

SmartPilot X-5

Wheel Operating Guide

Document reference: 81302-1
Date: October 2007

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Important Information

Safety notices



WARNING: Navigation aid

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

CAUTION: Calibration

When supplied, this product is calibrated to default settings which should provide initial stable performance for most boats. To ensure optimum performance on your boat, you must complete the procedures in the *SPX-5 Wheel Installation & Setup Guide* before use.

Your Raymarine SPX-5 Wheel system will add a new dimension to your boating enjoyment. However, it is the skipper's responsibility to ensure the safety of the boat at all times by following these basic rules:

- Ensure that someone is present at the helm **AT ALL TIMES**, to take manual control in an emergency.
- Make sure that all members of crew know how to disengage the autopilot.
- Regularly check for other boats and any obstacles to navigation – no matter how clear the sea appears, a dangerous situation can develop rapidly.
- Maintain an accurate record of the boat's position by using either a navigation aid or visual bearings.
- Maintain a continuous plot of your boat's position on a current chart. Ensure that the locked autopilot heading will steer the boat clear of all obstacles. Make proper allowance for tidal set – the autopilot cannot.
- Even when your autopilot is locked onto the desired track using a navigation aid, always maintain a log and make regular positional plots. Navigation signals can produce significant errors under some circumstances and the autopilot will not be able to detect these errors.

EMC Conformance

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

Limitations on pressure washing

CAUTION: Do not pressure wash Raymarine products

Raymarine products must NOT be subjected to water pressures in excess of CFR46 / IPX6 standards (for example, as generated by commercial high pressure washing equipment). Products subjected to water at these high pressures may experience water intrusion and subsequent failure.

Raymarine products are waterproofed to CFR46 / IPX6 standards, which means that when installed and operated in accordance with the appropriate product documentation, they can be used in most weather and sea conditions. However, any exposure to high-pressure water that exceeds the CFR46 / IPX6 standards, on or around Raymarine products will invalidate the warranty for those products.

Product documents

This document is part of a series of books associated with the SmartPilot X-5 series.

Documents can be downloaded from:

www.raymarine.com/handbooks.

Title	Part number
SmartPilot X-5 Wheel Operating Guide	81302
SmartPilot X-5 Wheel Installation and Setup Guide	87074
ST6002 Controller Installation sheet	87058
ST6002 SmartPilot Controller - Wheel Quick Reference Guide	86130
Fluxgate Compass Installation sheet	87011
Warranty Booklet	80017

To the best of our knowledge, the information in the product documents was correct when they went to press. However, Raymarine cannot accept liability for any inaccuracies or omissions in product documents.

In addition, our policy of continuous product improvement may change specifications without notice. Therefore, Raymarine cannot accept liability for any differences between the product and the accompanying documents.

Product disposal



Waste Electrical and Electronic (WEEE) Directive

The European WEEE Directive requires that waste electrical and electronic equipment is recycled.

Products carrying the crossed out wheeled bin symbol (illustrated above) must not be disposed of in general waste or landfill, but in accordance with local regulations for such products.

Although the WEEE Directive does not apply to all Raymarine products, we support its policy and ask you to be aware of the correct method for disposing of such products.

Please contact your local dealer, national distributor or Raymarine Technical Services for information on product disposal.

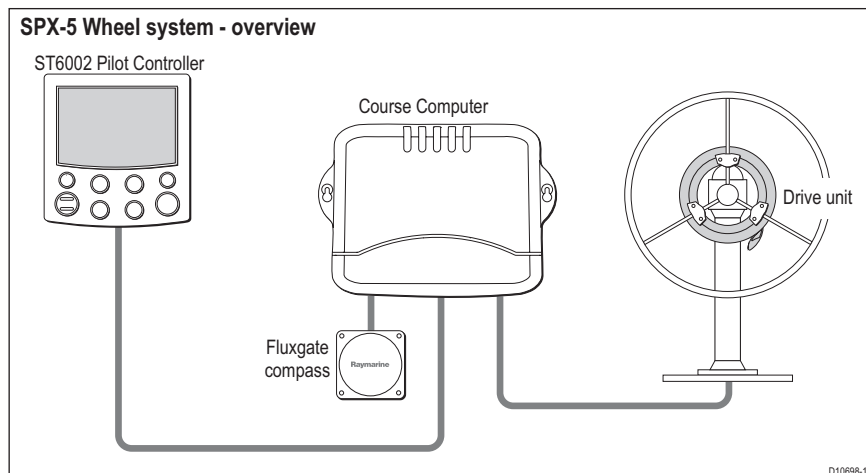
Warranty

To register your new Raymarine product, please take a few minutes to fill out the warranty card. It is important that you complete the owner information and return the card to us to receive full warranty benefits. You can also register online at www.raymarine.com by following the **Login or create an account** link.

Chapter 1: Basic operation

1.1 Introduction

The SmartPilot X-5 (SPX-5) Wheel system is intended for use as an aid to steering leisure marine craft with a fully-laden displacement of up to a maximum of 16,500 lbs (7,500 kg).



Your SPX-5 Wheel system is controlled by a Raymarine ST6002 Pilot Controller (supplied), and operates in the following modes:

- **Standby:** The SPX-5 Wheel system does not control the boat. You have full manual control.
- **Auto:** The SPX-5 Wheel system steers the boat to maintain a locked heading.
- **Track:** The SPX-5 Wheel system steers the boat to maintain a track between two waypoints created on a navigation aid.
- **Wind Vane:** The SPX-5 Wheel system steers the boat to maintain a course relative to a true or apparent wind angle.

The SPX-5 Wheel system also provides:

- Automatic tack (AutoTack) in Auto and Wind Vane modes.
- Waypoint advance feature in Track mode.

Extended systems

You can connect the Pilot Controller to other Raymarine SeaTalk equipment so it can send and receive SeaTalk data. The Pilot Controller uses:

- Waypoint information from a SeaTalk navigation instrument to provide track control.
- Boat speed information from a SeaTalk speed instrument to optimize track-keeping performance.
- Wind information from a SeaTalk wind instrument for Wind Vane steering.


You can use the SPX-5 Wheel system with any navigator or wind instrument that transmits National Marine Electronics Association (NMEA) 0183 data.




The Pilot Controller can display SeaTalk and NMEA instrument data in a user-defined selection of data pages.

For further information on other connections to your system see the *SmartPilot X-5 Wheel Installation & Setup Guide*.



1.2 Using the control unit

Switching on and off

When power is applied to the Pilot Controller, you can use the  disp button to switch it off and on as follows:

- To switch the Pilot controller off, ensure it is in the Standby mode, then hold down  disp for approximately 5 seconds. After this time, a switch off count down of 4 seconds occurs. Keep  disp pressed during this period, to switch off the instrument.
- To switch the instrument back on, hold down  disp for approximately 1 second.

If power is not applied, the Pilot Controller buttons have no effect.

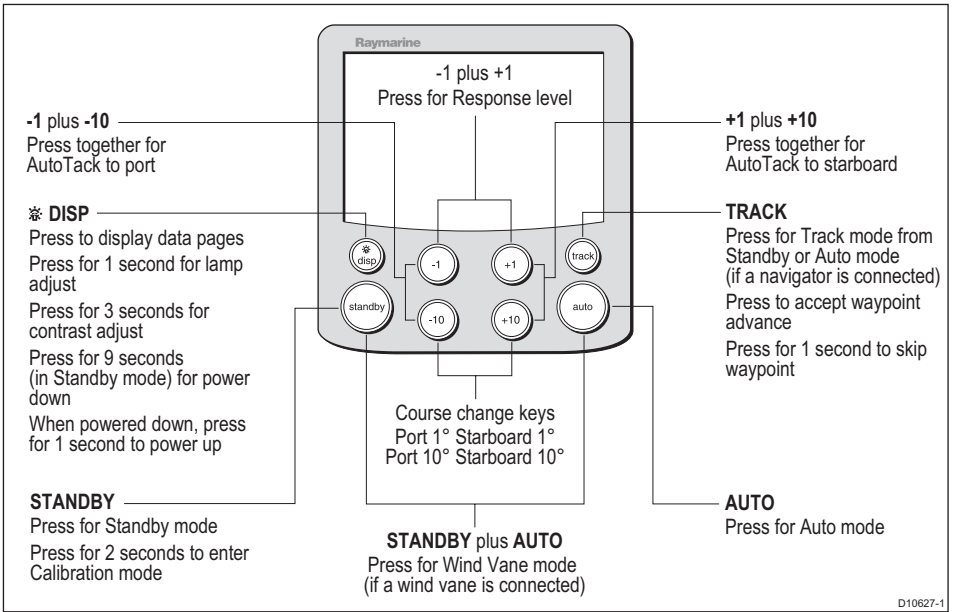
- Notes:**
- (1) *Each time power to the Pilot Controller is switched on, the controller is initially in the on condition. You do not need to use  disp to switch the controller on.*
 - (2) *When the SPX-5 Wheel system controller is on, the operation of  disp initiates other operating functions, as described below.*

Start-up mode

The SPX-5 Wheel system always powers up in Standby mode with the Pilot Controller display showing the boat's current compass heading.

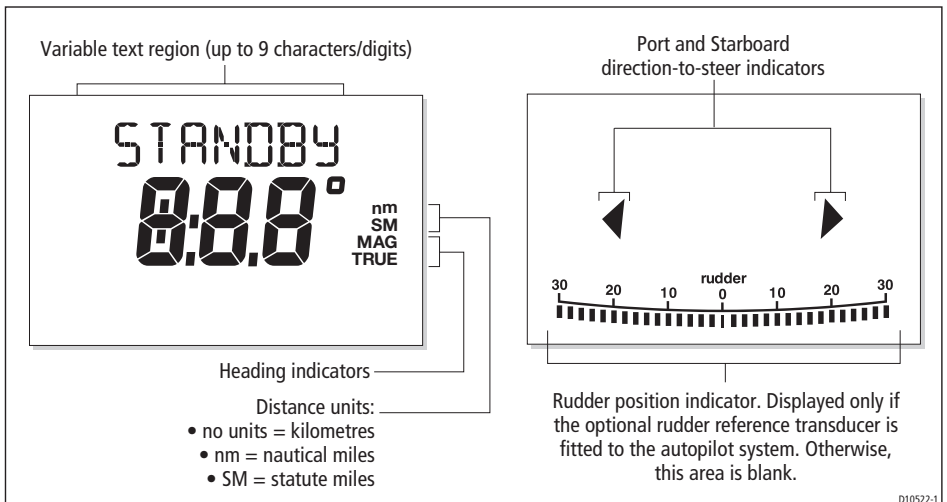
Keypad functions

The SPX-5 Wheel system is controlled by button presses at the Pilot Controller. Button operation is confirmed with a short beep. Single-button and dual-button operations are used.



Displayed information

The Pilot Controller display screen provides the following information:



If the optional Rudder Reference Transducer is fitted to an SPX-5 Wheel system, a rudder position indicator on the display indicates the current position of the rudder, as measured by the transducer. The rudder position indicator can be turned on or off during display calibration (see the *SmartPilot-X5 Wheel Installation & Setup Guide* for details).

1.3 Using the SPX-5 Wheel system to steer your boat



WARNING: Risk of gybe

Always be aware of the relative wind angle, especially when using the autopilot to sail down wind.



WARNING: Maintain a permanent watch

Automatic course control makes it easier to sail a boat, but it is NOT a substitute for good seamanship. ALWAYS maintain a permanent watch by the helm.

Automatically steering to a heading

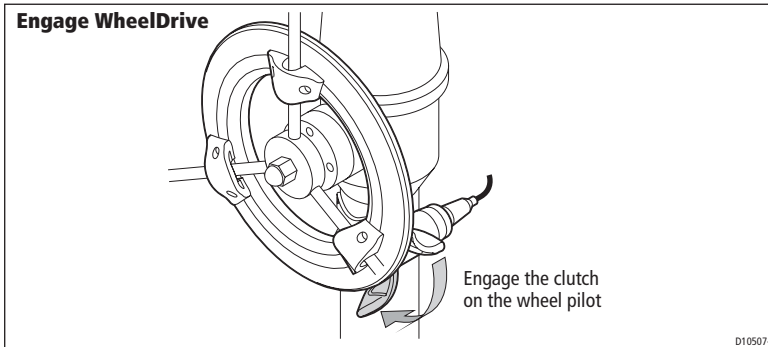


WARNING: Operate the **wheel drive clutch safely**

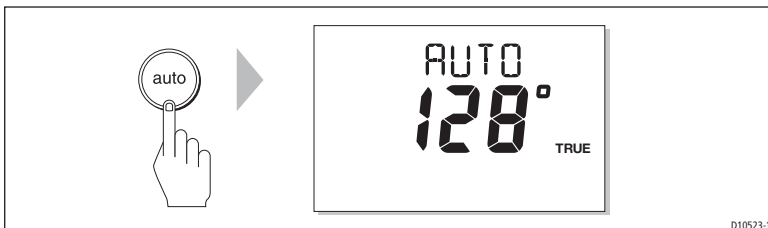
Do NOT reach through the wheel. Reach AROUND the wheel to operate the wheel drive clutch lever.

To use the SPX-5 Wheel system to steer to a heading:

1. Steady the boat on the required heading.
2. Engage the wheel drive clutch by reaching around the wheel and rotating the clutch lever clockwise, so the lever engages fully onto the locating pip.



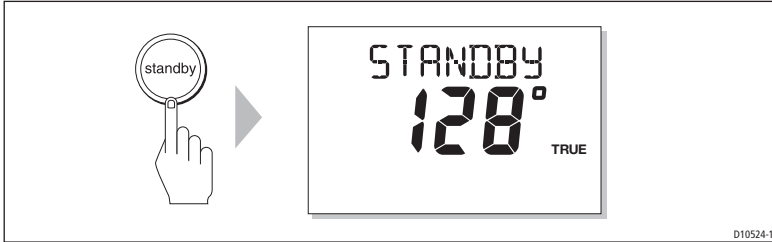
3. Press auto to engage Auto mode. The SPX-5 Wheel system will then steer the boat to the chosen heading, which is shown on the display. This mode is also known as "point-and-shoot".



Returning to hand steering

To return to hand steering:

1. Press standby to disengage the SPX-5 Wheel system and return to Standby mode. In Standby mode:
 - You have manual control of the boat.
 - The display shows **STANDBY** and the boat's current compass heading



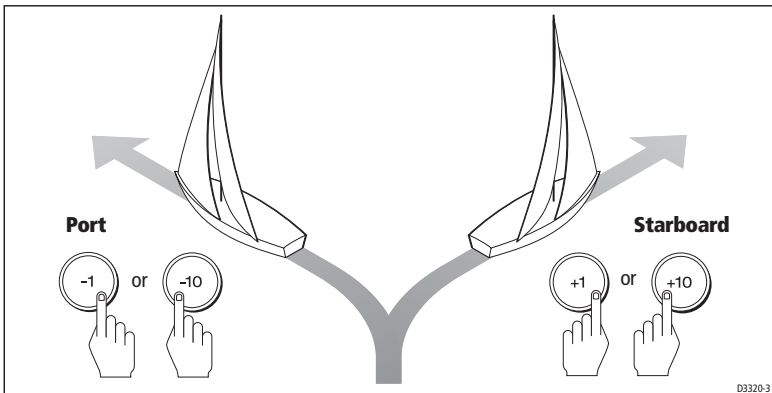
2. Physically disengage the wheel drive clutch by reaching around the wheel and rotating the clutch lever anti-clockwise, so the lever engages fully onto the locating pip).

CAUTION: Wheel drive systems

Away ensure that the clutch is **FULLY DISENGAGED** before you leave the boat.

Changing course in Auto mode

In Auto mode, use the -1, -10, +1 and +10 buttons to change the locked heading, in either 1° or 10° steps. Use -1 or -10 apply changes to port and +1 or +10 for changes to starboard. For example: press -10 three times for a 30° course change to port.

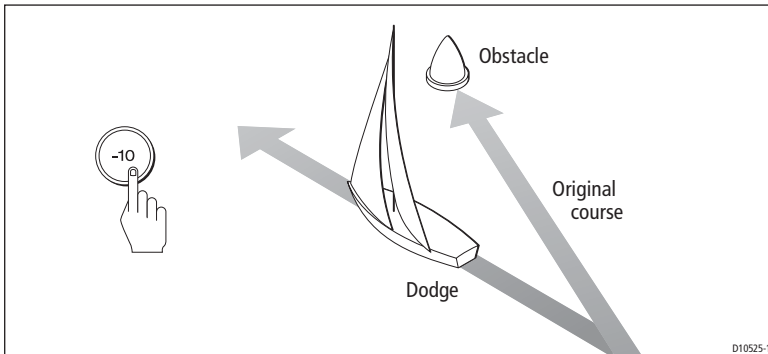


Avoiding obstacles

To avoid an obstacle when your boat is under autopilot control, you can change course to avoid the obstacle, then resume your previous course. To do this:

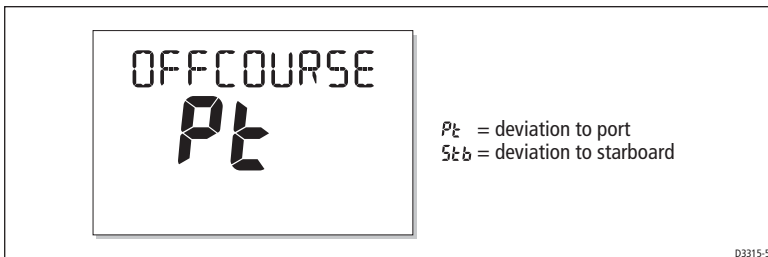
1. Select a course change in the appropriate direction. For example, for a 30°dodge to port, press -10 three times.

2. When you are safely clear of the obstacle, reverse the previous course change. For example, press +10 three times to reverse a 30°dodge to port.



Off Course alarm

If you have been off course from the locked heading for longer than 20 seconds, an alarm sounds and the Pilot Controller shows whether the deviation is to port or starboard.



To cancel an Off Course alarm, press standby to return to manual steering. The alarm clears automatically if the heading recovers or if you change course.

If an Off course Alarm occurs, ensure your boat is not carrying too much sail, and that the sails are well balanced. You can usually significantly improve course keeping by improving the sail balance.

Note: The default off course angle is set at 20°. You can adjust this angle in Dealer Calibration (see Commissioning Guide).

1.4 Adjusting pilot performance

The principal method of adjusting the performance of an SPX-5 Wheel system is by changing the response level. The response level controls the relationship between the course keeping accuracy of the SPX-5 Wheel system, and the amount of helm/drive activity.

Changing the response level should be the only adjustment you need to make to your SPX-5 Wheel system on a regular basis.

When you first turn on your SPX-5 Wheel system after installation, the response will initially be set to the default level, but you can change this level in User Calibration (refer to your *SmartPilot X-5 Wheel Installation & Setup Guide* for details). Changes made using user Calibration will be retained when the SPX-5 Wheel system is switched off.

You can also make temporary adjustments to the response level when using your SPX-5 Wheel system on a day-to-day basis, to quickly match performance to changing conditions. Note however that these temporary changes to response level will be lost when the system is powered off, with the default value being reapplied when the system is next switched on.

Response levels

As a general rule, higher response values give tighter course keeping (e.g. for pilotage in confined and sheltered waters). Lower values reduce drive activity and conserve battery power.

The SPX-5 Wheel system has nine levels of response:

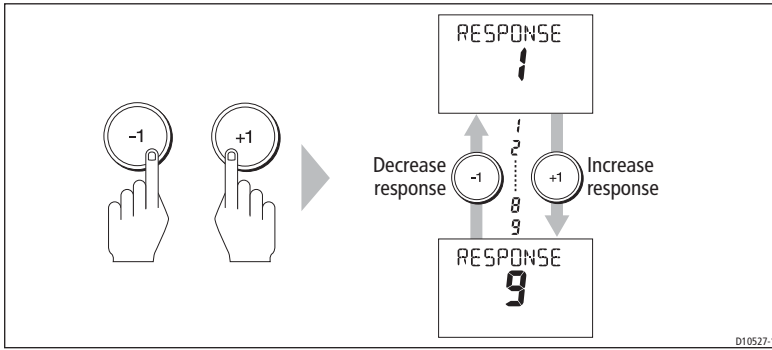
- **Levels 9 to 7** give the tightest course keeping and greatest rudder activity (and power consumption). This can lead to a rough passage in open waters as the SPX-5 Wheel system may 'fight' the sea.
- **Levels 6 to 4** should give good course keeping with crisp, well controlled turns under normal operating conditions.
- **Levels 3 to 1** minimize the amount of pilot activity. This conserves power, but may compromise short-term course-keeping accuracy.

Temporarily adjusting response

Use the following procedure to make temporary adjustments to the response level as required:

1. Press and release -1 and +1 simultaneously, to display the **RESPONSE** screen.

Note: The **RESPONSE** screen is set as a default data page (see *SmartPilot X-5 Wheel Installation & Setup Guide*) so you can also access it by pressing `disp` and then scrolling through the data pages.



2. Press -1 or +1 to change the response level.
3. Press disp or wait for 5 seconds to return to the previous display.

Note: You will lose temporary changes to response level when the system is powered off. You can make permanent adjustments in User Calibration.

1.5 Sailing functions

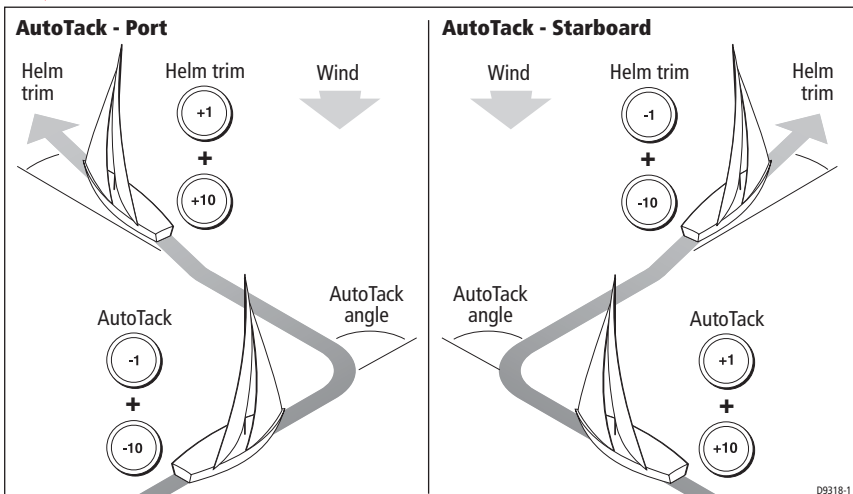
AutoTack

CAUTION: Allow time for course changes

When making major course changes, the trim on the boat may change substantially. Due to this, the SPX-5 Wheel system may take some time to settle accurately onto a new course.

The SPX-5 Wheel system has an automatic tack facility (AutoTack) that turns the boat in the required direction for a tacking maneuver.

Note: You can set the default AutoTack angle in User Calibration (see page 14).



When you AutoTack the boat turns through the AutoTack angle (100° default). You should then trim the helm to mirror the wind angle from the previous tack.

- To AutoTack to port
 - i. Press the -1 and -10 and release the buttons simultaneously, to engage AutoTack.
 - ii. Use the +1 and +10 buttons to trim the helm back to the required wind angle.
- To AutoTack to starboard:
 - i. Press the +1 and +10 buttons together. The boat will then AutoTack.
 - ii. Use the -1 and -10 buttons to trim the helm back to the required wind angle.

AutoTack with no wind information

If the SPX-5 Wheel system is not receiving wind information, set the AutoTack angle to 20° greater than the actual required change of heading (see *page 14*).

For example, if you want to tack through 80° (i.e when sailing at 40° to the wind):

1. Set the AutoTack angle to 100°. The SPX-5 Wheel system will AutoTack through the larger angle.
2. Use the Pilot Controller to trim the helm back to the required 40° relative to the wind.

Preventing gybes with AutoTack

Note: For the gybe inhibit feature to work, the SPX-5 Wheel system needs suitable wind information.

A gybe inhibit feature prevents an AutoTack away from the wind to prevent gybing during an AutoTack.

Gybe inhibit is switched on as a default but can be disabled in User Calibration if required (see *page 14*).

- With gybe inhibit on:
 - You will be able to perform an AutoTack into the wind.
 - The autopilot will prevent the boat from performing an AutoTack away from the wind, to prevent accidental gybes.
- With gybe inhibit off, you can perform an AutoTack into or away from the wind.

Gusty conditions



WARNING: Risk of gybe

Always be aware of the relative wind angle, especially when using the autopilot to sail down wind.

In gusty conditions, the course may tend to wander slightly, particularly if the sails are badly balanced. However, the SPX-5 Wheel system will maintain competent control even in gale force conditions, if you take the following measures:

- Improve course keeping by optimizing the sail balance:
 - Do not allow the boat to heel over excessively.
 - Ease the mainsheet traveler to leeward to reduce heeling and weather helm.
 - if necessary, reef the mainsail a little early.

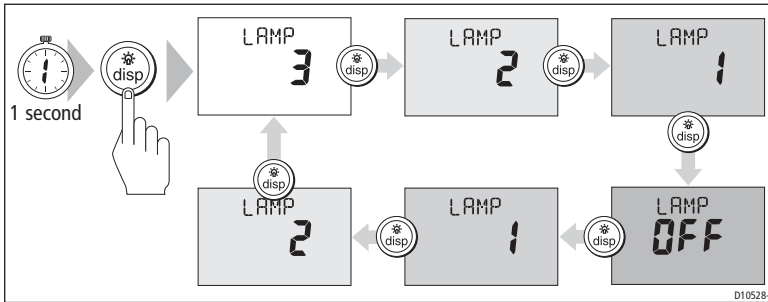
- In very strong winds and large seas, avoid sailing with the wind dead astern:
 - Ideally, bring the wind at least 30° away from a dead run.
 - In severe conditions, you may also need to remove the mainsail and sail under headsail only.

1.6 Adjusting display lighting & contrast

Lighting

To adjust the display and keypad lighting:

1. Press disp for 1 second from any mode to access the **LAMP** screen and turn on the lights.



2. Press disp to cycle through the possible illumination settings: **LAMP 3** (the brightest setting), **LAMP 2**, **LAMP 1**, **OFF**, **LAMP 1**, **LAMP 2**, **LAMP 3** and so on. As you change the setting, the illumination on other SeaTalk instruments or control units will also change.
3. The display automatically returns to the previous mode if you do not press a button for 10 seconds:
If you press another mode button within 10 seconds you will select the associated mode (for example: auto selects Auto mode, standby selects Standby mode).

- Notes:**
- (1) You can also adjust the lighting level from other SeaTalk instruments or control units.
 - (2) When you switch off, any changes you have made to the lighting level will be lost.

Contrast

To set the display contrast level:

1. With the autopilot in Standby mode, press disp for one second to access the **LAMP** screen.
2. Press disp for one second again, to display the **CONTRAST** screen.
3. Use +1 and -1 to set the required contrast level (from 1 to 15).
4. The display automatically returns to the previous mode if you do not press a button for 10 seconds:

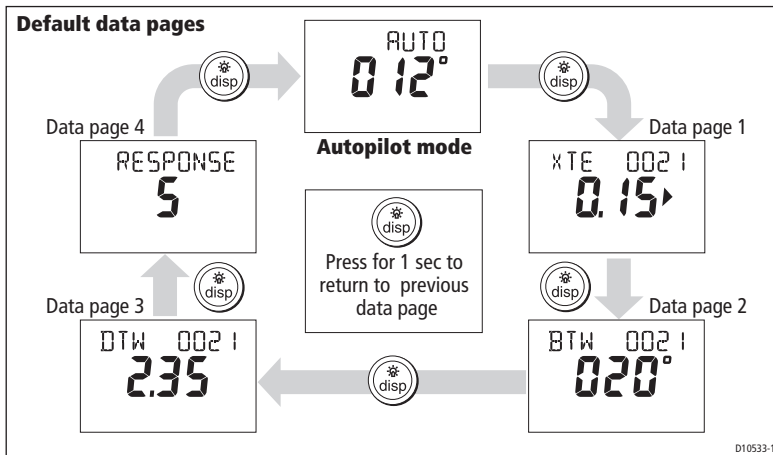
Note: If you press another mode button within 10 seconds you will select the mode assigned to that button (for example, auto selects Auto mode, standby selects Standby mode).

1.7 Data pages

A series of data pages on the Pilot Controller enables you to quickly monitor various information from your SPX-5 Wheel system. To access these data pages:

1. Press **disp** to access the first data page.
2. Press **disp** again to cycle the next data page, then continue this process to reach the page you want.
3. When all pages have been displayed and you press **disp** again, the display returns to the current SPX-5 Wheel system mode screen (for example, **AUTO**).

When you first use your SPX-5 Wheel system, four data pages are available, as in the following illustration, but you can configure up to fifteen data pages during Display calibration, as detailed in the *SPX-5 Wheel Installation & Setup Guide*.



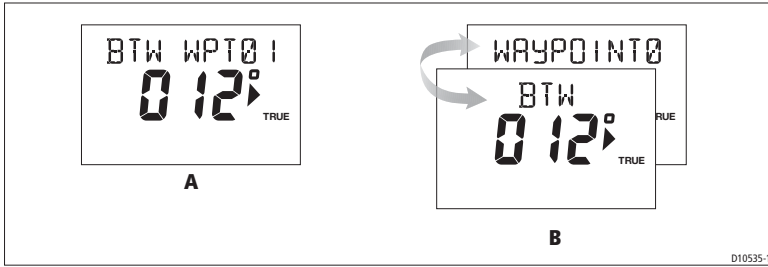
If the required information is not available for any data page, dashes are displayed.

Most data pages show repeated data so are for information only; you cannot adjust the values on them. An exception to this is the **RESPONSE** page, where you can adjust the value using the **-1** and **+1** buttons.

Waypoint names

If waypoints have been given names, the Pilot Controller will display them on the Cross Track Error (**XTE**), Bearing To Waypoint (**BTW**) and Distance To Waypoint (**DTW**) data pages:

- Waypoint names of five characters or less are displayed together with the page name (as shown by screen **A** below).
- Waypoint names of more than five characters alternate with the page name (as shown by screen **B** below).
- If a waypoint name has more than nine characters, the display only shows the first nine characters.



1.8 Alarms

The SPX-5 Wheel system supports the alarms listed on the following pages. When an alarm occurs, a beep sounds and the appropriate alarm message is displayed.

Responding to alarms

- Unless otherwise stated, if an alarm occurs, press standby to clear the alarm and return to hand steering.
- If more than one alarm occurs, as each alarm is cleared, the next is displayed.

Message	Description and possible actions
LARGE XTE	Large cross track error Occurs if the cross track error exceeds 0.3 nm. The alarm clears if the heading recovers.
MOB	Man OverBoard alarm The SPX-5 Wheel system activates the Man Overboard alarm if it receives a man overboard (MOB) message from another instrument on the SeaTalk system. It displays the text MOB instead of the waypoint number on the XTE, DTW and BTW data pages. If the autopilot is in Track mode, it will sound the Waypoint Advance alarm to notify you of the change in waypoint.
NEXT WPT?	Waypoint advance alarm The SPX-5 Wheel system activates the Waypoint Advance alarm whenever the target waypoint changes. This occurs when: <ul style="list-style-type: none"> • you select automatic acquisition by pressing track from Auto • you request waypoint advance by pressing track for 1 second in Track mode (with SeaTalk navigators only) • the boat arrives at the target waypoint and the navigator accepts the next waypoint • you activate the Man Overboard (MOB) function in Track mode When the alarm sounds, the pilot continues on its current heading but displays: <ul style="list-style-type: none"> • the bearing to the next waypoint • the direction the boat will turn to take up that bearing

Message	Description and possible actions
NEXT WPT? (continued)	<p>Responding to a Waypoint Advance alarm To respond to a Waypoint Advance alarm:</p> <ul style="list-style-type: none"> • check that it is safe to turn onto the new track, then press track to accept the waypoint advance • alternatively, you can cancel the alarm without accepting the waypoint advance by pressing: standby to return to hand steering, or auto to return to Auto mode. <p><i>Note: Waypoint advance only operates if the SPX-5 Wheel system is receiving valid bearing to waypoint and waypoint number information.</i></p>
OFFCOURSE (PT or Stb)	<p>Off course alarm Occurs if the vessel has been off course from the locked heading for longer than 20 seconds.</p> <ul style="list-style-type: none"> • PT = Deviation to port • Stb = Deviation to starboard <p>You can adjust the specified alarm angle in Dealer setup, see your Commissioning guide for details. If this happens frequently you should check sail balance and also review autopilot performance. See <i>page 7</i>.</p>
SHALLOW	<p>Shallow alarm The SPX-5 Wheel system activates the Shallow alarm if it receives a shallow depth alarm via SeaTalk:</p> <ul style="list-style-type: none"> • press standby or disp to cancel the alarm
WINDSHIFT	<p>Large wind shift warning Indicates a change in the apparent wind angle of more than 15°. See <i>page 24</i>.</p>

1.9 User setup options

User setup functions are accessed using a User calibration mode. The setup functions in this book are those likely to require adjustment during normal operation. Information on other setup functions is given in the *SmartPilot X-5 Wheel Installation & Setup Guide*.

Note: *Many of the setup functions are sailboat specific so will be displayed only if your vessel type is set to **SAILBOAT**.*

Accessing the setup functions

You can access the User Calibration mode only from Standby mode:

1. With the SPX-5 Wheel system in Standby mode, press and hold the standby button for 2 seconds. The display will change to show **DISPLAY CAL**.
2. Press the disp button once, the display will now show **USER CAL**.
3. Press auto to enter User Calibration.
The first page of User Calibration is displayed.
4. To access other User Calibration pages, press disp to scroll through the calibration functions (described below).

5. Use the **-1**, **+1**, **-10** and **+10** buttons to change the value of each function you want to change.
6. When you have made all the changes you want to make, press and hold **standby** for two seconds to exit calibration mode and save changes.

User Calibration pages

AutoTack

Use this screen to select how the vessel performs when using AutoTack. You can either:

- Set a default AutoTack angle. This is the angle through which the boat will turn when an AutoTack is performed.
or
- Select Relative Tack operation. With Relative Tack selected, the apparent wind angle when AutoTack is initiated, is mirrored the other side of the wind, on the opposite tack.

Screen Text	Options
AUTO TACK	40° to 125° in 1° steps

Setting default AutoTack angle

To set the required AutoTack angle:

- If the SPX-5 Wheel system is receiving wind information, set the AutoTack angle to the required change of heading.
- If the SPX-5 Wheel system is not receiving wind information, set the AutoTack angle to 20° greater than the actual required change of heading.
For example, to tack through 80° (i.e when sailing at 40° to the wind), set the AutoTack angle to 100°.

Selecting Relative Tack

To select Relative Tack, use -1 and -10, to reduce the tack angle value to 30°. This action selects Relative Tack and the screen displays **REL**, to indicate this.

Gybe inhibit

With gybe inhibit on:

- You will be able to perform an AutoTack into the wind
- The SPX-5 Wheel system will prevent the boat from performing an AutoTack away from the wind, to prevent accidental gybes.

With gybe inhibit off, you can perform an AutoTack into or away from the wind.

Screen Text	Options
GYBE STOP	ON (Default) = Gybe inhibit on (gybes prevented) OFF = Gybe inhibit off (gybes permitted)

Wind selection

This determines whether the boat steers to apparent or true wind in Wind Vane mode.

Screen Text	Options
WIND APP (Default)	SPX-5 Wheel system steers to apparent wind angle
WIND TRUE	SPX-5 Wheel system steers to true wind angle

WindTrim

WindTrim controls how quickly the SPX-5 Wheel system responds to changes in the wind direction. Higher wind trim settings will result in a system that is more responsive to wind changes.

Screen Text	Options
WIND TRIM	Range = 1 to 9 1 to 3 - Least responsive to wind changes (less system activity) 4 to 6 - Moderate response to wind changes 7 to 9 - Most responsive to wind changes (more system activity)

Response level

This sets the default SPX-5 Wheel system response level setting. The response level controls the relationship between course keeping accuracy and the amount of helm/drive activity. You can also make temporary changes to response during normal operation, as described earlier in this Chapter.

Screen Text	Options
RESPONSE	Range = 1 to 9 Levels 9 to 7 give the tightest course keeping and greatest rudder activity (and power consumption). This can lead to a rough passage in open waters as the SPX-5 Wheel system may 'fight' the sea. Levels 6 to 4 should give good course keeping with crisp, well controlled turns under normal operating conditions. Levels 3 to 1 minimize the amount of pilot activity. This conserves power, but may compromise short-term course-keeping accuracy.

Chapter 2: Following a route

2.1 Introduction

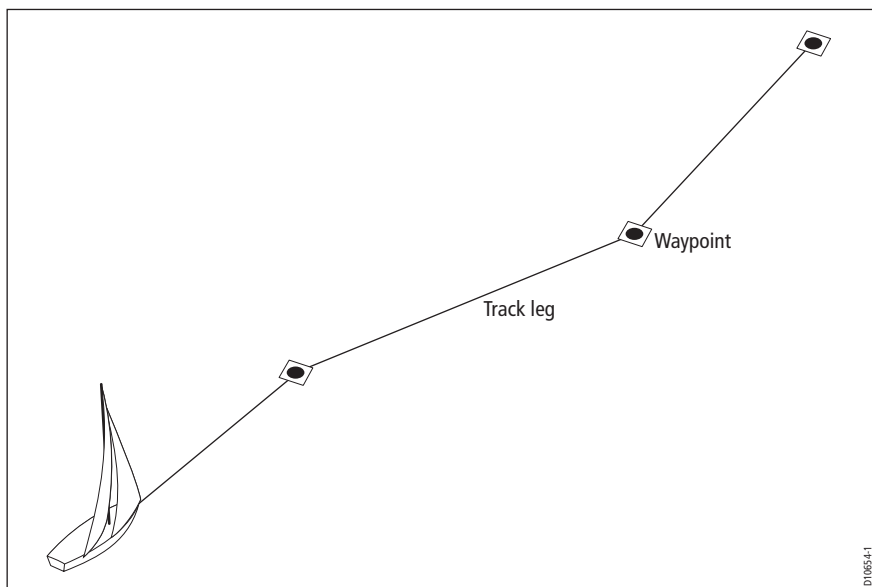
You can use your SPX-5 Wheel system to control your course. Use:

- Track mode to automatically follow a pre-determined route.
- Wind Vane mode to automatically maintain a predetermined wind angle

2.2 Using Track mode

Your autopilot can follow a route (or track) as set on your chartplotter or GPS.

A track is a predefined path through a series of waypoints with each “track leg” being a straight line between 2 consecutive waypoints.



In Track mode, the SPX-5 Wheel system will make any course changes necessary to keep your boat on the required track, automatically compensating for tidal streams and leeway.

Requirements for Track mode

To operate in Track mode, the SPX-5 Wheel system must receive route information from a suitable navigation system, such as:

- A SeaTalk compatible chartplotter or GPS unit.
- An NMEA 0183 compatible chartplotter or GPS unit.
- A SeaTalk^{ng} compatible chartplotter.

Refer to the *SmartPilot X-5 Wheel Installation and Commissioning Guide* for connection details.

Starting position and heading

When you enter Track mode, the SPX-5 Wheel system will steer the boat onto the required track. Before entering Track mode, ensure that the boat is as close as possible to the actual track and course heading. (For more information see *Track keeping & Cross Track Error* on page 19.)

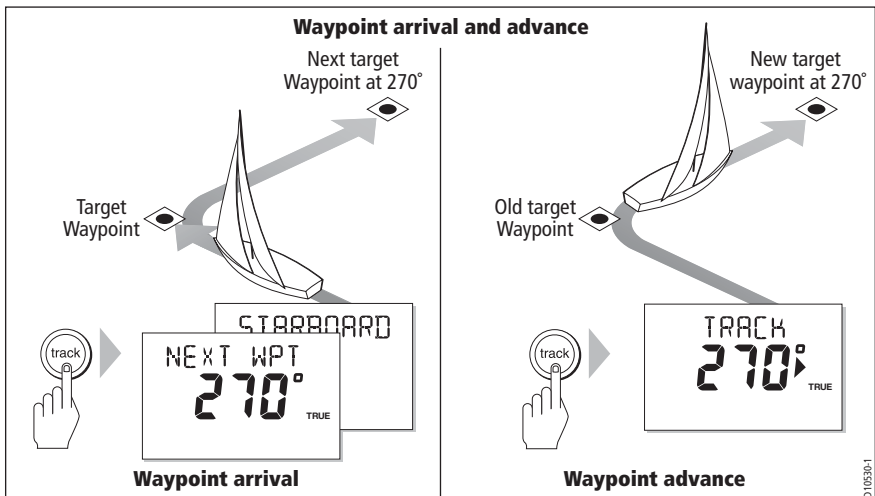
Entering track mode

Starting with the SPX-5 Wheel system in Auto mode and your chartplotter or GPS set to follow a route, enter track mode as follows:

1. Press track to enter Track mode.
2. The autopilot will sound an alarm and the display will show information regarding the next planned waypoint.
3. Check that it is safe for the boat to turn onto the new course, then press track again.

The SPX-5 Wheel system will turn the boat onto the new course and the display will show the heading required to achieve the required track.

Note: If the boat is more than 0.3 nm from the track, a Large Cross Track Error warning will sound (see page 20).



Leaving Track mode

You can leave Track mode at any time. To do this, either:

- Press auto to return to Auto mode.
or
- Press standby to take manual control of the boat.

Avoiding obstacles

In Track mode you still have full control from the keypad, so you can change course to avoid obstacles by using the course change buttons (**-1**, **+1**, **-10** or **+10**).

When avoiding obstacles in this way, the autopilot will revert to Auto mode. Once you are safely past the obstacle, you must re-initiate Track mode to continue on your planned route.

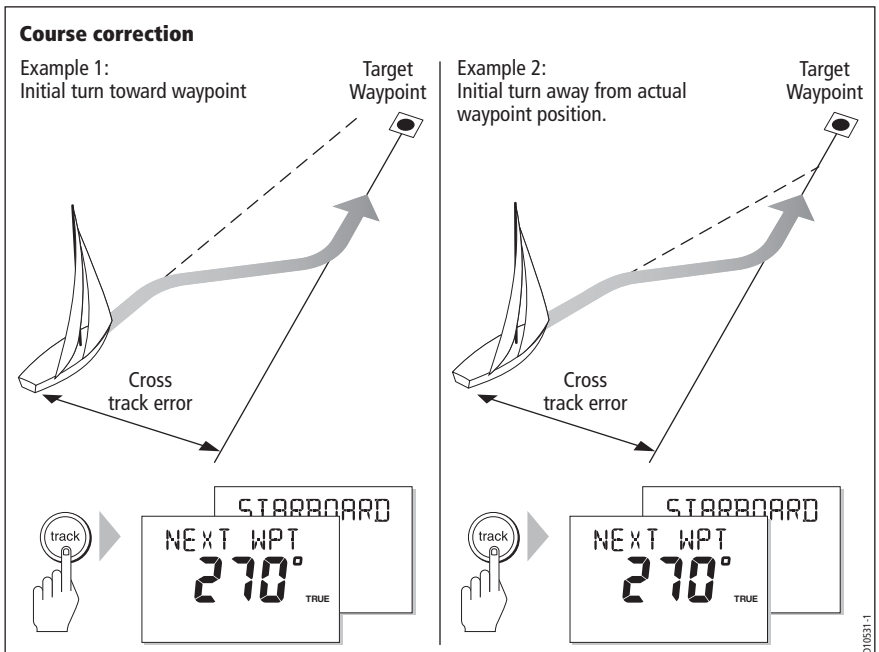
Track keeping & Cross Track Error

Cross track error (XTE) is the distance of the vessel from the planned track. There are a number of reasons why an XTE could be generated, such as:

- Entering Track mode at a position some distance from the route.
- Making a manual course change to avoid an object.
- Arriving at a waypoint (see page 22).

CAUTION:

When entering or returning to Track mode the autopilot will correct the XTE in order to keep to the defined track leg. The direction of turn may therefore not immediately coincide with the bearing to waypoint and so may be different from the expected bearing.

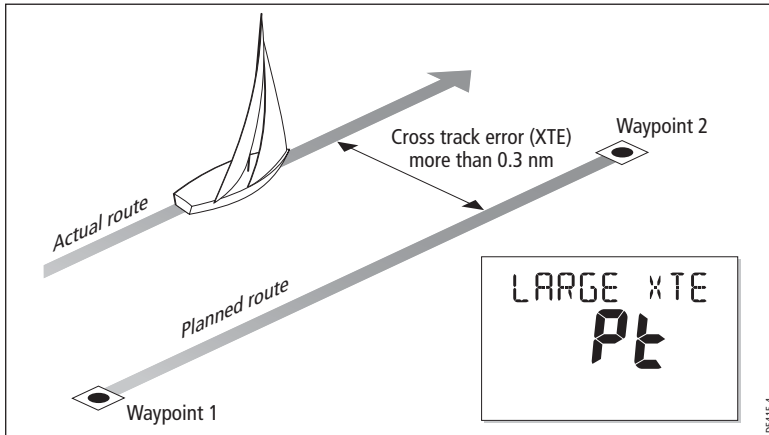


Best practice track keeping demands that the vessel follows the predefined Track Leg as closely as possible. This is to avoid potential collision with charted objects that may be near the defined path

The Raymarine Track keeping algorithm ensures safe operation by correcting any XTE as quickly as possible, but with a maximum convergence angle of 30° with the Track Leg. It then maintains the vessel tightly on the desired track.

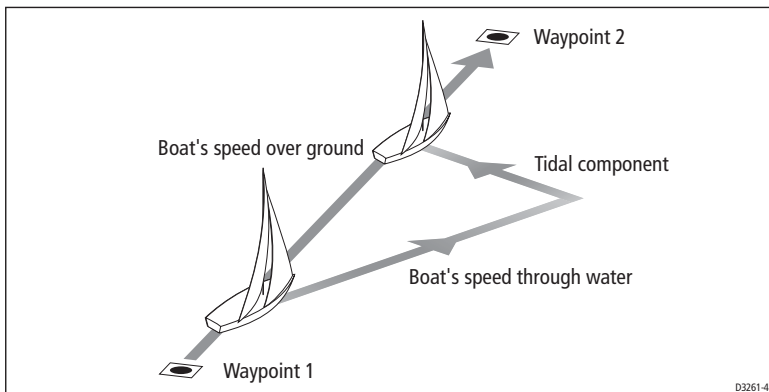
Large cross track error

If a cross track error of greater than 0.3 nm occurs, the SPX-5 Wheel system will sound a Large Cross Track Error warning and the Pilot Controller will show whether you are to the port (Pt) or starboard (Stb) of the planned track.



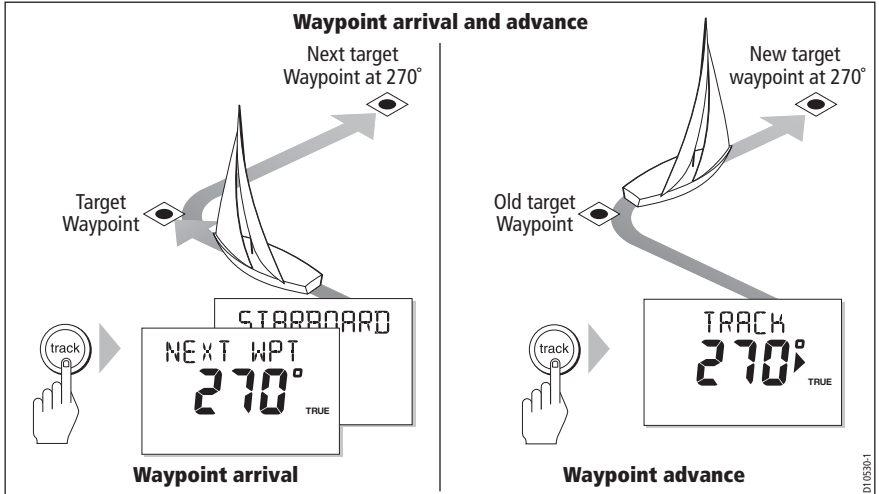
Tidal stream compensation

Under most conditions, the SPX-5 Wheel system will hold the selected track to within ± 0.05 nm (300 ft) or better. It takes account of the boat's speed when computing course changes to ensure optimum performance.



Waypoint arrival

As your vessel nears the waypoint a an audible Waypoint Advance warning sounds and a next waypoint (**NEXT WPT**) screen is displayed. This shows the bearing to the next waypoint.



WARNING: Ensure safe navigation

Before changing course, always ensure it is safe to do so. Always be aware of the relative wind angle, especially when turning away from the wind.

To steer to the next waypoint in the route

When the Waypoint Advance warning sounds, the SPX-5 Wheel system suspends Track mode and maintains the current boat heading. To advance to the next waypoint:

1. Check that it is safe to turn onto the new track.
2. Press the track button, to cancel the Waypoint Advance warning and steer the boat to the next track leg.

Note: If you do not press track to accept the Waypoint Advance, the SPX-5 Wheel system will maintain the current heading and continue to sound the warning.

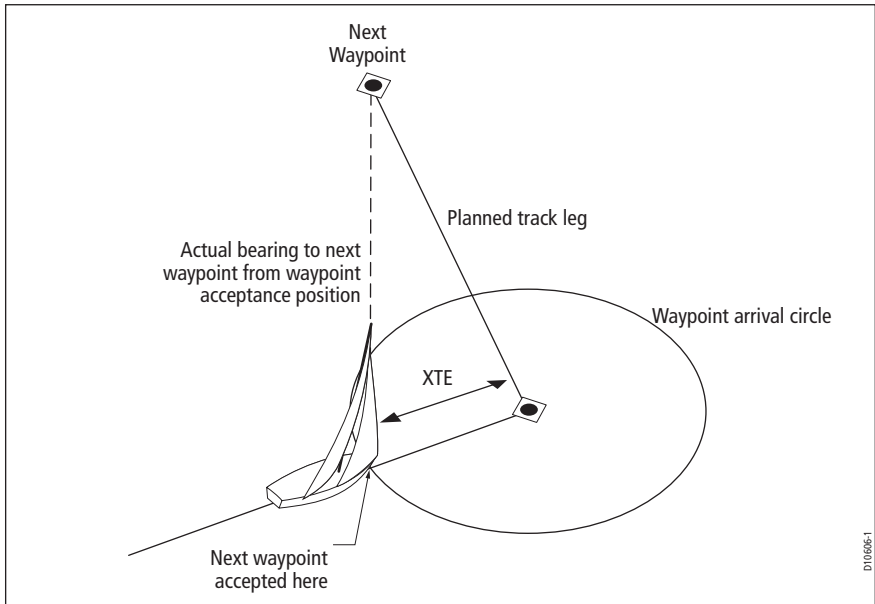
To skip a waypoint (SeaTalk chartplotters only)

If you want to advance to the next waypoint **before** you have arrived at the current target waypoint, you can skip the current waypoint by pressing track for 1 second. The display will then show a Waypoint Advance screen for the next waypoint. Check it is safe to turn, then press track to turn the boat towards the next waypoint.

Waypoint arrival circle

As the next Waypoint warning occurs within a circle around the actual waypoint, the next waypoint will probably be accepted some distance from the planned track leg. This can result in a cross track error and associated course correction.

Refer to *Track keeping & Cross Track Error* on page 19 for more details.



Route completion

when you have reached the last waypoint of a route in Track mode, the Pilot Controller displays a **ROUTE COMPLETED** message. You can either:

- Press auto to continue on the same heading.
- or
- Press standby to return to manual control.

Note: *If waypoints are provided using an NMEA connection the controller will display NO DATA when you reach the final waypoint.*

2.3 Using Wind Vane mode

Introduction

In Wind Vane mode, the SPX-5 Wheel system adjusts the locked heading, to maintain the original wind angle as changes in the true or apparent wind angle occur. The Fluxgate Compass provides the primary heading reference.

Note: *You can only select Wind Vane mode if the SPX-5 Wheel system is receiving suitable SeaTalk or NMEA wind direction information.*

Requirements for Wind Vane mode

To operate in Wind Vane mode, the SPX-5 Wheel system must receive wind information from one of the following sources:

- SeaTalk wind instrument connected via SeaTalk.
- NMEA wind instrument.
- SeaTalk^{ng} wind transducer.

True and apparent wind

SPX-5 Wheel systems can maintain a course relative to either an apparent or true wind angle in Wind Vane mode

The default setting is apparent wind. If required, you can change this to true wind in User Calibration (see *page 15*).

Note: *In order to sail to true wind, the SPX-5 Wheel system needs a wind speed input.*

WindTrim

In Wind Vane mode the SPX-5 Wheel system uses WindTrim, to provide smooth and precise performance with minimal power consumption by eliminating the effects of turbulence and short term wind variations. You can adjust the wind response (WindTrim) level in User Calibration (see *page 15*) to control how quickly the SPX-5 Wheel system responds to changes in the wind direction. Higher wind trim settings will result in a pilot that is more responsive to wind changes.

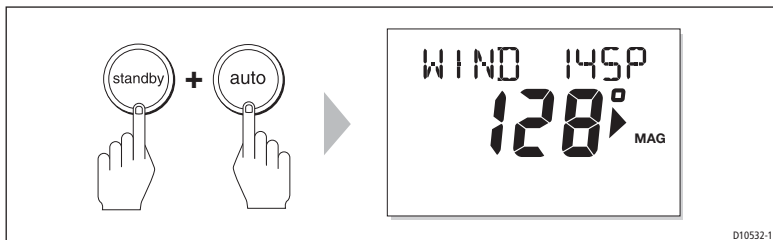
Operating hints for Wind Vane mode

- Always trim your sails carefully to minimize the amount of standing helm.
- Reef the headsail and mainsail a little early rather than too late.
- In Wind Vane mode the SPX-5 Wheel system will react to long-term wind shifts, but will not correct for short-term changes such as gusts.
- In gusty and unsteady inshore conditions, it is best to sail a few degrees further off the wind so that changes in wind direction can be tolerated.

Entering Wind Vane mode

You can enter Wind Vane mode from either Standby or Auto mode. To do this:

1. Steady the boat onto the required wind angle.
2. Press standby and auto together to select Wind Vane mode and lock the current wind angle.



In Wind Vane mode:

- The SPX-5 Wheel system sets the boat's heading to achieve the locked wind angle then continually adjusts the boat's heading to maintain this.
- The display shows the locked heading (e.g. **128°**) and the wind angle (e.g. **WIND 145P** indicates a wind angle of 145° to port).

If the SPX-5 Wheel system will not enter Wind Vane mode, it is probably not receiving wind data, so check the relevant connections.

Leaving Wind Vane mode

To leave Wind Vane mode, either:

- Press auto to return to Auto mode.
or
- Press standby to return to manual control.

Adjusting the locked wind angle

You can adjust the locked wind angle by using the -1, +1, -10 and +10 buttons to change course. For example, to bear away by 10° when the boat is on a starboard tack:

- Press -10 to turn the boat 10° to port – the locked wind angle and locked heading will both change by 10°.
- The autopilot will then adjust the locked heading as required to maintain the new wind angle.

Because turning the boat affects the relationship between the true and apparent wind angles, use this method only to make minor adjustments to the wind angle. To make major changes, return to Standby mode, steer onto the new heading, then reselect Wind Vane mode.

Avoiding obstacles in Wind Vane mode

In Wind Vane mode you still have full control from the keypad. You can change course to avoid obstacles by using the course change buttons (-1, +1, -10 or +10) to select the desired course change.

After you have dodged a hazard, make an equal course change in the opposite direction to cancel the dodge course change.

Wind Shift warning

If the autopilot detects a wind shift of more than 15° it will sound the wind shift warning and display a **WIND SHIFT** message:

- To cancel the warning, and retain the new heading, press standby and auto together.
- If you do not want to adopt the new heading, leave Wind Vane mode (i.e. return to either Auto or Standby). This cancels the warning.

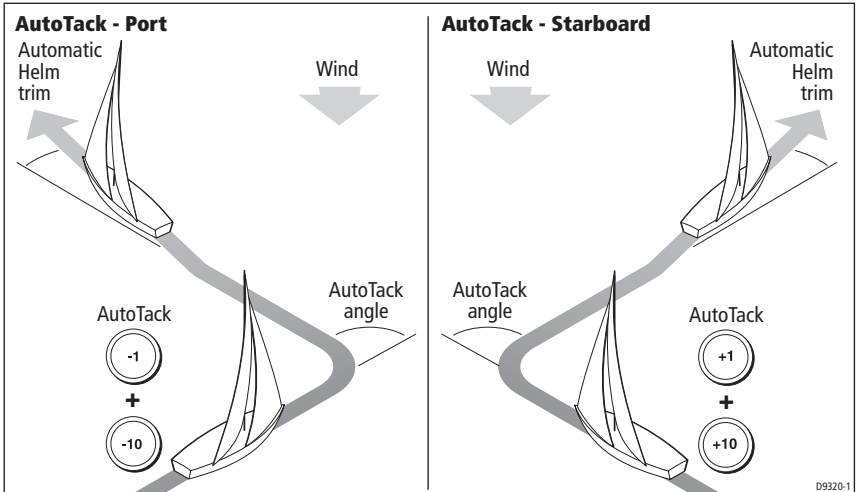
Using AutoTack in Wind Vane mode

Note: Before using the AutoTack function in Wind Vane mode, make sure the wind vane has been centered accurately.

The SPX-5 Wheel system has a built in automatic tack facility (AutoTack) that turns the boat in the required direction for a tacking maneuver.

When you AutoTack in Wind Vane mode, the boat turns to mirror the locked wind angle from the previous tack.

- To AutoTack to port: press the -1 and -10 buttons together.
- To AutoTack to starboard: press the +1 and +10 buttons together



No boat speed information

If boat speed data is not available, a tack maneuver will turn the boat through the tack angle set during calibration (see *page 14*).

If the SPX-5 Wheel system is not receiving boat speed information, set the AutoTack angle to 20° greater than the actual required change of heading.

For example, if you want to tack through 80° (i.e when sailing at 40° to the wind):

1. Set the AutoTack angle to 100°. The SPX-5 Wheel system will AutoTack through the larger angle.
2. Use the Pilot Controller to trim the helm back to the required 40° relative to the wind.

Chapter 3: Troubleshooting & maintenance

This chapter provides information to enable you to identify problems, interpret alarm messages, maintain your SPX-5 Wheel system and obtain product support.

Raymarine products are designed to provide many years of trouble-free operation. They are also put through comprehensive testing and quality assurance procedures before shipping.

However, if a problem occurs with your SPX-5 Wheel system, use the troubleshooting tables in this section to help identify the problem and provide a solution. If you cannot resolve the problem yourself, refer to the product support information.

3.1 Troubleshooting

Symptom	Possible cause and remedy
Display is blank	No power – check the power and SeaTalk fuses on Course Computer, then check main fuse/circuit breaker.
Data page display shows stationary dashes	The Pilot Controller is not receiving necessary data from other instruments – check cabling.
Display shows rotating dashes	Compass calibration in progress (see <i>SmartPilot X-5 Wheel Installation & Setup Guide</i>).
Displayed compass heading does not agree with the boat's compass	You have not calibrated the compass. Carry out the deviation and alignment procedures (see <i>SmartPilot X-5 Wheel Installation & Setup Guide</i>).
Boat turns slowly and takes a long time to come onto course	Rudder gain too low. Complete AutoLearn or increase gain setting (see <i>SmartPilot X-5 Wheel Installation & Setup Guide</i>).
Boat overshoots when turning onto a new course	Rudder gain too high. Complete AutoLearn or decrease gain setting (see <i>SmartPilot X-5 Wheel Installation & Setup Guide</i>).
The SPX-5 Wheel system 'hunts' when trying to position the rudder	Adjust the RUDD DAMP setting (see <i>SmartPilot X-5 Wheel Installation & Setup Guide</i>). Increase the damping one level at a time until the autopilot stops hunting, and always use the lowest acceptable value.
You cannot enter Seatrial Calibration	Seatrial calibration lock is on – turn off the calibration protection feature in Dealer Calibration (see <i>SmartPilot X-5 Wheel Installation & Setup Guide</i>).
The SPX-5 Wheel system will not 'talk' to other SeaTalk products	Cabling problem – make sure all the cables are connected properly.
Navigation information not received	Navigator not transmitting the correct data.

Symptom	Possible cause and remedy
The SPX-5 Wheel system will not auto advance to the next waypoint	No bearing to waypoint information received from the navigator.
Jog (+ and -) buttons do not work in standby mode.	Vessel type is set incorrectly. Check vessel type is set to SAILBOAT (see <i>SmartPilot X-5 Wheel Installation & Setup Guide</i>).

SPX-5 Wheel system alarm messages

If a fault or failure occurs in the SPX-5 Wheel system, an appropriate alarm message is generated.

If this happens and unless otherwise stated, press standby to clear the alarm and return to manual control, before you attempt to resolve the problem. If more than one alarm occurs, as each alarm is cleared, the next is displayed.

Alarm messages, possible causes and remedies are detailed in the following table.

Alarm message	Possible cause and remedy
CURRENT LIMIT	Serious drive failure – the drive is taking too much current due to short-circuit or jamming. Check the drive unit.
DRIVE STOPPED	The SPX-5 Wheel system is unable to turn the rudder. This can occur if the weather load on helm is too high, or if the (optional) rudder position sensor has passed beyond the preset rudder limits or rudder end-stops. Check drive and, if appropriate, the rudder position sensor.
LOW BATTERY	Supply voltage has dropped below acceptable limits. <ul style="list-style-type: none"> • press standby to clear the alarm and return to hand steering • start the engine to recharge the battery
LRN FAIL 1, 2, 4, 5 or 6	AutoLearn not completed successfully. Failure codes: 1 = AutoLearn has not been carried out (default setting) 2 = AutoLearn failed, usually due to manual interruption 4 = AutoLearn failed, probably due to drive or compass failure 5 = AutoLearn failed, probably due to motor current limiting 6 = AutoLearn failed, probably due to boat spinning Repeat the AutoLearn procedure (see <i>SmartPilot X-5 Wheel Installation & Setup Guide</i>).
MOT POW SWAPPED	Motor cables are connected to power terminals (and power cables are connected to motor terminals) at course computer. Turn off power and swap over connections.
NO DATA	Caused by any of the following situations: <ul style="list-style-type: none"> • the compass is not connected • the SPX-5 Wheel system is in Wind Vane mode but has not received wind angle data for 30 seconds • the SPX-5 Wheel system is in Track mode and: <ul style="list-style-type: none"> • is not receiving SeaTalk navigation data, or • the position sensor (GPS) is receiving a low strength signal – this will clear when the signal improves Check connections to the compass, wind instrument and navigator. Note: <i>The SPX-5 Wheel system stops adjusting the heading as soon as it loses data.</i>

Alarm message	Possible cause and remedy
NO PILOT	The Pilot Controller is not receiving data from the SPX-5 Wheel system computer. Check connections and check the Course Computer is switched on.
NO RUDREF	Only applicable if rudder reference option is fitted. Possible fault with rudder position sensor – check connections.
RG FAIL	GyroPlus yaw sensor has failed: • Internal gyro failure – call a Raymarine service agent.
NO SPD	No speed data
NO COMP	No compass data
NO WIND	No wind data
SEATALK and FAIL	The Pilot Controller cannot transmit data to the SeaTalk system. Make sure all SeaTalk cables are connected properly.

3.2 Maintenance

Important

Before attempting any maintenance procedure on the SPX-5 Wheel system, ensure the boat is securely moored alongside and that power to all system components is switched off.

CAUTION: Avoid damage when cleaning

Do NOT use solvent or abrasive cleaners on any SPX-5 component.

CAUTION: Do not dismantle SPX-5 Wheel system products

The SPX-5 Wheel system Course Computer and Pilot Controller do not contain any user serviceable parts and so should be serviced only by authorized Raymarine service technicians.

The only user-serviceable components in the SPX-5 Wheel system are the Course Computer fuses and the clutch belt in the drive unit. If any other parts require servicing or replacement, please contact your Raymarine authorized service agent.

Spare parts

The following replaceable parts are available from your Raymarine dealer.

Description	Location	Value	Part Number
Drive belt	Wheel drive unit	-	A18083
Power-in fuse	F1 in Course Computer	10 A	
SeaTalk Fuse	F2 in Course Computer	2 A	-

EMC Servicing and maintenance

- Undue noise and interference may be a symptom of an EMC related problem, Always report any EMC-related problem to your nearest Raymarine dealer. We use such information to improve our quality standards.
- To minimize any EMC related problems and ensure the best possible performance from your Raymarine equipment, follow the guidelines given in the installation instructions.

Suppression ferrites

Raymarine cables may be fitted with suppression ferrites. These are important for correct EMC performance. Any ferrite removed for maintenance purposes must be replaced in the original position once the maintenance is complete.

Use only ferrites of the correct type, supplied by Raymarine authorized dealers.

Pilot Controller

The Pilot Controller is a sealed unit, so user maintenance is limited to the following routine tasks:

- Ensure all cable connectors are securely connected.
- Examine the controller and cables for signs of wear or damage. Replace any damaged components.

The Pilot Controller does NOT contain any user-serviceable parts. If you attempt to dismantle it, you will invalidate the warranty.

CAUTION: Avoid damage when cleaning

Do NOT wipe the Pilot Controller display screen with a dry cloth as this could scratch the screen coating.

Using a clean, damp cloth, wipe the Pilot Controller. Do NOT use chemical or abrasive materials to clean the controller.

Note: *In certain conditions, condensation may appear inside the display screen. This will not harm the unit, and you can clear it by switching on the illumination for a short time.*

Wheel drive

Routine maintenance

After each trip, flush inside the drive unit with fresh water, by inserting a hose pipe in the free slot on the back cover.

Cleaning

CAUTION: Avoid damage when cleaning

Do not use mineral-based solvents (such as WD40) to clean or lubricate the wheel drive as they will damage the material.

To prevent the build-up of salt on the wheel drive bearings and drive belt, we recommend that each season you:

1. Remove the wheel drive from the wheel as follows:
 - i. Remove the wheel from the pedestal
 - ii. Remove the spoke clamp screws
 - iii. Remove the wheel drive front cover

2. Check inside the drive unit for any signs of damage.
3. Thoroughly flush the wheel drive interior with fresh water to remove any salt build-up on the bearings and drive belt.

Do not lubricate any part of the wheel drive. It is designed to run without lubrication.

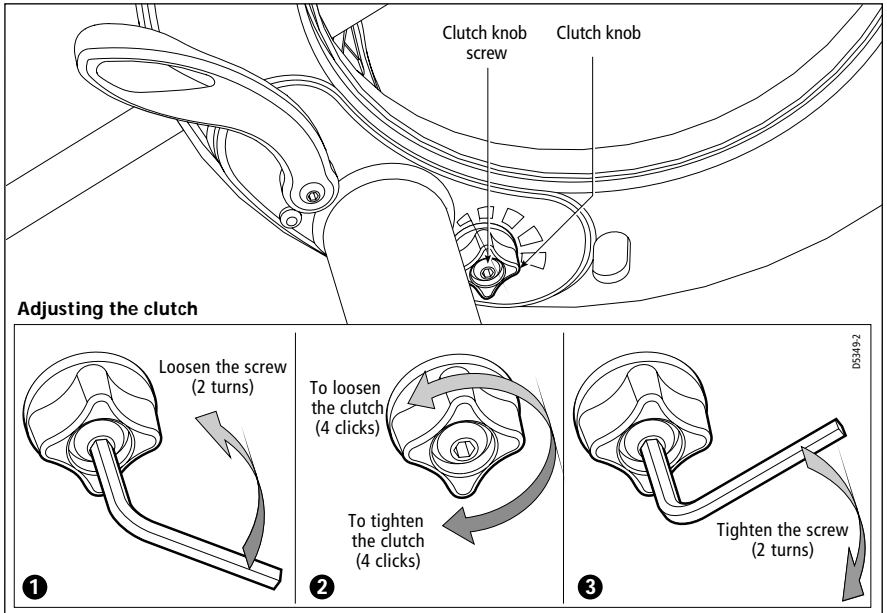
4. Replace the front cover then fit the wheel drive back onto the wheel.
5. Fit the wheel and wheel drive back onto the pedestal.
6. Clean the wheel drive case, then flush thoroughly with fresh water.

Adjusting the clutch

If the drive belt slips in Auto mode or drags in Standby mode, you need to adjust the clutch. If during normal use, the motor operates but the drive does not turn the wheel, the clutch requires adjusting.

To adjust the clutch:

1. Ensure that the autopilot is in Standby mode and the clutch is disengaged.
2. Using the 3 mm allen key supplied, loosen the clutch knob screw about 2 turns counter-clockwise.
3. Turn the clutch knob either 4 clicks clockwise to tighten the clutch, or 4 clicks counter-clockwise to loosen the clutch.
4. Use the allen key to re-tighten the clutch knob screw.



5. Check that the wheel still moves freely with the clutch off.

Note: If the wheel does not move freely, reduce the clutch tension by turning the clutch knob 2 clicks counter-clockwise and check again

6. Check the operation of the drive with the clutch engaged.

This procedure is usually sufficient to correct a slipping or dragging drive belt. However, in some cases, you may need to repeat the steps to adjust the clutch further.

Replacing the belt

If there is insufficient adjustment to rectify a slipping clutch, or if the drive belt is damaged in any way (e.g. broken, frayed or stretched), replace the drive belt. You can obtain a replacement belt from any Raymarine dealer (part number A18083). Fitting instructions are supplied with the belt.

3.3 Product support

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

World wide web

Please visit the Customer Support area of our web site at:

www.raymarine.com

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

Telephone help line

If you do not have access to the world wide web, please call our help line.

In the USA, call:

- +1 603 881 5200 extension 2444

In the UK, Europe the Middle East or the Far East, call:

- +44 (0) 23 9271 4713 (voice)
- +44 (0) 23 9266 1228 (fax)

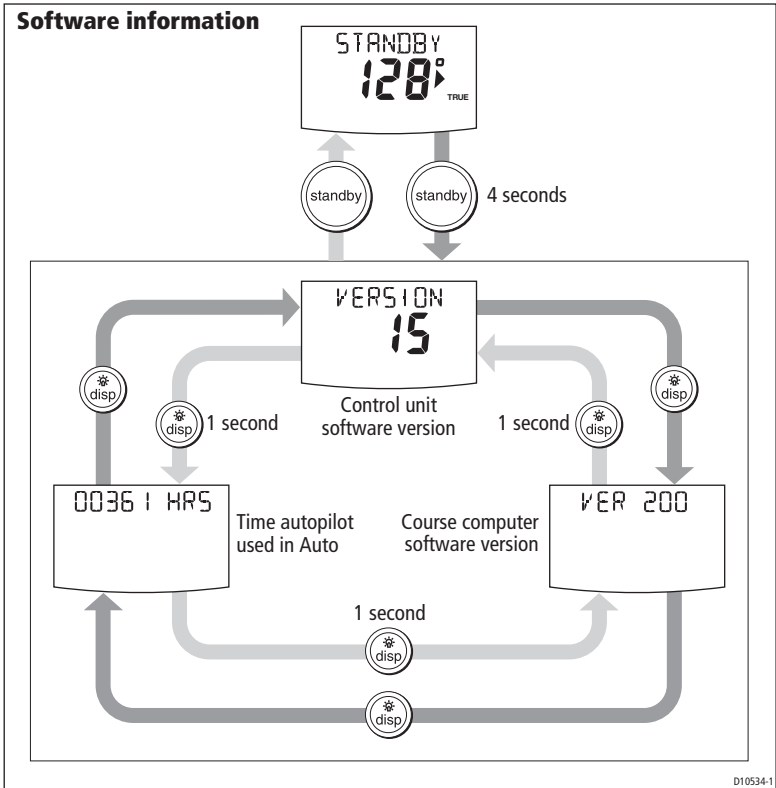
Help us to help you

When requesting service, please quote the following product information:

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

The following illustration shows how to display the software information:

- press and hold standby for 4 seconds:
 - After 2 seconds you will see the **DISPLAY CAL** screen
 - After another 2 seconds you see controller software version
- Press disp to display the computer software version
- Press disp again to display the total number of hours the SPX-5 Wheel system has been used in Auto mode.



Product details table

For future reference, you may want to use this table to record serial and software information for your SPX-5 Wheel system:

	Serial Number	Software Version
SPX-5 Wheel Pilot Controller		
SPX-5 Wheel Course Computer		
Hours Used		hours

Glossary

Term	Meaning
ac	Alternating current.
AST	Advanced Steering Technology (AST) is Raymarine's unique advanced steering algorithm. It uses inputs from a wide variety of sensors to tune the autopilot's operation to provide superior control of the boat in any condition.
AutoLearn	Self-learning calibration feature.
AutoTrim	The AutoTrim 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.
AWG	American Wire Gauge.
CE	Marked on Raymarine products that comply with defined European Community standards.
Counter rudder	Counter rudder is the amount of rudder the autopilot applies to try to prevent the boat from yawing off course. Higher counter rudder settings result in more rudder being applied.
dc	Direct current.
EMC (Electromagnetic Compatibility)	When powered up, all electrical equipment produces electromagnetic fields. These can cause adjacent pieces of electrical equipment to interact with one another, causing a degradation of their performance. Use the EMC guidelines in this book, to ensure optimum Electromagnetic Compatibility (EMC) between equipment and minimize any unwanted interactions.
Fluxgate	Standard Raymarine compass supplied as part of the SPX-5 Wheel system.
GPS	Global Positioning System.
MOB	Man overboard.
nm	Nautical mile.
NMEA	The NMEA (National Maritime Electronics Association) protocol is an internationally accepted serial communication interface standard for sharing data between electronic equipment. Raymarine products can share information with non-SeaTalk equipment using the NMEA 0183 protocol.
Response	The autopilot response level controls the relationship between course keeping accuracy and the amount of helm/drive activity.
Rudder gain	Rudder gain is a measure of how much helm the autopilot will apply to correct course errors. The higher the setting the more rudder will be applied.
SeaTalk	Raymarine's proprietary communication system. It links the products to provide a single, integrated system sharing power and data.
SM	Statute (land) mile.
VHF	Very High Frequency (radio).

Term	Meaning
WindTrim	WindTrim (wind response) controls how quickly the autopilot responds to changes in the wind direction. Higher wind trim settings will result in a pilot that is more responsive to wind changes.
XTE	Cross track error.
Yaw	The boat's rate of turn ($^{\circ}$ /sec).

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