m (12 in) long  |
| D284     | Flat moulded plugs at both ends – 1 m (3 ft 3 in) long |

| Part No: | Description   |
|----------|---|
| D285     | Flat moulded plugs at both ends – 3 m (9 ft 9 in) long  |
| D286     | Flat moulded plugs at both ends – 6 m (19 ft 6 in) long |
| D287     | Flat moulded plugs at both ends – 9 m (29 ft 3 in) long |

### Cable types



### Typical SeaTalk cabling

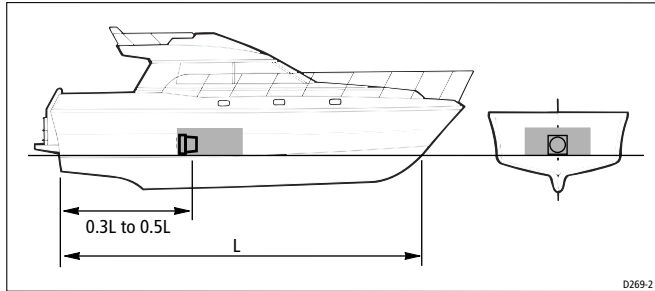


## 5.3 Fluxgate compass

Correct positioning of the fluxgate is crucial if ultimate autopilot performance is to be achieved.

The fluxgate should, to minimise gimbal disturbance, be positioned as near as possible to the pitch and roll centre of the vessel.



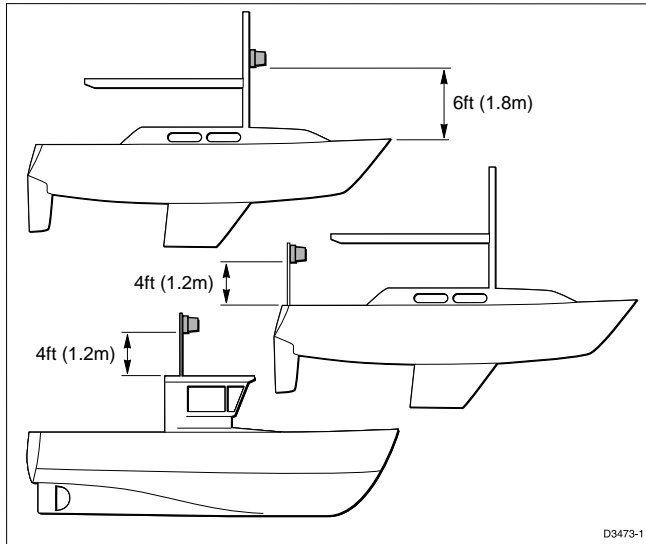


- To avoid deviation of both compasses, the fluxgate compass should be installed at least 0.8 m (2.5 ft) away from the steering compass.
- The fluxgate compass must be positioned as far away as possible from large iron masses, such as the engine and other magnetic devices, which may cause deviation and reduce the sensitivity of the sensor.
- If you have any doubts about the magnetic suitability of the chosen site, the position may be surveyed using a simple hand bearing compass. The hand bearing compass should be fixed in the chosen position and the vessel swung through 360°.
- Differences between the hand bearing compass and the main steering compass should, ideally, not exceed 20° on any heading.

## Mounting location for steel-hulled vessels

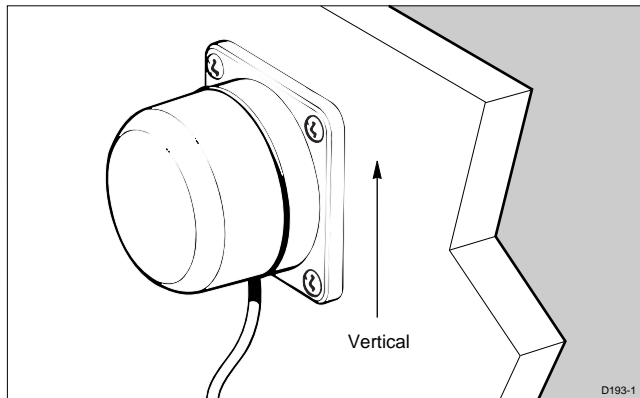
If you have a steel-hulled vessel and mount the compass in the conventional location, you will obtain significant deviation due to the effects of steel on the Earth's magnetic field.

To minimise this effect, you should raise the compass transducer above the main deck or wheelhouse. However, the higher above the waterline you mount the transducer, the more the vessel's pitch and roll will affect the compass performance. Recommended mounting positions are shown in the following diagram.



## Installing the fluxgate compass

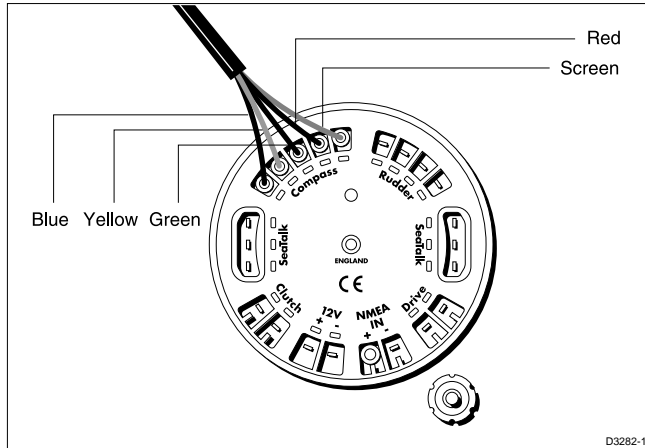
Attach the fluxgate compass to a bulkhead using the four self-tapping screws provided.



**Note:** A label is supplied to warn people of the area in which the compass is mounted. This label should be attached where it can be clearly seen.

## Cabling

1. Route the fluxgate compass cable back to the control head.
2. Connect the five core cable (colour for colour) to the **Compass** terminals.

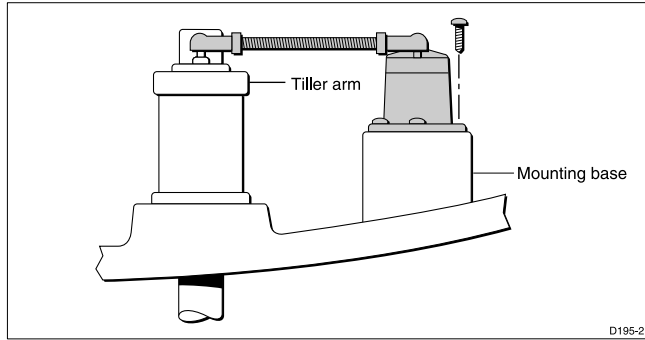


## 5.4 Rudder reference transducer

The rudder reference transducer is supplied with the ST5000 Plus Hydraulic system, and is available as an optional extra (Catalogue No. Z131) for Sterndrive systems. This device provides the autopilot with accurate information on the position of the rudder.

### Mounting position

- The rudder reference transducer should be attached to a suitable base adjacent to the rudder stock.
- The base height must maintain the correct vertical alignment of the transducer arm and tiller arm.
- If it is more convenient, the transducer may be mounted upside down (logo downwards).
- The transducer has a built in spring to remove any free play in the linkage to the tiller. This gives very precise rudder position.
- Transducer arm movement is limited to  $\pm 60^\circ$ .



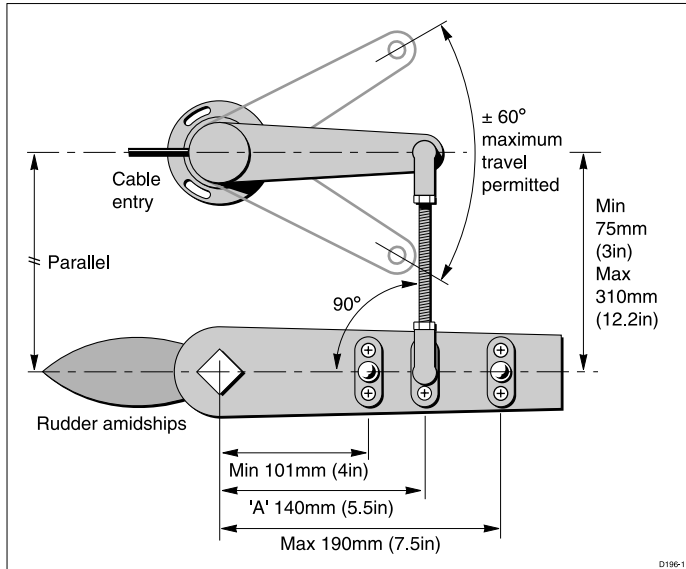
- Care must be taken during installation to ensure the transducer arm is opposite the cable entry when the rudder is amidships. Failure to position the arm correctly could result in damage if the arm is driven onto its end stops by the steering system.

## Control dimensions

- The dimensions must be within the specified limits.
- The tiller and transducer arms must be parallel to each other.
- With the rudder amidships, the transducer arm should be opposite the cable entry and at 90° to the connecting bar.
- Minor adjustments can be made by slackening off the retaining screws and rotating the transducer body.

## Installing the rudder reference transducer

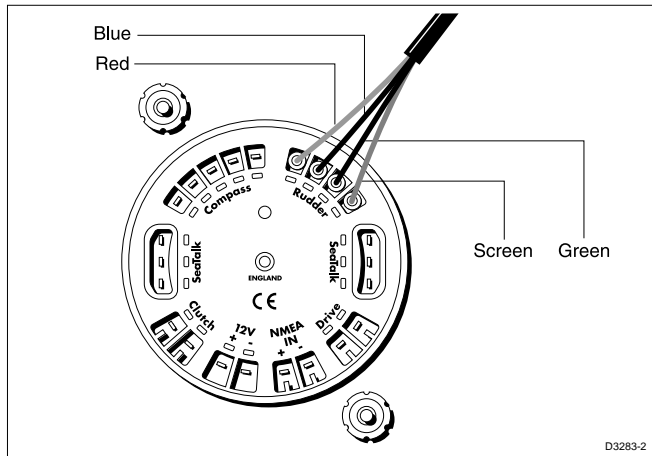
1. The tiller pin must be within the limits shown.
2. Dimension A should, ideally, be 140 mm (5.5 in) – changes within the limits shown will not degrade the autopilot performance but will slightly alter the scaling of the rudder angle display
3. Use the self-tapping screws to secure the tiller pin to the tiller arm.
4. Cut the threaded rod to the required length.
5. Screw on the lock nuts and ball pin sockets.
6. Press the sockets onto the tiller pins.
7. Move the rudder from side to side to ensure the linkage is free from obstructions at all rudder angles.



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## Cabling

1. Run the rudder reference transducer cable back to the control head.
2. Connect the 4 wires (colour for colour) to the **Rudder** terminals.

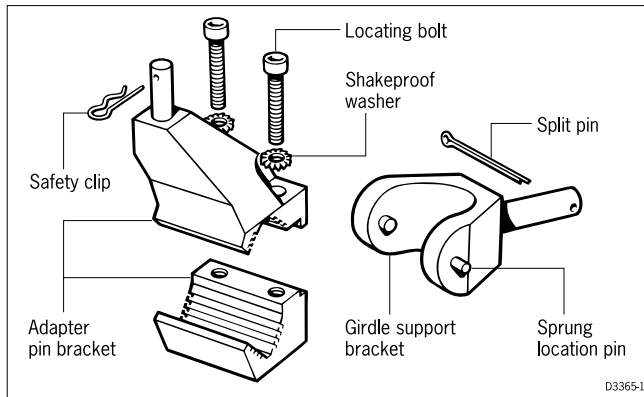


D3283-2

## 5.5 Sterndrive actuator installation

The Sterndrive Actuator can be fitted to power assisted sterndrive systems made by Volvo, Mercruiser, OMC and Yamaha.

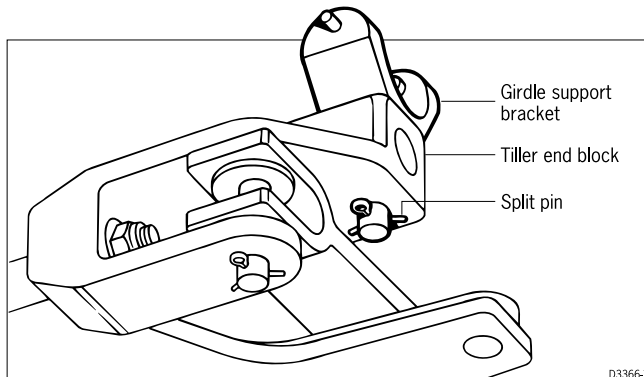
- The ST5000 Plus for the Mercruiser 95 system (Part Number Z329) includes a special installation kit (D309).
- The ST5000 Plus for the Mercruiser 93, OMC, Yamaha and Volvo systems (Part Number Z333) includes the universal installation kit shown in the following diagram.



**Note:** Older Volvo steering systems (Pre type 872215) require a D129 adapter bracket.

### Installation for Volvo (post Type 872215)

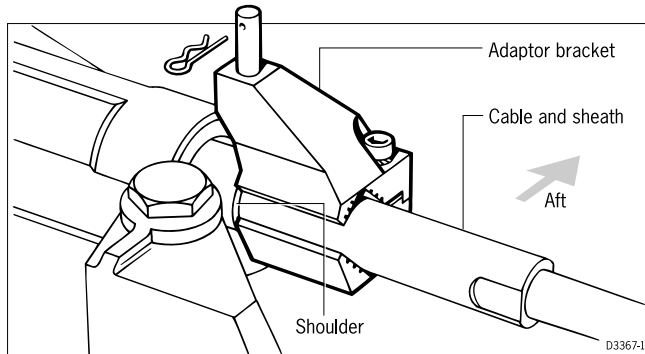
1. Remove the locating pin attaching the cable rod to the tiller end block and replace it with the girdle support bracket.



2. Secure the assembly with the supplied split pin.
3. Install the adaptor pin bracket onto the cable end sheath.

**Note:** *The adaptor pin bracket must sit against, but not on, the shoulder on the cable end sheath. Also, the securing bolts **must** be on the sternside of the steering cable end sheath.*

4. Make sure the bracket is vertical.
5. Tighten the two locating bolts.
6. Rotate the girdle support bracket so that the sprung locator pin is facing forward.
7. Position the sterndrive actuator to locate the fixed support pin (on the girdle support bracket) into its location hole in the girdle tube

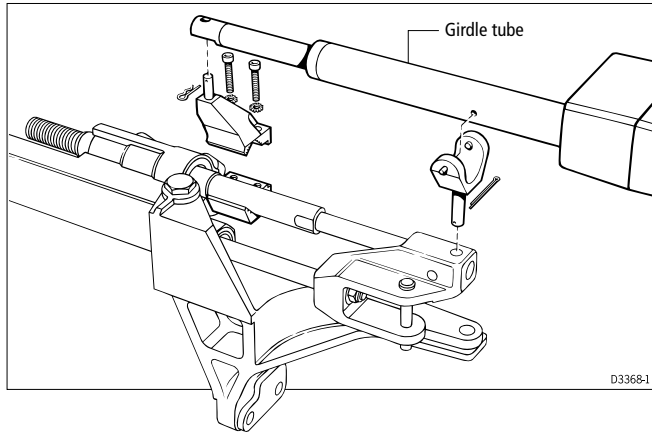


8. Twist and lower the actuator into the girdle support bracket until the spring loaded pin locates in the opposite side of the girdle tube.

**CAUTION:**

**The solid and sprung location pins must be fully engaged in the actuator girdle tube. Failure to do so will result in autopilot failure.**

9. Position the drive unit pushrod over the top of the adaptor pin and secure with the safety clip.



10. Slowly turn the steering system from hard over to hard over.
11. **Make sure that there is no contact between the drive unit and the adaptor pin bracket and any part of the engine or steering system. This includes any engine hoses that may have a passing contact with the autopilot actuator.**

## Installation for Mercruiser 93/OMC/Yamaha

1. Remove the locating pin attaching the cable rod to the tiller end block and replace it with the girdle support bracket as shown.
2. Secure the assembly with the split pin (supplied).
3. With the helm turned hard to port, assemble the adaptor pin bracket onto the cable end sheath.

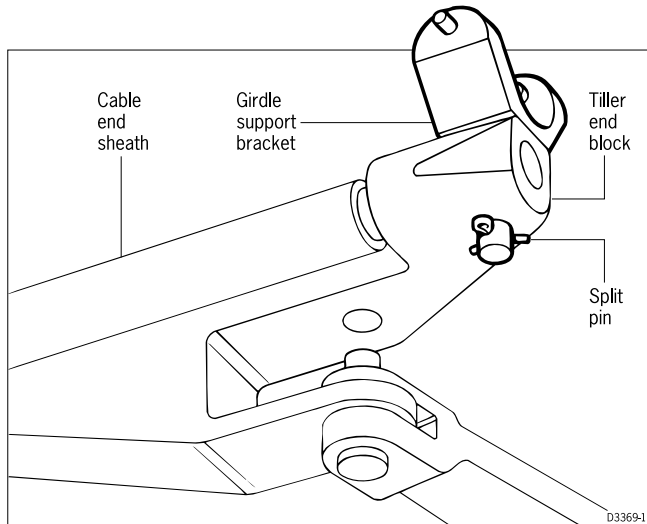
Make sure that the securing bolts are bow side of the cable end sheath. The bracket should be positioned 165 mm (6.5 in) from the girdle support bracket.

4. Make sure that the bracket is vertical.
5. Tighten the two locating bolts.
6. Rotate the girdle support bracket so that the spring loaded locator pin is facing forwards.
7. Position the sterndrive actuator so as to locate the fixed support pin (on the girdle support bracket) into its location hole in the girdle tube.
8. Gently twist and lower the actuator into the girdle support bracket until the spring loaded pin locates into the opposite side of the girdle tube.

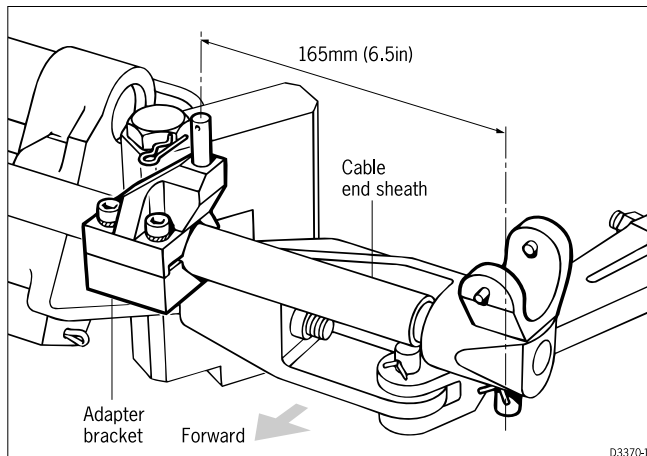


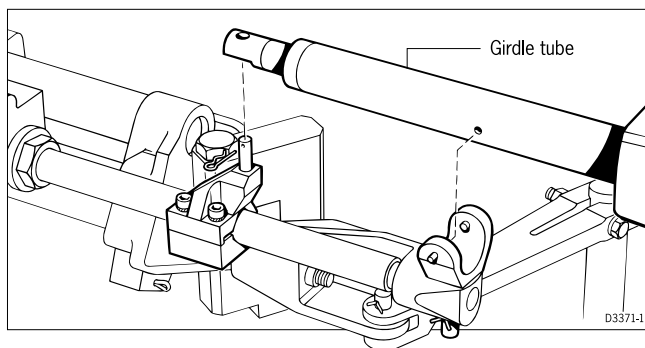
**CAUTION:**

The solid and sprung location pins must be fully engaged in the actuator girdle tube. Failure to do so will result in autopilot failure.



9. Position the drive unit pushrod over the top of the adaptor pin and retain with the safety clip.
10. Slowly turn the steering system from hard over to hard over. **Make sure that there is no contact between the drive unit and the adaptor pin bracket and any part of the engine or steering system. This includes any engine hoses that may have a passing contact with the autopilot actuator.**





## Installation for Mercruiser 95 (Z329)

This section describes how to assemble the Sterndrive Actuator to anti-feedback, power assisted steering systems fitted to Mercruiser engines manufactured after 1993 (D309).

### Important Pre-installation check...

Before you install any of the autopilot components, make sure there is sufficient space between the complete drive unit and the engine manifold.

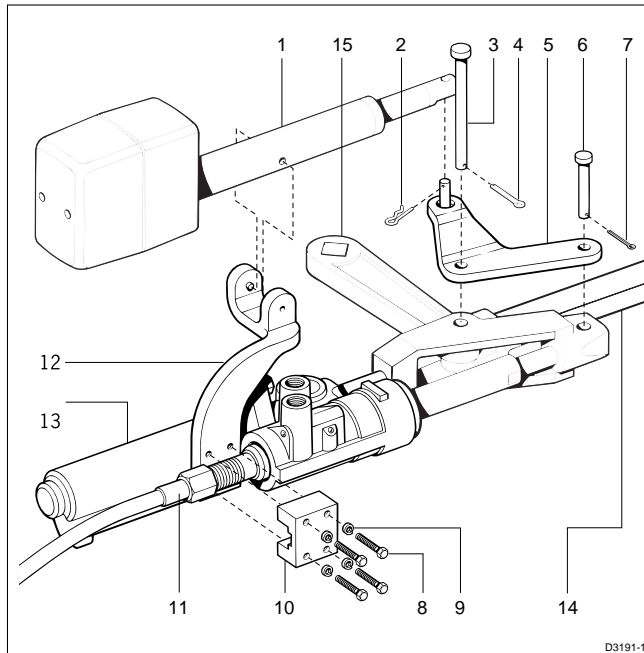
### Installation

The following instructions must be carried out in the order given.

**Note:** *The existing location pin (3) for the tiller and twin-engine connecting bars is retained by a split pin (4). This split pin cannot be easily removed – get someone to assist you during the removal procedure.*

1. Get your assistant to keep the legs of the split-pin closed and stationary while you remove the split pin.
2. Remove the existing location pin securing the tiller bar (15) and the twin-engine connecting bar (14) to the power-steering ram (13).
3. Remove the existing pin (6) connecting the steering cable to the power steering ram.
4. Locate the pivot assembly (5) as shown and fit the retaining pins (3 and 6) – retain the pins with split pins (4 and 7).
5. Position the main support bracket (12) behind the spool valve cable connection (11).

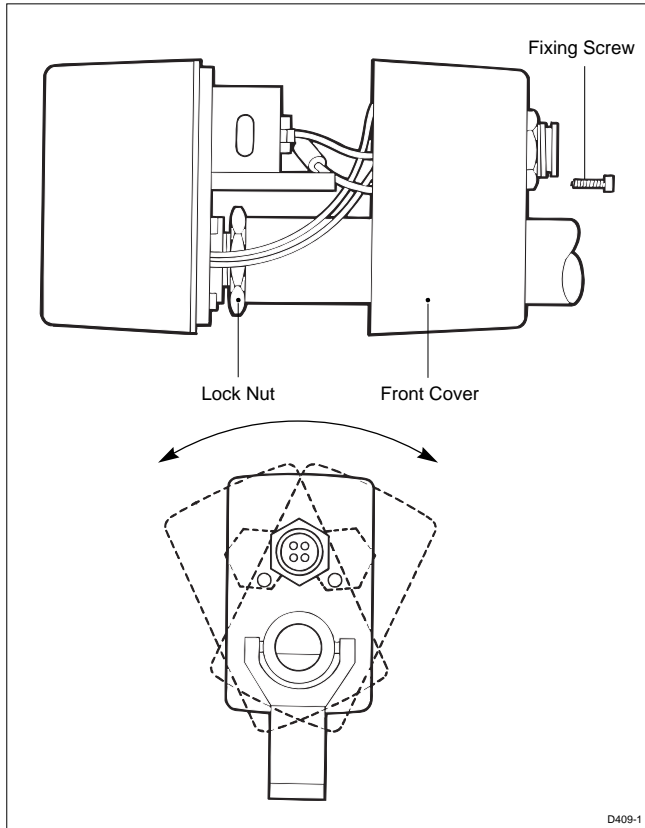
6. Assemble the spring washers (9) to the four bolts (8)
7. Fit the clamp (10) around the spool valve cable connection.
8. Tighten the bolts (8) until the main support bracket is secure.
9. Assemble the shaft of the Sterndrive Actuator (1) to the pivot assembly (5) pin – the flat should rest on top of the pivot assembly.
10. Fit the “R” clip (2) to the pivot assembly (5) pin to retain the Sterndrive Actuator (1).
11. Lower the Sterndrive Actuator (1) into the main support bracket (12). Make sure that the fixed and spring loaded pins locate in the corresponding holes in the outer tube of the Sterndrive Actuator.
12. Make sure that the shaft of the Sterndrive Actuator is parallel with the power steering ram.
13. Slowly turn the steering system from hard-over to hard-over.
14. Make sure the steering system operates correctly – the engine and steering systems must be free from obstructions.



1 Sterndrive Actuator 2 'R' clip 3 Pin 4 Split pin 5 Pivot assembly 6 Pin 7 Split pin 8 Bolts 9 Spring washers 10 Clamp 11 Spool valve cable connection 12 Main support bracket 13 Power steering ram 14 Twin-engine connecting bar 15 Tiller bar

## Mounting in a restricted area

If an obstruction prevents installation of the drive unit as supplied, the main body can be rotated relative to the mounting bracket as follows:

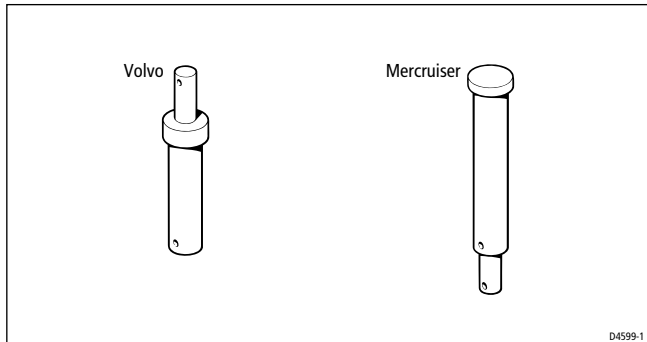


1. Remove the two fixing screws.
2. Carefully slide the cover forwards – don't pull the four cables out of the plug located inside the cover.
3. Slacken the lock nut.
4. Rotate the main body as required.
5. Tighten the lock nut securely – make sure that the lock nut is not more than one turn from the start of the thread.
6. Replace the cover – make sure you don't trap any cables.
7. Use the steering wheel to move from hard over to hard over – make sure that no part of the drive unit touches any part of the vessel or vessel fittings.

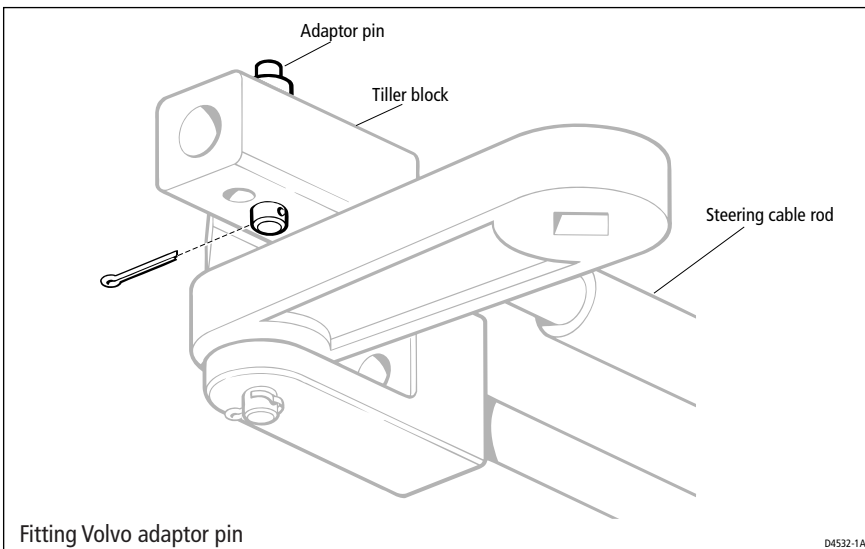
## Installing the Universal I/O Drive

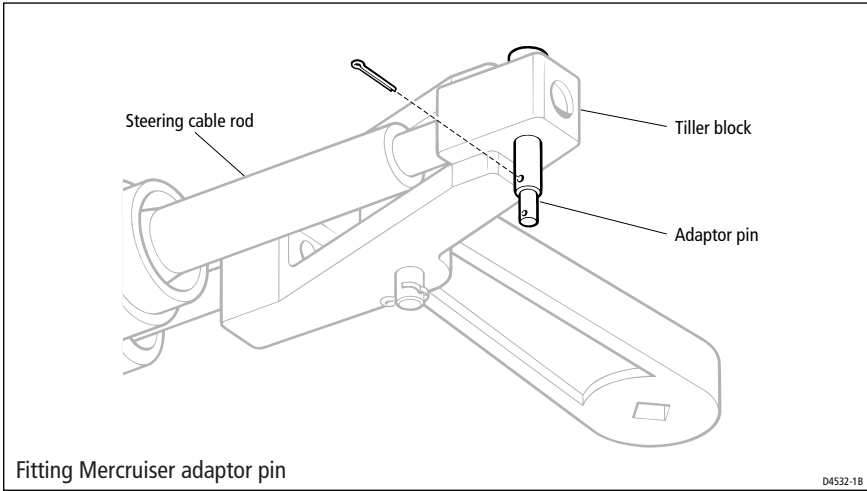
The Universal I/O Drive can be used with both Volvo and Mercruiser engines. As the method of fitting to both engine types is similar, a common procedure is given. Differences between the two engine types are shown in the accompanying illustrations:

1. Referring to the following illustration, select the correct adaptor pin for your engine type.

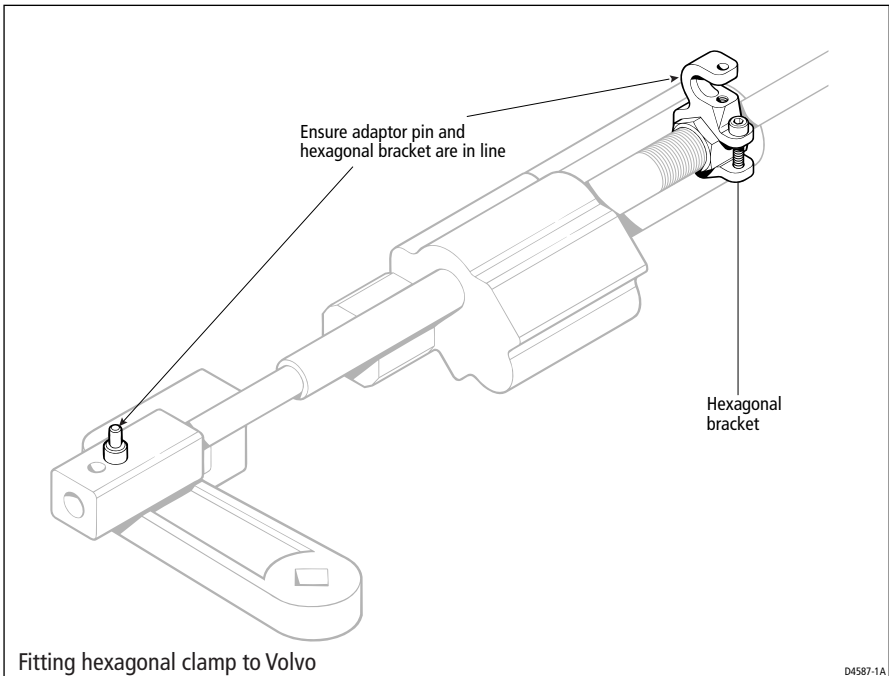


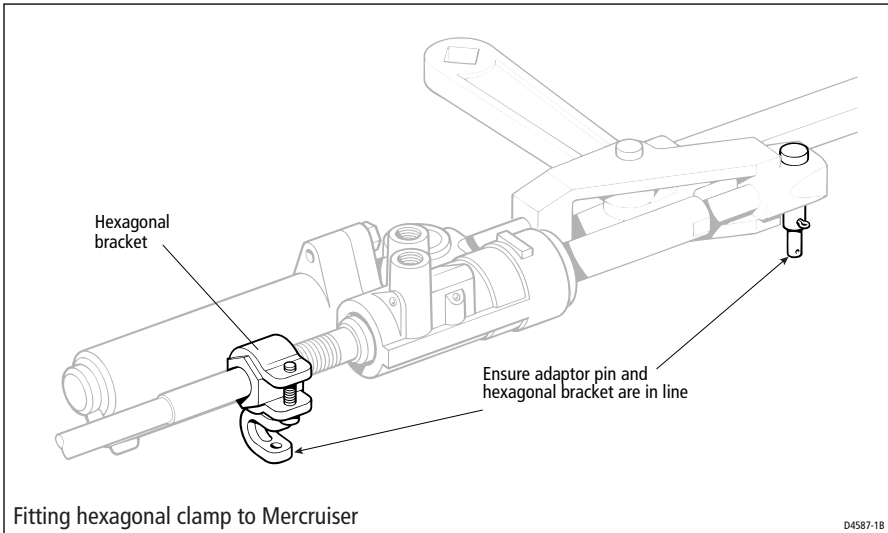
2. Remove the locating pin attaching the cable rod to the tiller block and replace it with the adaptor pin supplied, as shown.



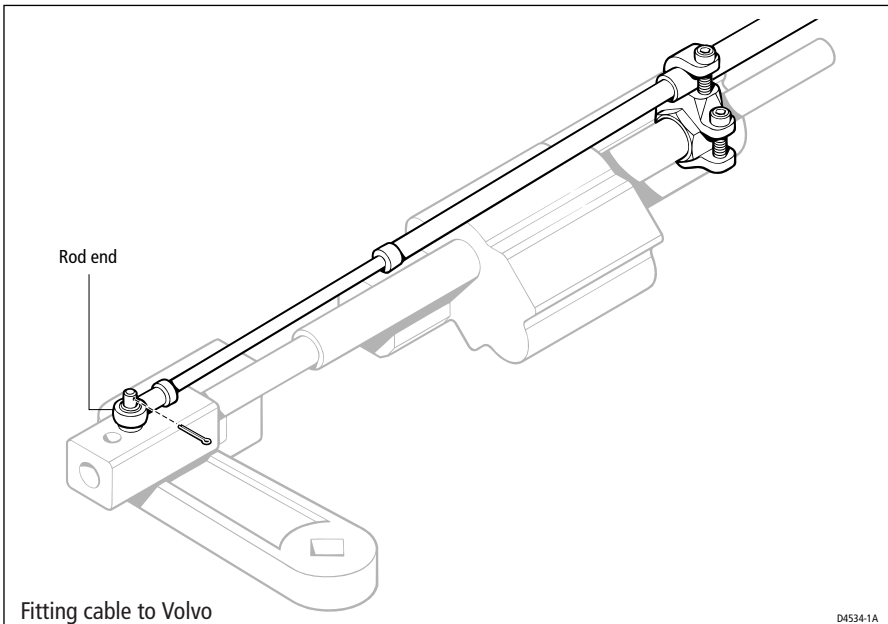


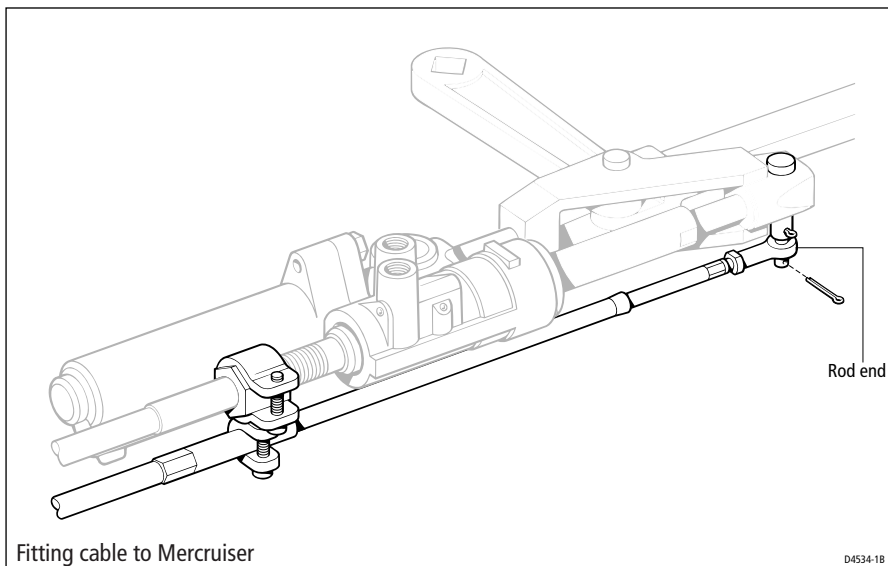
3. Secure the adaptor pin with the supplied split pin.
4. Fit the supplied hexagonal bracket centrally on the existing steering cable securing nut as shown in the appropriate following illustration. Secure the bracket with one of the socket cap screws supplied, ensuring that it is correctly aligned with the adaptor pin.



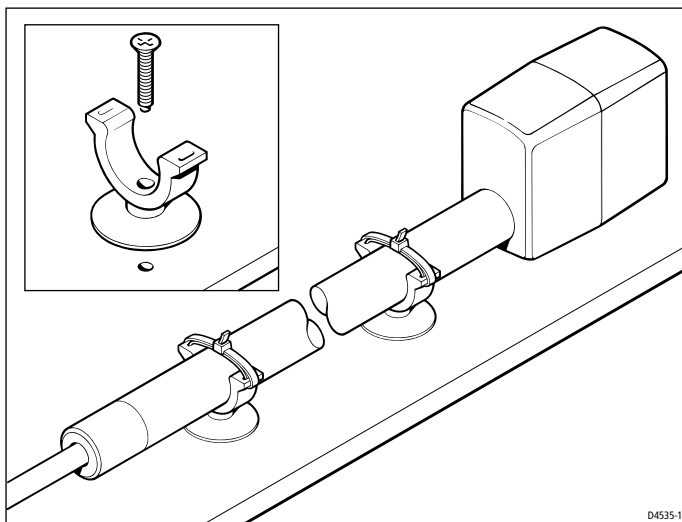


5. Insert the Universal I/O Drive cable into the clamp on the hexagonal bracket, so that the recess on the cable engages with the protrusion in the clamp. Secure the clamp with the remaining socket cap screw .
6. Extend the Universal Drive cable until the rod end is aligned with the adaptor pin, then fit the rod end onto the adaptor pin .





7. Secure the rod end on the adaptor pin with the split pin supplied.
8. Fit the Universal I/O Drive assembly in a suitable, safe position, remote from the engine, using the clamps and tie-wraps provided.

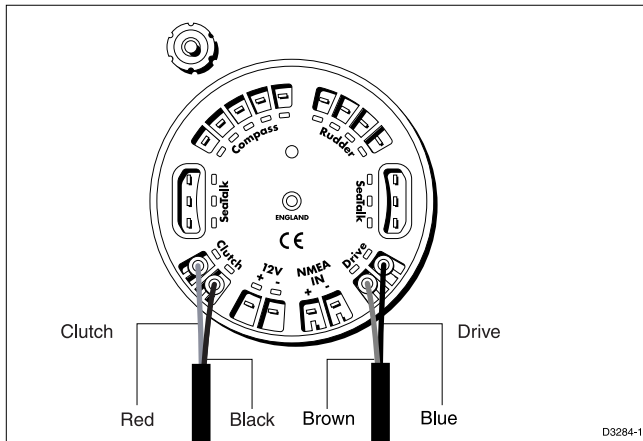


9. Slowly turn the steering system from hard over to hard over. **Ensure that the steering system operates freely and there is no contact between the cable and any part of the engine.**



## Cable connection

1. Fit the cable supplied with the drive unit – make sure the connector is locked in place by turning the locking ring clockwise.
2. Route the cable back to the control head.
3. Secure the cable close to the drive unit – make sure there is sufficient free length to allow for movement of the drive unit.



4. Once again use the steering wheel to move the rudder from hard over to hard over and check that the cable does not catch on any part of the vessel or fittings.

## 5.6 Hydraulic pump installation

### Introduction

The hydraulic drive unit should be mounted horizontally so that it is clear of spray and any possibility of immersion in water. The drive unit should also be located as near as possible to the hydraulic steering cylinder.

It is important to bolt the hydraulic drive unit securely to a substantial member to avoid any vibration that could damage the interconnecting pipework.

Care should be taken to avoid losing excessive hydraulic fluid. If the system is pressurised, release the pressure at the reservoir in

accordance with the manufacturers instructions before breaking into the system.

On non pressurised systems, temporarily fit a solid plug to the upper helm reservoir vent – this will minimise fluid loss during installation.

It is most important to keep the steering system free of dirt as the valves in both the manual helm pump and the autopilot pump will stick if the hydraulic fluid is contaminated.

All tee pieces used in the installation should be fitted in accordance with the manufacturers instructions.

### **CAUTION:**

**Do not use PTFE tape on hydraulic pipe connections. If a sealant is required to ensure a leakfree joint, use “Loctite Threadlock” or a similar sealant.**

## **Cabling**

Connect the hydraulic pump to the DRIVE connections on the back of the control head using suitable cable (see below).

The following table shows the minimum acceptable cable sizes.

### **Hydraulic**

| <b>Cable length</b> | <b>Copper area</b>  | <b>AWG</b> |
|---------------------|---------------------|------------|
| Up to 2.5 m (8 ft). | 2.5 mm <sup>2</sup> | 14         |
| Up to 4 m (13 ft)   | 4 mm <sup>2</sup>   | 12         |
| Up to 6 m (19.5 ft) | 6 mm <sup>2</sup>   | 10         |

## Types of steering system

There are three basic types of hydraulic steering system:

- Two line system
- Three line system
- Two line pressurised system

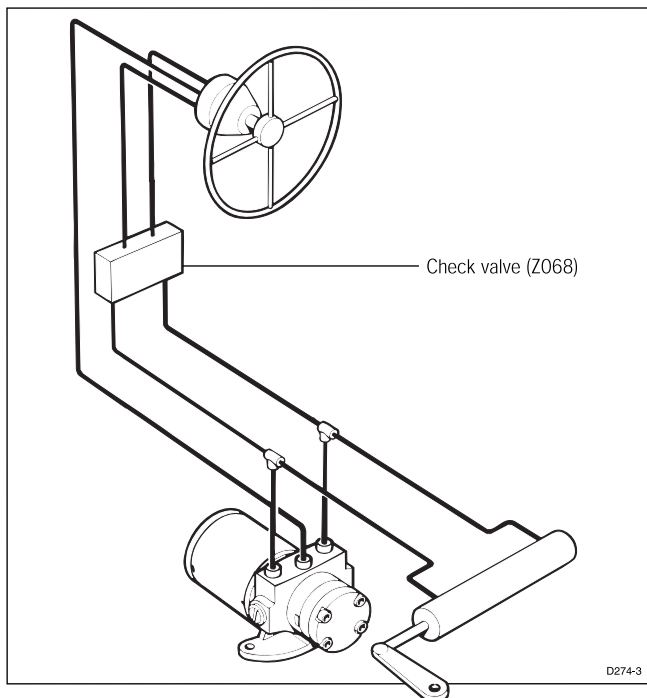
Typical connection points for autopilot pumps are illustrated for each type.

In all cases it is strongly recommended that you consult the steering gear manufacturer.

All hoses used to fit the pump should match, or exceed, the specification of those used in the existing steering system.

Make sure the helm pump is fitted with reversing check valves. If reversing check valves are not fitted, the autopilot pump will drive the helm pump in preference to moving the ram.

Single helm pump systems without check valves should incorporate the Z068 double pilot check valve block. This is installed as shown.



If the vessel has two steering positions, check valves will already be installed to ensure independent operation of the two wheels.

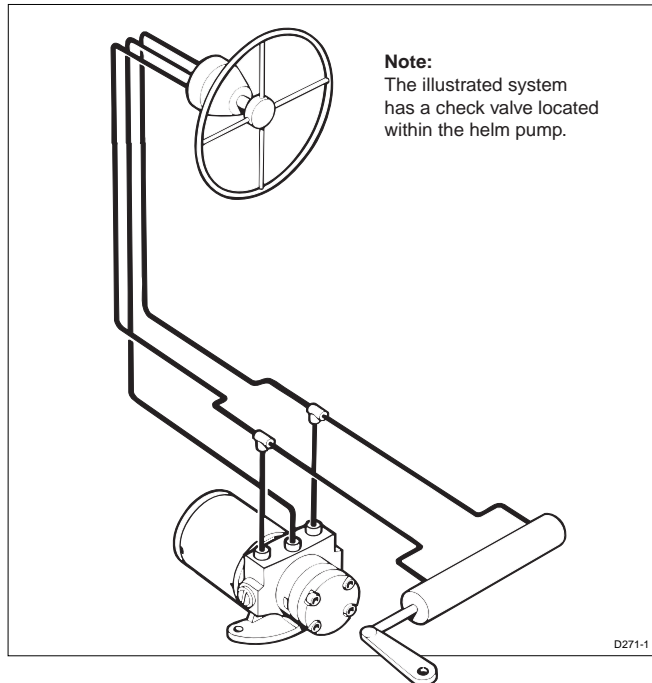
Minimisation of hydraulic fluid loss during connection of the drive unit will help to reduce the time and effort required later to bleed the system of trapped air.

Absolute cleanliness is important since even the smallest particle of foreign matter could interfere with the correct function of the steering system check valves.

## Two line system

A typical two line steering system is shown below. Hydraulic fluid can be pumped into the ram in either direction, depending on the direction of helm pump rotation.

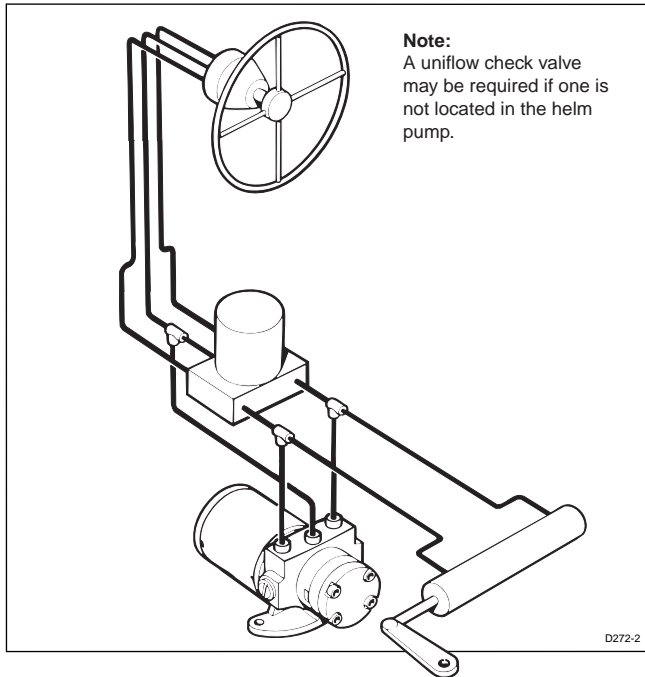
The autopilot pump is connected to the system as shown below.



## Two line pressurised system

A two line pressurised system has an external pressurised reservoir to reduce the chances of inducing air into the system. This also reduces any sponginess due to pipe expansion.

The autopilot pump is connected to the system as shown below.

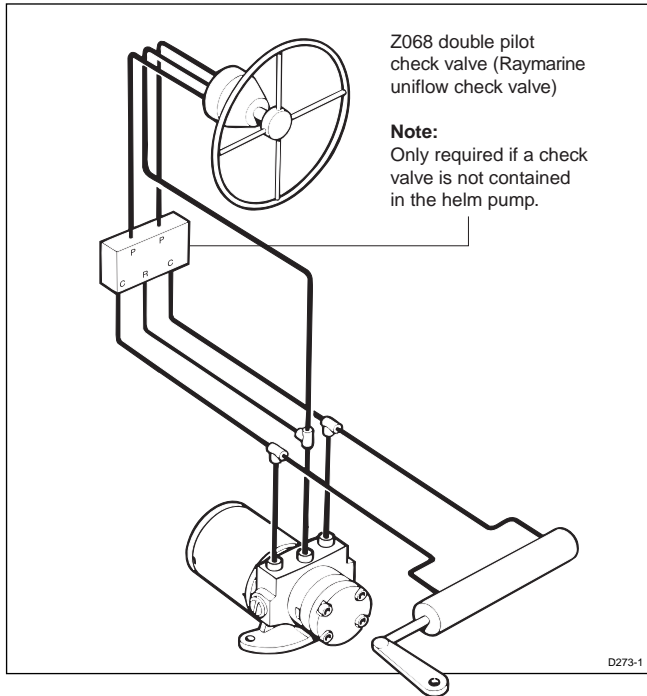


## Three line system

In the three line system, hydraulic fluid flows in one direction – out of the helm pump to the ram and then returning from the other side of the ram to the reservoir via a common return line.

A uniflow valve block will be fitted in the system. This ensures that the return fluid from the ram is directed back to the reservoir.

The autopilot pump is connected to the system as shown.



## Bleeding the system

Correct bleeding of the hydraulic system is one of the most important steps when installing the hydraulic pump. The presence of air within the hydraulic steering system will not only degrade the performance of the autopilot but also affect the overall operation of the steering system.

In addition to the manufacturer's instructions for bleeding the steering system, the following procedures should be carried out to bleed the autopilot pump:

1. With the autopilot in Standby mode, press and hold down the **-10** key – the autopilot pump will try to drive the rudder over to port.
2. Counter this rudder movement by turning the helm to starboard to keep the rudder stationary – any air in the pump will rise to the helm pump and be exhausted into the reservoir.
3. Clear any air on the other side of the pump by pressing and holding the **+10** key – the autopilot will now try to drive the rudder to starboard.

4. Turn the helm to port to counter the rudder movement.

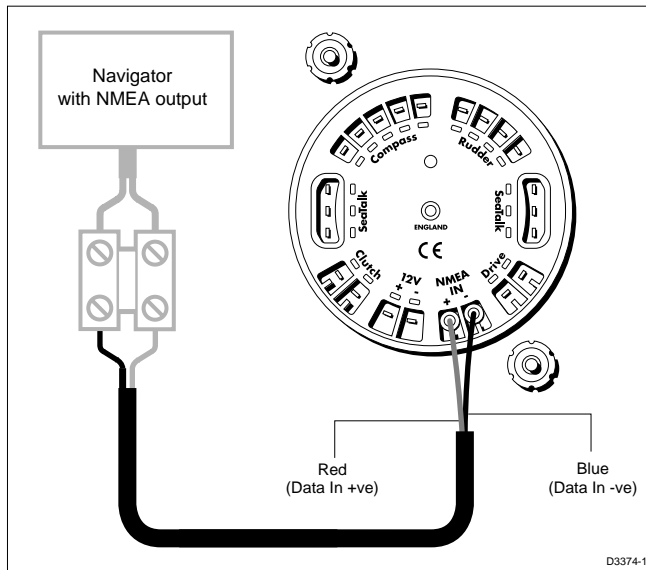
**Note:** Monitor the reservoir tank at all times and top up with the manufacturers recommended fluid as required. If air is left in the system the steering will feel spongy, particularly when the wheel is rotated to the hardover position.

## 5.7 NMEA interface

ST5000 Plus will accept navigation data in the NMEA format for use in Track Control. The required data formats are shown in the table at the end of this section.

### Cabling

The NMEA data port is on the rear of the ST5000 Plus and should be connected to a Position Transducer or Wind Instrument.



### NMEA data transmission to other equipment

If you wish to transmit NMEA information to other equipment a SeaTalk Interface (Z290) should be installed.

## Data formats

The following NMEA 0183 wind and navigation data can be decoded by ST5000 Plus.

| <b>Data</b>          | <b>NMEA 0183</b>        |
|----------------------|-------------------------|
| Course Over Ground   | VTG, RMC, RMA           |
| Speed Over Ground    | VTG, RMC, RMA           |
| Cross Track Error    | APB, APA, RMB, XTE      |
| Bearing to Waypoint  | APB, BWR, BWC, RMB      |
| Distance to Waypoint | BWR, BWC, RMB           |
| Waypoint Number      | APB, APA, BWR, BWC, RMB |
| Apparent Wind Speed  | VWR, MWV                |
| Apparent Wind Angle  | VWR, MWV                |
| Speed Through Water  | VHW                     |
| Depth                | DBT                     |
| Water Temperature    | MTW                     |

**Note:** *The autopilot only decodes the last four characters of waypoint names. Therefore, if long waypoint names are used, the last four characters must be unique to enable the waypoint advance function to work.*

## Transmission of NMEA data on SeaTalk

If any of the above NMEA data is received and the equivalent data is not present on SeaTalk, the autopilot will transmit the data onto SeaTalk to make it available to other SeaTalk compatible instruments.

Depth is transmitted in the units defined by the first page in the data page rollover. Water temperature is always transmitted in °C.



# Chapter 6: Post Installation Procedures

Once you have installed the system, you need to confirm that the system is wired correctly and is also set up to suit your type of boat.

This chapter provides instructions for the following procedures:

- **Functional test**, consisting of a few simple tests to confirm that the system is wired correctly
- **Dockside procedure**, necessary if a rudder reference transducer is fitted, to ensure that the rudder reference transducer is correctly aligned with the rudder
- **Initial sea trial**, to swing the compass and align the heading, check the autopilot's operation and check the rudder gain

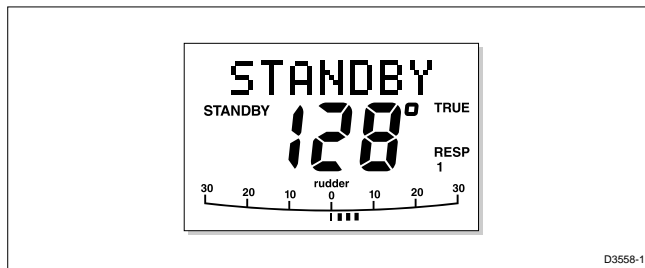
Further customisation can be performed after the sea trial, as described in *Chapter 4*.

## 6.1 Functional test

### Switch on

Having installed your ST5000 Plus autopilot, switch on the main power breaker. If the control head is active and the system operating, the following will occur:

- The control head beeps and displays the pilot type (5000 STRN or 5000 HYDR).
- After the pilot type has been displayed for 2 seconds, the Standby mode screen should be displayed.



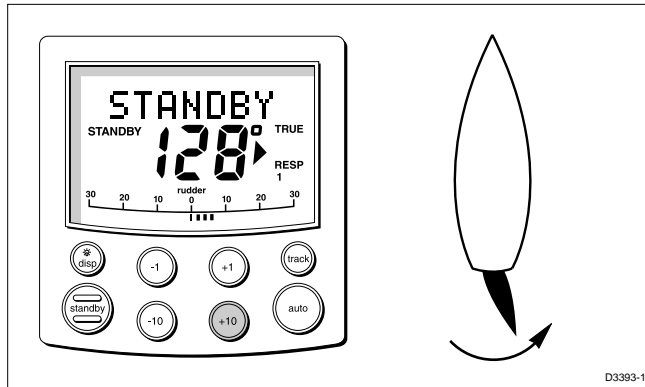
This shows that the control head is active.

- If the head does not beep, check the fuse/circuit breaker.
- If the SEATALK FAIL alarm is displayed, check the SeaTalk connections.

## Operating sense

The operating sense defines the direction the helm will be applied when a course change key is pressed or the vessel goes off course. Check the operating sense as follows:

1. Press **auto**.
2. Press the **+10** key. The helm should move to produce a turn to starboard.



3. If the helm produces a turn to port, reverse the drive connections on the back of the control head.

## Navigation interface (GPS, Decca, Loran)

If the ST5000 Plus is interfaced to a navigator, via its NMEA data port, the interface can be checked by displaying the default Data Pages. These are XTE, BTW and DTW.

Press **disp** to display the first page, and check that the expected data is displayed. Press **disp** again to check each successive page.

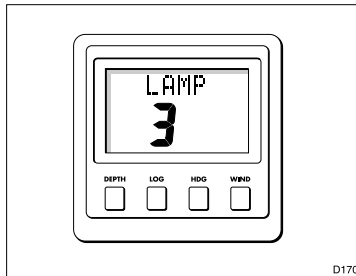
If dashes are displayed instead of data values, the cause could be one or more of the following:

- A cabling error. Check for an open circuit, short circuit or reversed wires.
- The navigator is not configured to transmit the required data format.
- The signals being received by the navigator are too weak for reliable navigation. Refer to the navigator handbook for further action.

## SeaTalk interface

If the ST5000 Plus has been linked to other SeaTalk instruments via SeaTalk, the link can be checked as follows:

1. Press **standby**.
2. Select display illumination level 3 on any other SeaTalk instrument or autopilot control unit.



The ST5000 Plus should immediately respond by switching on its display illumination.

If the illumination does not switch on then a cabling fault exists in the SeaTalk cabling between the ST5000 Plus control head and the instruments/control unit.

## 6.2 Dockside procedures

The dockside procedures are only required if a rudder reference transducer is fitted, and ensures that the rudder reference transducer is correctly aligned with the rudder.

To carry out the procedure:

1. Move the helm to its centre position, using the **-1**, **+1**, **-10** and **+10** keys.
2. Check the rudder bar display. The rudder angle should be within  $\pm 7^\circ$  of centre.
3. To improve the alignment, slacken the rudder reference mounting bolts and rotate the base until the reported rudder angle is as close to zero as possible. Then tighten the bolts again.
4. Fine adjustment, to align the display and helm accurately, is achieved using the *Align rudder* option in *Dealer Setup* (see *Chapter 4*). However, this cannot be used to correct an offset of more than  $\pm 7^\circ$ .

5. Carry out the *Rudder limits* procedure in *Dealer Setup* (see *Chapter 4*).

## 6.3 Initial sea trial

### 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 possible to prevent the equipment from being affected by external influences. In general this will not damage the equipment but can lead to it resetting, or momentarily may result in faulty operation.

### Overview

Having checked that the system is functioning correctly, a short sea trial is now required to complete the setup. It involves the following procedures:

- Automatic compass deviation correction
- Heading alignment adjustment
- Autopilot operation check
- Rudder gain adjustment

**Note:** *The ST5000 Plus has a built-in calibration capability which enables it to be fine tuned to suit the individual vessel, its steering system and dynamic steering characteristics. As supplied from the factory the unit is calibrated to provide safe stable autopilot control for the majority of vessels.*

The initial sea trial should be performed in the following circumstances:

- After all the installation, functional test and dockside procedures have been completed successfully
- Before any other changes have been made to the default calibration settings: check and, if necessary, reset the values to the recommended levels, as described in *Chapter 4*

- In conditions of light wind and calm water, so that autopilot performance can be assessed without the influence of strong winds or large waves
- In waters clear of any obstructions

**Note:** *At any time during the sea trial you can press **standby** to return to hand steering.*

## Automatic compass deviation correction

The ST5000+ will correct the fluxgate compass for most deviating magnetic fields. Compass errors due to deviating magnetic fields can be up to 15°, depending on your vessel type. The correction procedure reduces this to a few degrees, so it is essential to perform the procedure as the first item during the initial sea trial.

### CAUTION:

**Failure to carry out the deviation correction may result in impaired autopilot performance on some compass headings.**

To allow the system to determine the deviation and calculate any correction required, you must turn your vessel in slow circles. This procedure must be carried out in calm conditions and preferably in flat water.

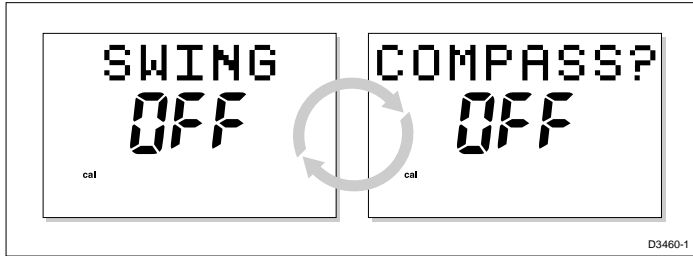
To perform the deviation correction:

1. Make sure that the autopilot is in Standby mode.
2. Press and hold the **standby** key for 2 seconds to display the User Setup entry page.



If CAL LOCK is displayed, you need to turn off the lock feature contained in Dealer Setup (see *Chapter 4*).

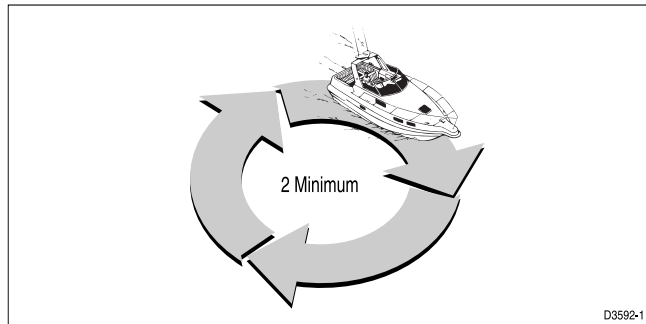
3. Press the **DISP** key to move on to the Swing Compass page.



4. Press the **+1** or **-1** key to change the setting from OFF to YES. The TURN BOAT page is then displayed.



5. Keeping the boat speed below 2 knots, turn your vessel in slow circles. It should take at least 3 minutes to complete 360°.



### What if I turn the boat too quickly?

If you turn the boat too quickly for the compass to be corrected correctly, the text **TOO FAST** will be displayed. Slow down and continue to circle.



### Can I cancel the process?

You can abort the correction process by pressing the **DISP** key to move on to the Deviation screen.

If you wish to attempt deviation correction again, you can step back to the Swing Compass page or keep pressing **disp** to cycle through the calibration options until the page is displayed again. (To step back to the previous screen, press and hold the **disp** key for one second. You can only do this within two seconds of advancing to the current screen.) Repeat the procedure from step 4.

6. Keep turning your boat until the unit beeps and the DEVIATION screen is displayed.



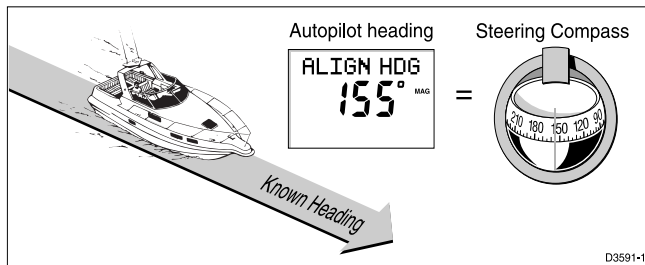
This shows the maximum deviation detected, and indicates that compass correction has been completed successfully.

**Note:** *If the deviation value exceeds 15° or a deviation value is not displayed at all, you should consider moving the fluxgate compass to a better location.*

7. Press the **disp** key to move on to the Heading Alignment page.



8. Use the **+1** and **-1**, keys, or the **+10** and **-10** keys, to increase or decrease the displayed heading, until it agrees with the ship's steering compass or a known transit bearing.



9. Press and hold **STANDBY** for 2 seconds to exit calibration and save the new settings.

**Note:** *Setup options are always saved on exit.*

## Further heading alignment adjustment

You should always check the compass alignment after swinging the compass. However, once the initial deviation correction procedure has been performed, you can make adjustments to the alignment as often as you wish, without swinging the compass again.

Although the compass deviation correction procedure removes most of the alignment error, you will probably be left with small errors (of the order of a few degrees) that will vary depending on the heading.

Ideally, you should 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. This value can then be entered 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 slower and in move favourable conditions.

## Checking autopilot operation

Having calibrated the compass the following procedure is recommended to familiarise yourself with autopilot operation:

1. Steer onto a compass heading and hold the course steady.
2. Press **auto** to lock onto the current heading. A constant heading should be achieved in calm sea conditions.
3. Use the **-1**, **+1**, **-10** and **+10** keys to alter course to port or starboard in multiples of 1° and 10°.
4. Press **STANDBY** and disengage the autopilot to return to hand steering:

## AutoRelease (sterndrive systems only)

The AutoRelease feature provides an emergency manual override for ST5000 Plus Sterndrive systems. It is only available on installations with a ST5000 STRN pilot type, and the default setting is ON (see *Chapter 4*).

1. In an area clear of obstructions, press **auto** to lock onto the current heading.
2. Turn the steering wheel.

The ST5000 Plus should display the text AUTO RELSE and sound an alarm for 10 seconds, and then return to Standby mode.

There is a slight delay before the autopilot returns to Standby: excessive force is not required and will not reduce this delay.

3. Repeat the procedure two or three times until you are confident with its operation.
4. Press **standby** and disengage the autopilot to return to hand steering.

**Note:** *AutoRelease is intended for emergency use only. In normal use, you should press the **standby** key to disengage the ST5000 Plus.*

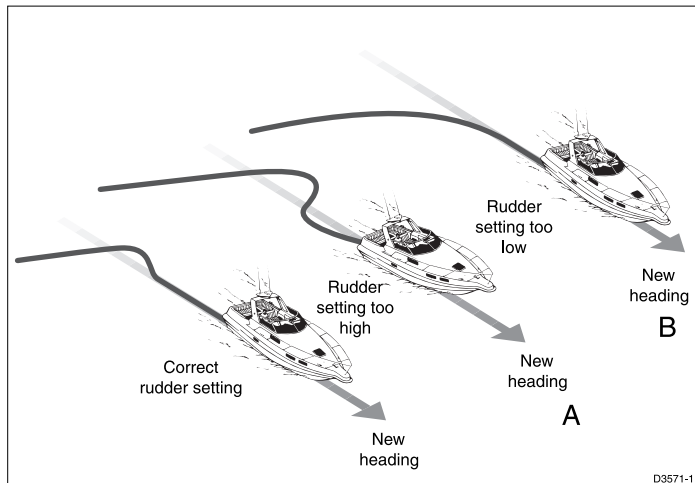
## Checking the rudder gain

The factory set rudder gain level will provide stable control for initial sea trials. However, vessels can vary widely in their response to the helm, and further adjustment to the rudder gain may improve the autopilot's steering characteristics.

It is particularly important that the rudder gain is set correctly on high-speed craft. Incorrect adjustment will lead to poor steering performance and is a dangerous condition at high speed.

The following test will determine whether the rudder gain is set too high or too low.

1. In clear water and with the autopilot in Auto, alter course to starboard by  $40^\circ$  by pressing the **+10** key four times.
  - At cruising speeds, course changes of  $40^\circ$  should result in crisp turns followed by an overshoot of no more than  $5^\circ$ . If this occurs the rudder gain is adjusted correctly.
  - An excessively high rudder setting results in oversteer. This is recognised by a distinct overshoot of more than  $5^\circ$  (A). This condition can be corrected by reducing the rudder gain setting.
  - Similarly, an insufficient rudder control setting will result in understeer which gives sluggish steering performance (B). If the vessel takes a long time to make the turn and there is no overshoot then the rudder setting is too low.



These actions are most easily recognised in calm sea conditions where wave action does not mask basic steering performance.

2. To make a temporary adjustment to the rudder gain, press the **-1** and **+1** keys together for 1 second to display the Rudder Gain screen, then press **+1** or **-1** to change the level. Wait for 5 seconds, or press **disp**, to return to the previous display.
3. Repeat the test until a crisp course change with no more 5° of overshoot is achieved.

The rudder control setting should be set to the lowest setting consistent with accurate course keeping. This will minimise helm movements and hence reduce power consumption and wear and tear.

4. Once you have determined the correct setting, change the default Rudder Gain setting in Dealer Setup, as described in *Chapter 4, Customising the ST5000 Plus*.



# Chapter 7: Maintenance

## General

- In certain conditions, condensation may appear on the LCD window. This will not harm the unit, and can be cleared by switching on the illumination for a while.
- **Never** use chemical or abrasive materials to clean your autopilot. If the pilot is dirty, wipe it with a clean, damp cloth.
- Periodically check the cabling for chafing or damage to the outer casing – replace any damaged cables.

## Servicing and Safety

- Raymarine equipment should be serviced only by authorised Raymarine service engineers. 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, and so never handle the cables/connectors when power is being supplied to the equipment.
- Always report any EMC related problem to your nearest Raymarine dealer. We will use any such information to improve our quality standards.

## Advice

Should any difficulties arise with this product, please contact the Raymarine Product Support department in the UK, or your own national distributor who will be able to provide expert assistance.

The working parts of the drive system are sealed and lubricated for life during manufacture – servicing is not required.

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 chapter of this handbook. If the fault cannot be traced or rectified, please contact your nearest Raymarine dealer or Service Centre.

Always quote the product serial number, which is printed on the rear cover of the autopilot, and the software version number, which is displayed when you enter Intermediate Setup (see *Chapter 4*).



# Chapter 8: Fault Finding

All Raymarine products are subjected to a comprehensive test procedure prior to packing and shipping. In the unlikely event that a fault does occur with your autopilot, the following check list should help identify the problem and provide a cure.

## **The autopilot display is blank**

- No power – check the fuse/circuit breaker.

## **The displayed compass heading does not agree with the ships compass**

- The compass has not been corrected for deviation – carry out the deviation and alignment procedures.

## **Vessel turns slowly and takes a long time to come on to course**

- Rudder gain too low.

## **Vessel overshoots when turning on to a new course**

- Rudder gain too high.

## **The autopilot appears to be unstable in Track mode, or track-holding is slow**

- If tide speed exceeds 35% of boat speed, and boat speed is not available via SeaTalk, change the Cruise Speed setting in Dealer Setup to the boat's cruising speed.

## **The autopilot appears to be unstable on Northerly headings in the Northern hemisphere and Southerly headings in the Southern hemisphere**

- Northerly/Southerly heading correction not set up.

## **Display shows CAL LOCK when entering calibration**

- Calibration locked out – calibration protection feature is turned on in Dealer Setup.

## **The autopilot will not “talk” to other SeaTalk instruments**

- Cabling problem – make sure all the cables are connected properly.

**Position information not received**

- Navigator not transmitting the correct position data.

**The autopilot will not auto advance to the next waypoint**

- No bearing to waypoint information received from the navigator.

**A series of rotating dashes are displayed on screen**

- Compass deviation correction is running.

**The display shows a series of stationary dashes**

- Data is not being received – check the cabling.

**The display shows NO DATA**

- The signals received from the navigator are too weak – refer to the navigator handbook for further action.



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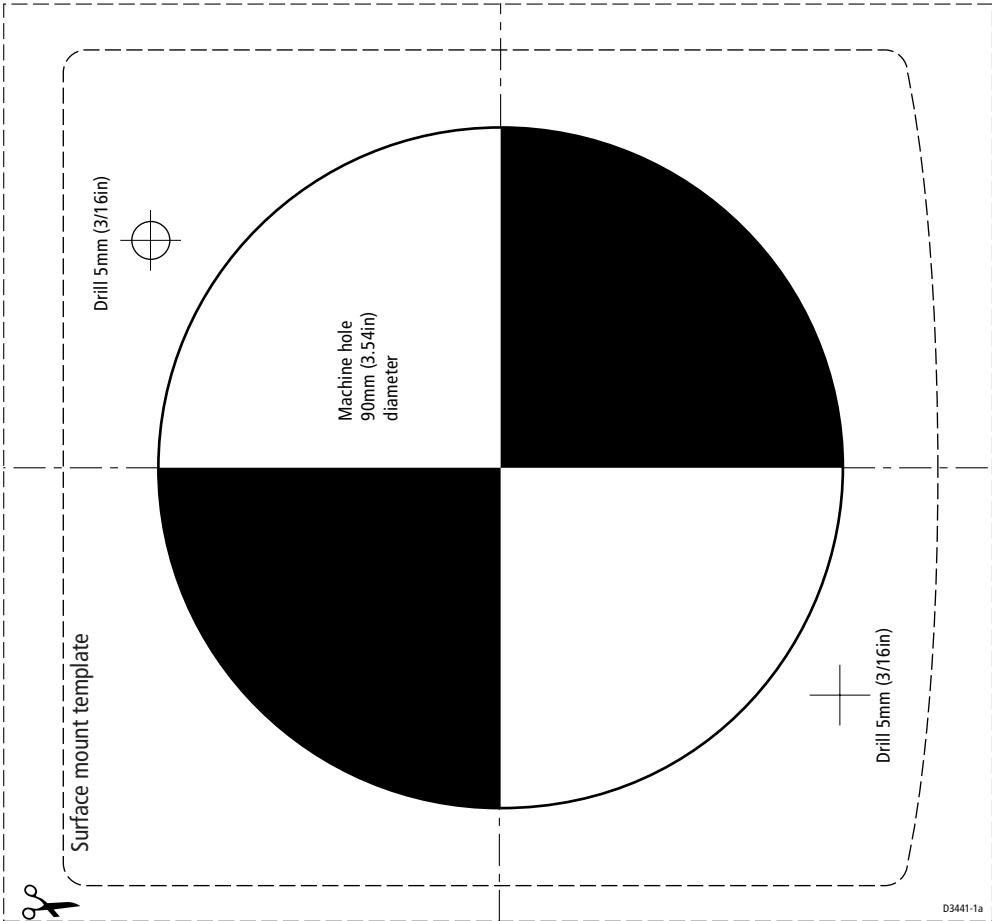
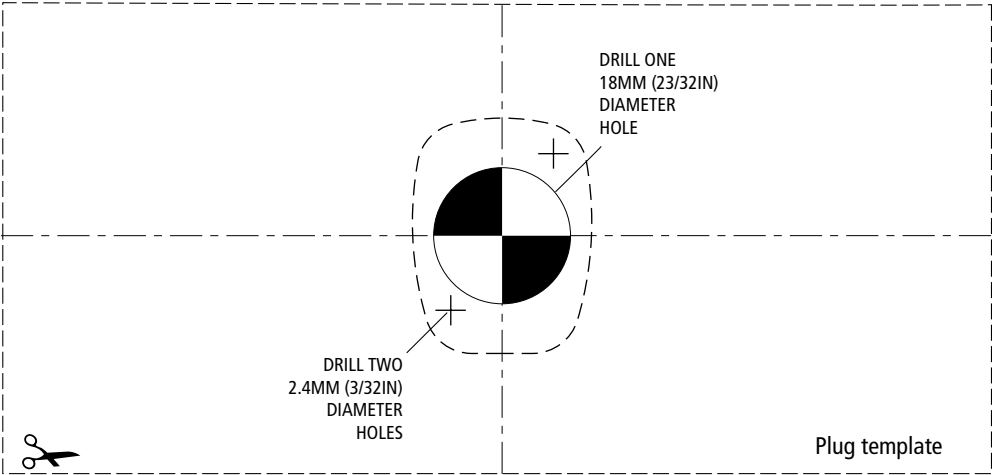
**V**

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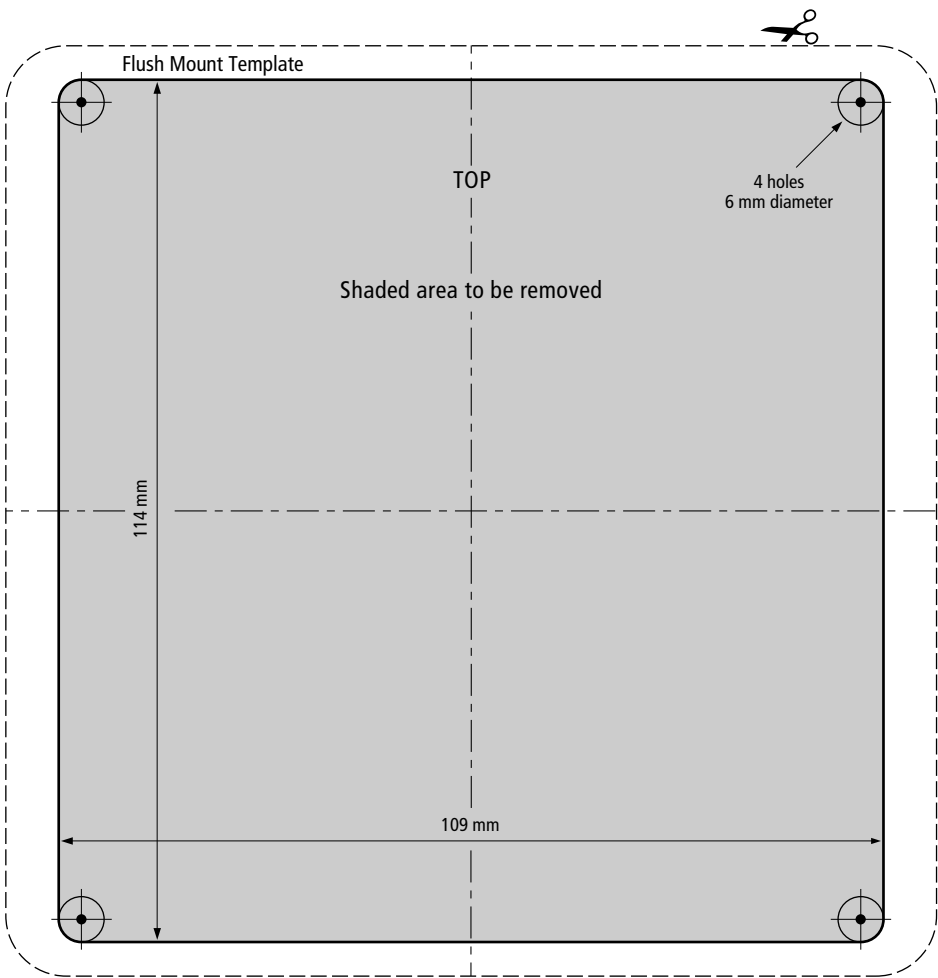
**W**

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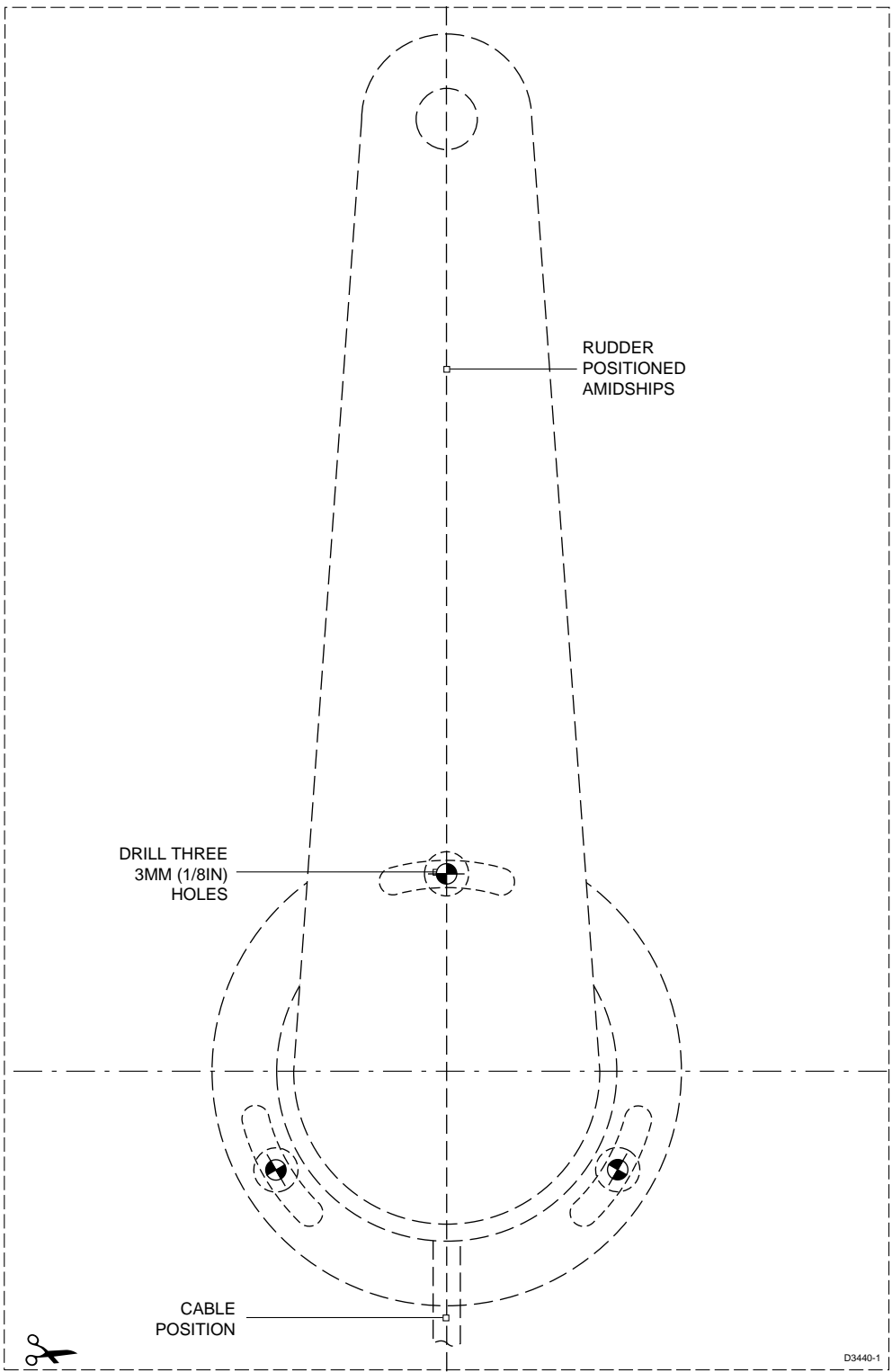












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DRILL THREE  
3MM (1/8IN)  
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