Raymarine®

Owner's Handbook

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- SeaTalk compatibility also allows additional fixed and hand-held autopilot control units to be easily connected at secondary steering and control positions

The ST1000 Plus and ST2000 Plus tiller pilots can also be used with any navigator transmitting NMEA 0183 or NMEA 0180 data.

The tiller pilot can be calibrated to suit each installation to provide maximum performance with many types of boat.

1.2 Specifications

General specifications	
Power supply:	10 V to 15 V DC
Drive unit thrust torque:	ST1000 Plus: 57 kg (125 lb) ST2000 Plus: 77 kg (170 lb)
Maximum boat displacement:	ST1000 Plus: 3 000 kg (6 600 lb) ST2000 Plus: 4 500 kg (10 000 lb)
Drive mechanism:	ST1000 Plus: lead-screw and nut drive ST2000 Plus: re-circulating ball drive
Helm speed (lock to lock):	ST1000 Plus: 8 seconds ST2000 Plus: 4.5 seconds
Current consumption:	• Standby: 40 mA (90 mA with full lighting) • Auto: 0.5 A to 1.5 A depending on boat trim, helm load and sailing conditions
Operating temperature:	0°C to +70°C (32°F to 158°F)
Main features:	• 6 button digital keypad • Backlit LCD display of heading, locked course and navigational information • User calibration for optimum performance • WindTrim control in WindTrim mode • SeaTalk compatible • Automatic compass deviation correction • Northerly/Southerly heading compensation • Automatic heading deadband – seastate control • Automatic tack • Built-in navigator interface (NMEA and SeaTalk) • Waypoint advance feature

EMC conformance

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

1.3 About this handbook

This handbook contains important information about installing, using and maintaining your new Raymarine product. To get the best from the product, please read this handbook thoroughly.

Important Information

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.

Waste from Electrical and Electronic Equipment (WEEE) Directive

The Waste from Electrical and Electronic Equipment (WEEE) Directive requires the recycling of waste electrical and electronic equipment. Whilst the WEEE Directive does not apply to some of Raymarine's products, we support its policy and ask you to be aware of how to dispose of this product.

The crossed out wheelie bin symbol, illustrated above, and found on our products signifies that this product should not be disposed of in general waste or landfill.

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

Handbook information

To the best of our knowledge, the information in this handbook was correct when it went to press. However, Raymarine cannot accept liability for any inaccuracies or omissions it may contain. In addition, our policy of continuous product improvement may change specifications without notice. As a result, Raymarine cannot accept liability for any differences between the product and the handbook.

Safety notices

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

WARNING: Electrical safety
Make sure the power supply is switched off before you make any electrical connections.

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

Your Raymarine autopilot 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:

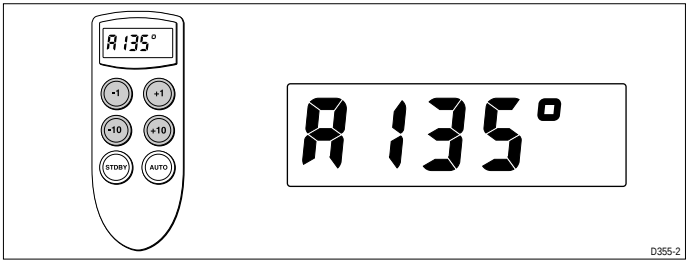
- Ensure that someone is present at the helm AT ALL TIMES, to take manual control in an emergency.
- Make sure that all crew members know how to disengage the autopilot.
- Regularly check for other boats and any obstacles to navigation – no matter how clear the sea may appear, a dangerous situation can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

Chapter 2: Using the Tiller Pilot

2.1 Overview

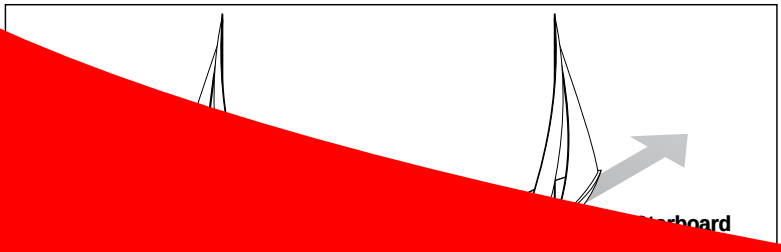
WARNING:
Passage making under autopilot control is an enjoyable experience that can, if you are not careful, lead to the relaxation of the permanent watch. Always maintain a permanent watch no matter how clear the sea may appear to be.

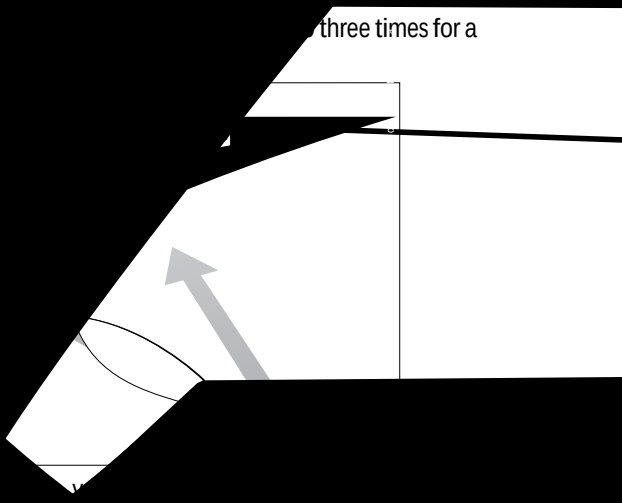
- The tiller pilot always powers up in Standby mode (indicated by a flashing 'C' alongside the boat's current compass heading).
- The tiller pilot is controlled using simple push-button operations, all of which are confirmed with a short beep. In addition to the main single key functions, there are several dual key operations.
- To select automatic steering:
  - steady the boat on the required heading
  - place the pushrod over the tiller pin (if necessary, extend or retract the pushrod using the **-1**, **+1**, **-10**, and **+10** keys)
  - press **auto**: the display will then show an '**A**' alongside the current heading
- To return to manual steering at any time:
  - press **standby**
  - remove the pushrod from the tiller pin
- You can use the **-1**, **+1**, **-10**, and **+10** keys to make course changes when the boat is under autopilot control.



Changing course

In Auto mode, use the **-1** and **-10** (port) and **+1** and **+10** (starboard) keys to change course in steps of 1° and 10°.




three times for a

To switch back to AutoSeastate, press **-1** and **+**

Note: *The autopilot reverts to Automatic Deadband ... ch time you select Standby mode.*

Operating hints – trim changes

CAUTION:
Only make major course changes when s... g MANUALLY. This ensures that the boat will safely clear any ...uctions or other boats, and you can take into account the c... ed wind and sea conditions on the new heading before eng... g the autopilot.

Large course changes which change the apparent wi... ection can produce large trim changes. When a sudden trim change occu... example due to weather helm or sail imbalance) there will be a delay o... to one minute before the automatic trim applies rudder to restore the locked ... ding.

In these situations, the autopilot will not immediately as... ne the new automatic heading, and will only settle onto course when the auto... tic trim has been fully established. To minimize this problem, use the following p... ocedure to make major course changes:

1. Note the required new heading.
2. Press **standby**, remove the pushrod from the tiller pin, and steer manually.
3. Bring boat onto the new heading and fit the pushrod back onto the tiller pin.
4. Press **auto** and let the boat settle on course.
5. Bring your boat onto the final course in 1° steps using **-1** ... **+1**.

Gusting conditions

In gusting conditions, the course may tend to wander slightly ... ticularly if the sails are badly balanced. By improving sail balance, you can i... ve course keeping.

If you take the following precautions, the autopilot will be ab... intain competent control even in gale force conditions:

- Do not allow the boat to heel over excessively.
- Ease the mainsheet traveller to leeward to reduce heeling ... er helm.
- If necessary, reef the mainsail a little early.
- It is also advisable (whenever possible) to avoid sailing wi... nd astern when there are very strong winds and large seas.
- Ideally, the wind should be at least 30° away from a dead ...

Tiller Pilots

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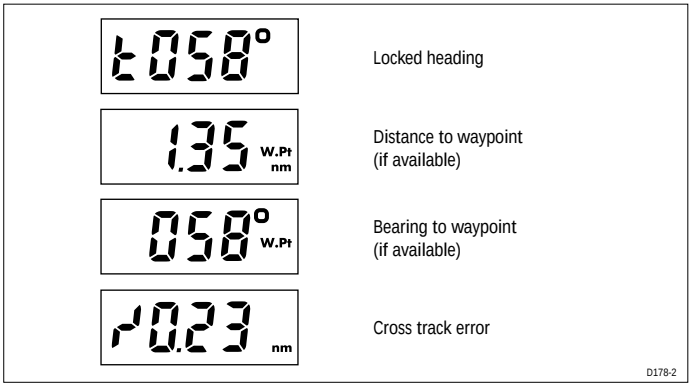

Manual track acquisition

If your navigator only provides cross track error information, you must acquire the track manually:

1. Steer the boat 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 **-10** and **+10** together to enter Track mode:
   - the autopilot will start tracking to the waypoint
   - the display will alternate between cross track error and the locked pilot heading

Manual track acquisition at low speeds

Using manual acquisition at low speeds requires additional care as tidal streams have a far more significant effect at lower speeds than at higher speeds.

In general terms, if the tidal flow is less than 35% of the boat's speed, you will not notice any difference in the tiller pilot's performance in Track mode. However, you should take extra care during manual acquisition, as follows:

- before you select Track mode, make sure that the boat is as close as possible to track, and that the direction made good over the ground is as close as possible to the direction of the next waypoint
- positive checks of the boat's position at regular intervals are vital, especially if you are close to potential navigational hazards

Re to from Track mode

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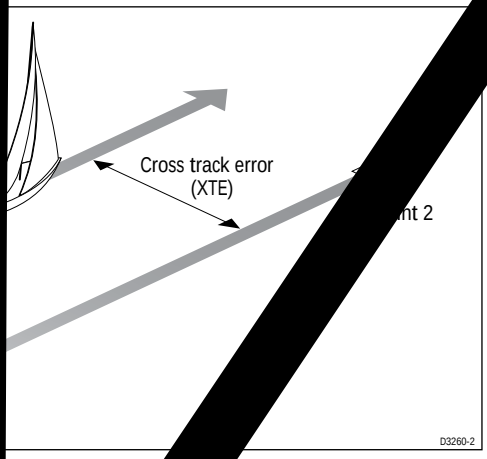
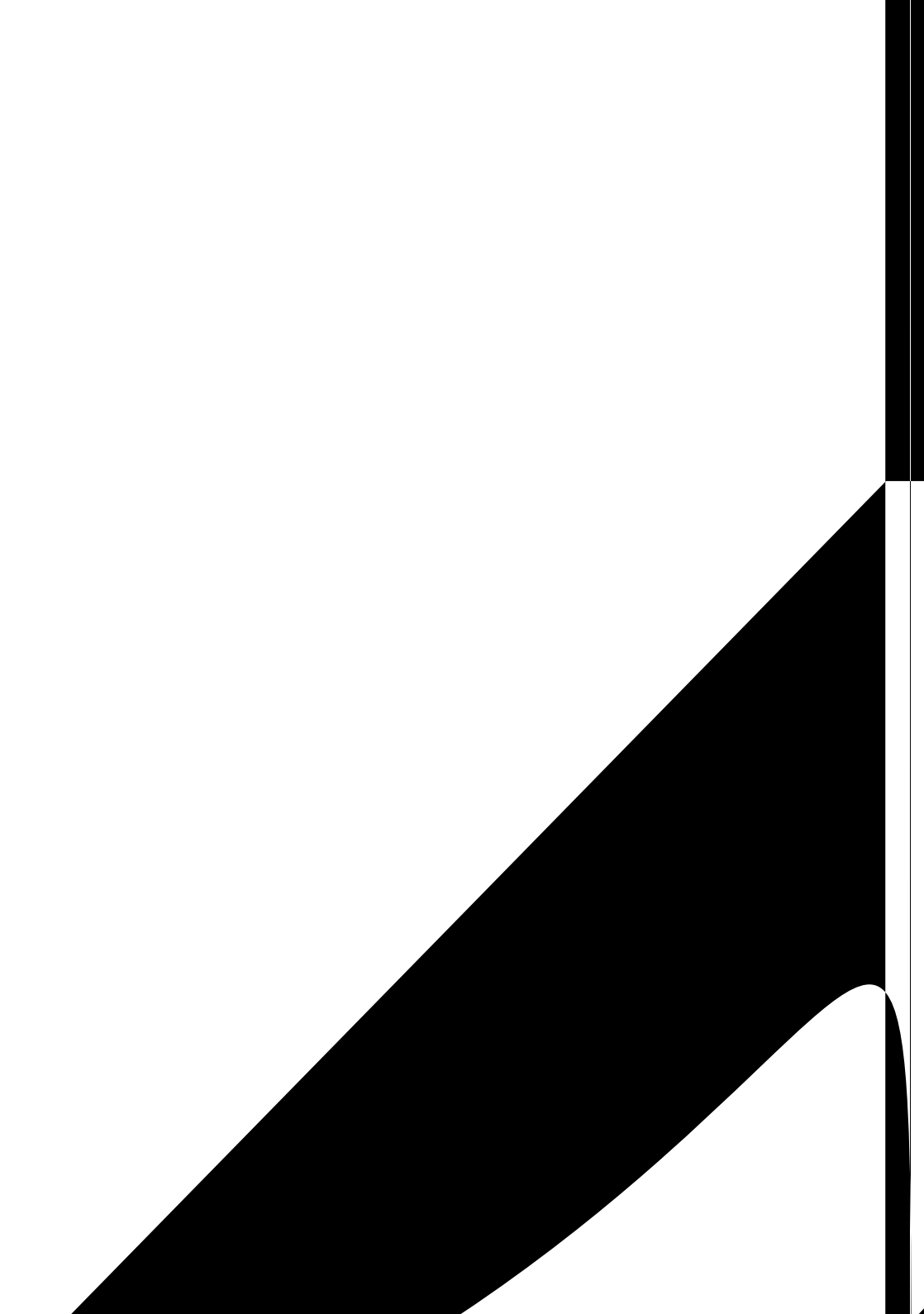
is the distance between your current position and the
displayed in nautical miles (nm) and is taken directly fr



s the cross trac n the following ways:



Arrival

As the boat passes the target waypoint, the navigator manually or automatically selects the next target waypoint. The pilot will then:

- detect the new target waypoint name
- sound the waypoint advance alarm
- display the new bearing to waypoint and the direction the boat will turn to acquire it

Advance

When the waypoint advance alarm is sounding, the tiller pilot will suspend Track mode and maintain the current heading:

- check that it is safe to turn onto the new track
- press the **-10** and **+10** keys together: this will cancel the waypoint arrival alarm and turn the boat towards the next waypoint

Unless you accept the waypoint advance in this way, the alarm will continue to sound and the tiller pilot will maintain the current course.

Dodges in Track mode

In Track mode, you still have full control from the keypad:

- to make a dodge maneuver: use the **-1**, **+1**, **-10** or **+10** keys
- after you have avoided the hazard, reverse the course change selected for the dodge maneuver by selecting an equal course change in the opposite direction
- if the boat remains within 0.1 nm of track, there is no need to steer back towards the track

Safety in Track mode

WARNING:
Track mode provides accurate track keeping even in complex navigational situations. However, it is still the skipper's responsibility to ensure the safety of their boat at all times through careful navigation and frequent position checks.

Passage making in Track mode assists precise navigation and removes the tasks of compensating for wind and tidal drift. However, you MUST still maintain an accurate log with regular plots:

Confirming position at the start of a journey

- At the start of a journey you must always use an easily identifiable fixed object to confirm the fix given by the navigation system.
- Check for fixed positional errors and compensate for them.

Verifying computed positions

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

Plot frequency

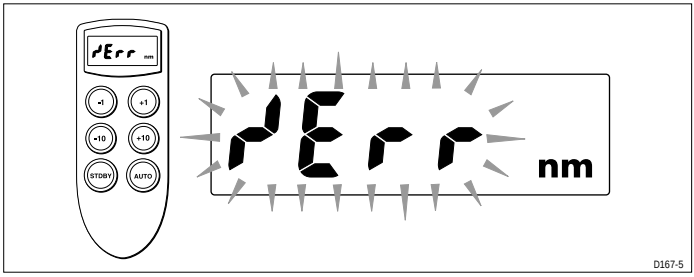
- In open water, you should make plots at least every hour.
- In confined waters or when near to potential hazards, you should make plots more frequently.

Setting waypoints

- Local variations in radio signal quality and changes in the tidal stream can produce deviations from the desired track. When setting waypoints, remember that deviations can 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 this zone.
- For the waypoint advance function to work, the last four characters of adjacent waypoint names must be different.

Warning messages in Track mode

Track data not received



The tiller pilot displays this message if you select Track mode when the autopilot is not receiving any navigation data.

- the pilot will turn onto the new bearing and track towards the next waypoint

Note: *Waypoint advance will only operate if your pilot receives valid bearing to waypoint and waypoint number information.*

2.5 Using WindTrim mode

Note: *You can only use WindTrim mode if the tiller pilot is connected to a suitable wind sensor/instrument providing wind direction data.*

To use WindTrim mode, the tiller pilot must receive wind information from one of the following sources:

- SeaTalk wind instrument
- NMEA wind instrument
- Raymarine pushpit wind vane (part number Z159) connected via supplied SeaTalk interface

In WindTrim mode the tiller pilot maintains a course relative to an apparent wind angle. The pilot uses WindTrim to eliminate the effects of turbulence and short term wind variations. This provides smooth precise performance with minimum power consumption.

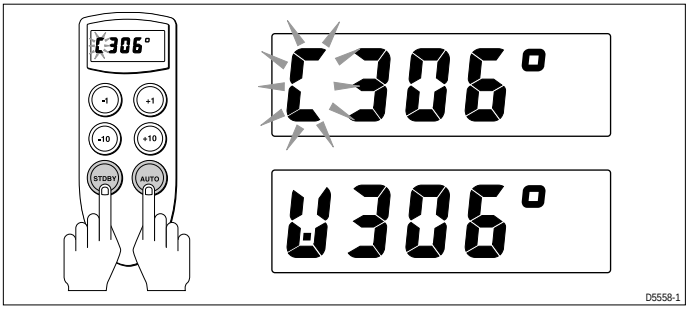
WindTrim mode uses the fluxgate compass as the primary heading reference. When changes in the apparent wind angle occur, the tiller pilot adjusts the locked compass heading to maintain the original apparent wind angle.

In WindTrim mode, the tiller pilot ignores short-term changes in wind direction, yet still tracks real wind shifts as subtle as 1°.

Selecting WindTrim mode

From Standby mode or Auto mode, press **standby** and **auto** together to select WindTrim. The tiller pilot will then maintain the current apparent wind angle.

Note: *The tiller pilot beeps once every 30 seconds in WindTrim mode.*



To cancel the wind shift alarm:

- check that the new course does not take e boat into danger
- press **standby** and **auto** together mom arily to accept the alarm an the wind shift alarm value to the current mpass heading

Operating hints for WindTrim ode

- WindTrim filters the wind vane output. T provides optimum respo e for offshore conditions where genuine shifts wind direction occur g ually.
- In gusting and unsteady inshore conditio , it is best to sail a fe ees further off the wind so that changes in appa nt wind direction erated.
- It is important to minimize the amount o tanding helm th ful sail trimming and positioning of the mainshe traveller.
- It is recommended that the headsail and ainsail ar rly rather than too late.

Chapter 3: Maint

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obtaining prod

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equipment but it can lead to spurious resetting action, or momentarily may result in faulty operation.

3.2 Product support

Raymarine products are supported by a worldwide network of distributors and Authorized Service Representatives.

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 following Fault Finding section.

If you cannot trace or rectify the fault, contact either your national distributor, service representative, or the **Raymarine Technical Services Call Center**. Refer to the back cover or the Worldwide Distributor List for contact details.

Always quote the product serial number (this number is printed on the underside of the tiller pilot).

3.3 Fault finding

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

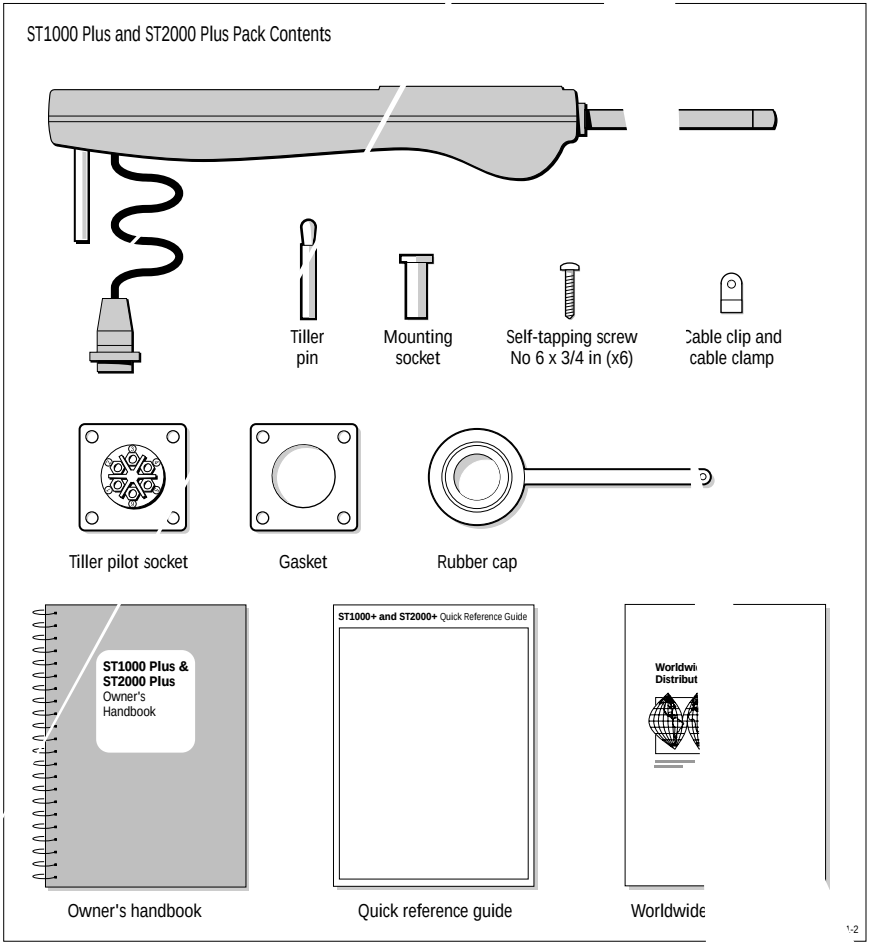
In the unlikely event that a fault does occur with your autopilot, use the following table to help identify the problem and provide a solution. If you cannot resolve the problem yourself, contact either your national distributor, service representative, or the **Raymarine Technical Services Call Center**.

SYMPTOM	SOLUTION
The autopilot display is blank.	No power – check the fuse/circuit breaker.
The displayed compass heading does not agree with the boat's compass.	The compass has not been corrected for deviation – carry out the deviation and alignment procedures (see *page 53*).
Boat turns slowly and takes a long time to come on to course.	Rudder gain too low (see *page 56*).
Boat overshoots when turning on to a new course.	Rudder gain too high (see *page 56*).

Chapter 4: Installing the T Pilot

4.1 Planning the installation

Before you start installing your tiller pilot system, llustration to check the parts supplied. Then read through the following in on and the relevant installation sections in this chapter.



Cabling guidelines

- consider how you will run cables to and from ea ıent
- avoid running cables through bilges where po›si
- avoid running cables close to fluorescent lig'ıts, e ıdio transmitting equipment etc.

EMC installation guidelines

All Raymarine equipment and accessori›s are designed ıest industry standards for use in the recreational m›arine environmen

Their design and manufacture confr›rms to the appropria tromagnetic Compatibility (EMC) standards, b›ıt correct installation is ed to ensure that performance is not compromise›ı.

Although every effort has be›en taken to ensure that they w rform under all conditions, it is important t› understand what factors could ct the operation of the product.

The guidelines given he›re describe the conditions for optimum MC performance, but it is recognized th›ıt it may not be possible to meet all of the conditions in all situations.

To ensure the be›ıt possible conditions for EMC performance wit ıin the constraints imp›osed by any location, always ensure the maximum separation possible betw›een different items of electrical equipment.

For **optim›um** EMC performance, we recommend that:

- Ray›rnarine equipment and cables connected to it are:
  - At least 3 ft (1 m) from any equipment transmitting or cab carrying radio signals e.g. VHF radios, cables and antennas. In the of SSB radios, increase the distance to 7 ft (2 m).
  - More than 7 ft (2 m) from the path of a radar beam. A rada ı can normally be assumed to spread 20 degrees above and below 'iating element.
- The equipment is supplied from a separate battery from that u ıgine start. Voltage drops below 10 V, and starter motor transients, the equipment to reset. This will not damage the equipment, but r 'he loss of some information and may change the operating mode
- Raymarine specified cables are used. Cutting and rejoining the compromise EMC performance and must be avoided unless do detailed in the installation manual.

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4.2 Install

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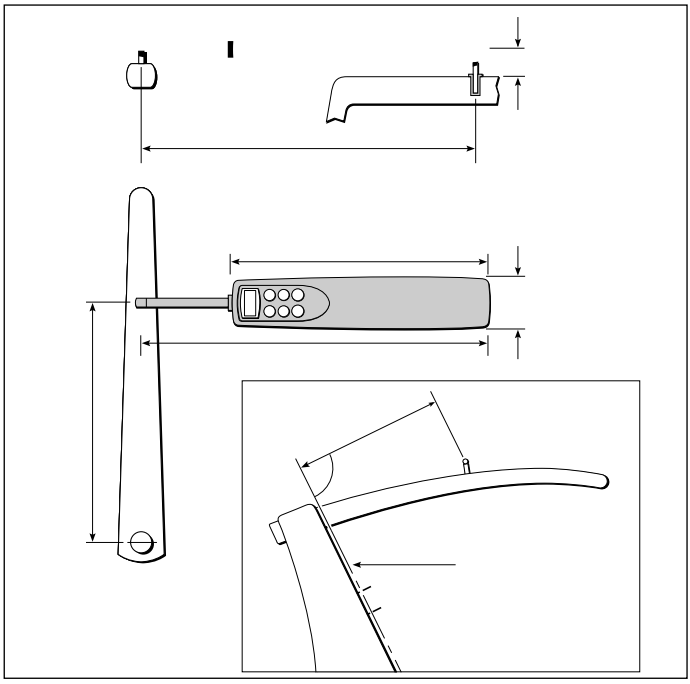


To measure the critical dimensions:

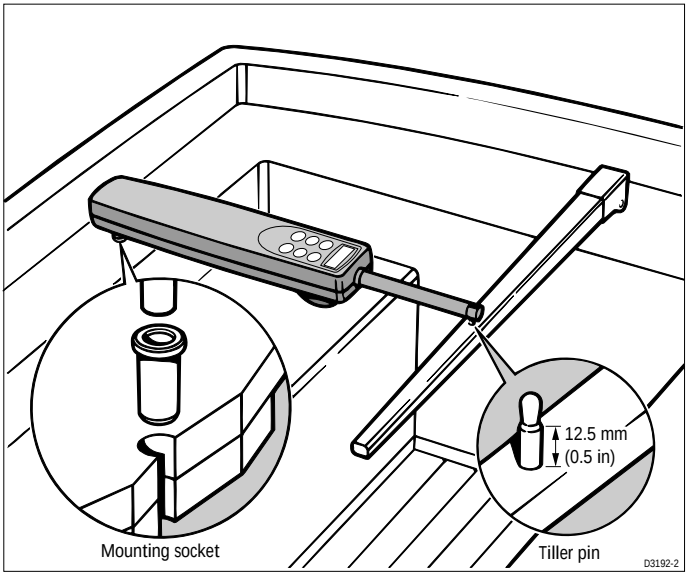
1. Clamp the tiller on the boat's center line.
2. Mark dimensions **A** and **B** and use masking tape to locate the fixing points.

Note: *For standard installations, dimension A is measured on the starboard side of the cockpit. If you need to mount the tiller pilot on the port side of the cockpit, you can measure dimension A to port. However you will need to reverse the tiller pilot's operating sense when you have completed installation (see page 49).*

3. Make sure that:
   - dimensions **A** and **B** are at **right angles** to each other (as shown on the diagram opposite)
   - the tiller pilot is mounted **horizontally**

Basic installation

After establishing control dimensions A and B, you can usually mount the tiller pilot directly onto the cockpit seat.



Installing the tiller pin

1. Drill a 6 mm ($^1/_4$ in) diameter hole to a depth of 25 mm (1 in) at the fixing point you have marked on the tiller.
2. Use a two part epoxy (e.g. Araldite) to fix the tiller pin in place.
3. Position the shoulder of the pin so it is 12.5 mm ($^1/_2$ in) above the tiller surface.

Installing the mounting socket

1. Drill a 12.5 mm ($^1/_2$ in) hole to a depth of 25 mm (1 in) at the fixing point you have marked on the cockpit seat.
2. If the structure at the mounting position is less than 25 mm (1 in) thick, reinforce the underside with plywood bonded into position.
3. Fix the mounting socket in place using a two part epoxy.

…ket, yo…
…ot is hor…

…ket

…er line.

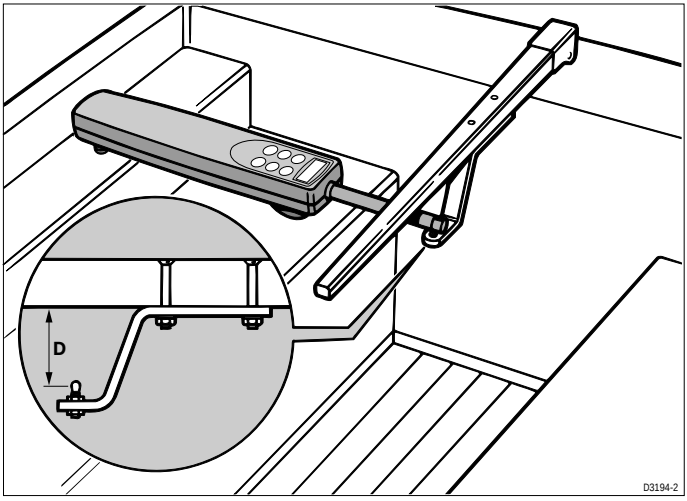
…ushrod is above t…

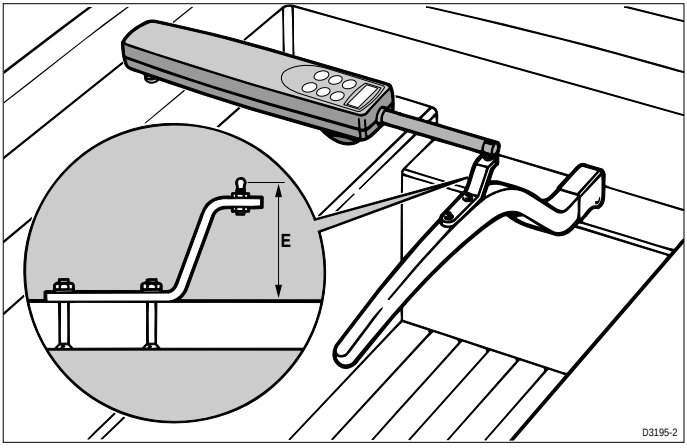
…

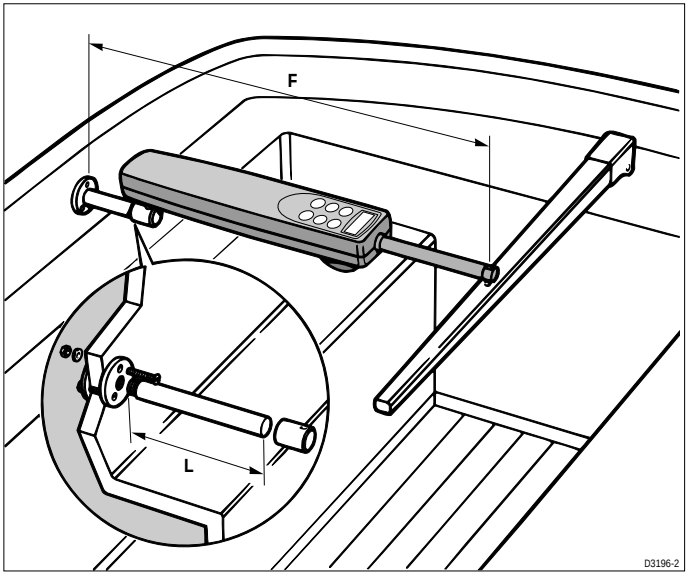
…bracket from the follow…

…w tiller)	**Dimension E (pushrod above tille**	
…)	51 mm (2 in)	
…1 (2 in)	76 mm (3 in)	
…6 mm (3 in)	102 mm (4 in)	D011

Dimension D (pushrod below tiller)	Dimension E (pushrod above tiller)	Bracket part no.
102 mm (4 in)	127 mm (5 in)	D159
127 mm (5 in)	152 mm (6 in)	D160







Mounting the cantilever assembly

To mount the cantilever assembly:

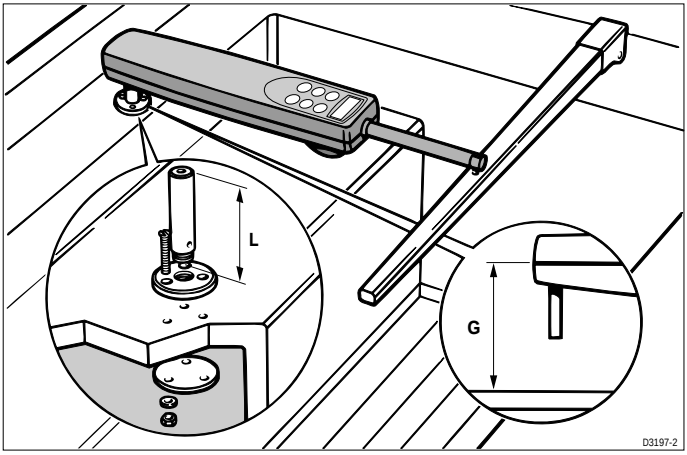
1. Temporarily assemble the cantilever by screwing the rod into the mounting ring.
2. Ensure the tiller pilot is **horizontal** and then mark the location of the mounting ring and its mounting holes.
3. Drill three 6 mm ($^1/_4$ in) diameter holes at the positions you have marked.
4. Bed the mounting ring on a thin coat of silicon sealant.
5. Use three 6 mm ($^1/_4$ in) diameter bolts, nuts and washers to attach the mounting ring to the backing plate (with the backing plate on the other side of the mounting surface, as shown above).
6. Screw the rod firmly into place.
7. Roughen the end of the cantilever rod and the inside of the cap to provide a key. Then apply two part epoxy adhesive to the rod end and the cap.
8. Place the cap over the rod end, **making sure the hole for the tiller pilot mounting pin faces upwards**. Allow the epoxy adhesive to harden fully before applying a load.

Note: *When the tiller pilot is not in use, you can unscrew the complete rod assembly to leave the cockpit unobstructed.*

Pedestal socket mounting

If you need to raise the height of the mounting socket to keep the tiller pilot horizontal, use a Raymarine pedestal socket assembly.

Identifying the correct pedestal socket



1. Clamp the tiller on the boat's center line.
2. Establish the standard control dimensions **A** and **B**.
3. With the tiller pilot horizontal, measure dimension **G**.
4. Select the appropriate pedestal socket assembly from the table.

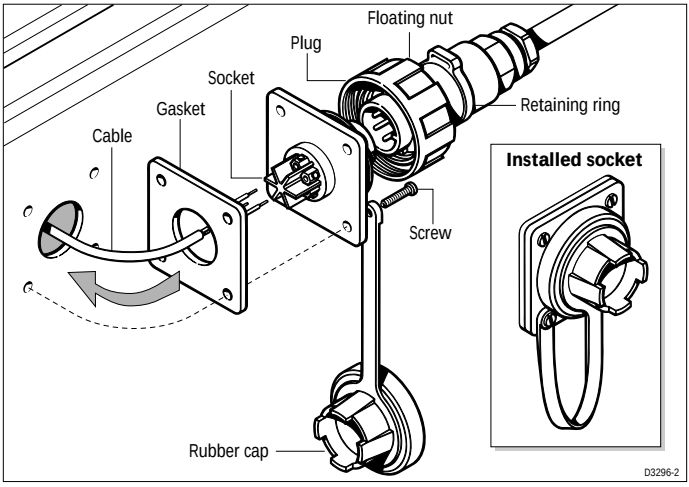
Dimension G	Pedestal socket length L	Part no.
64 mm (2.5 in)	Standard dimension	-
102 mm (4.0 in)	38 mm (1.5 in)	D026
114 mm (4.5 in)	50 mm (2.0 in)	D027
127 mm (5.0 in)	64 mm (2.5 in)	D028
140 mm (5.5 in)	76 mm (3.0 in)	D029
153 mm (6.0 in)	89 mm (3.5 in)	D030

Mounting the pedestal socket

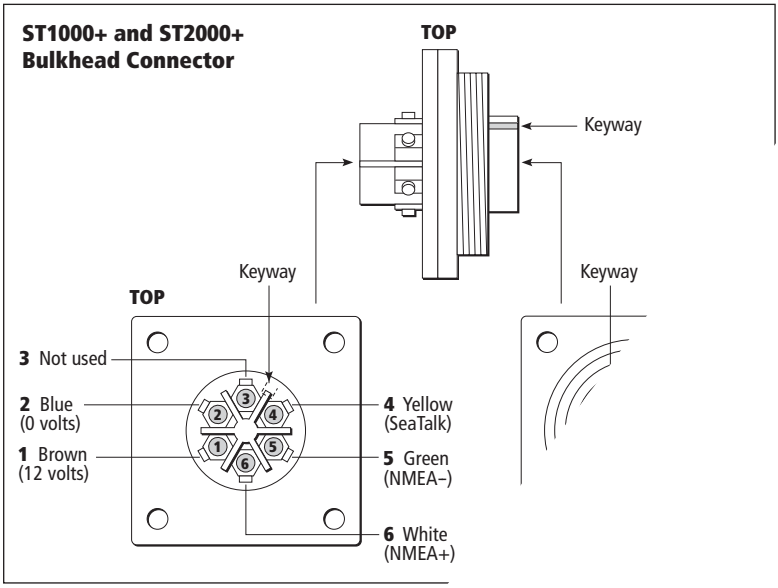
1. Mark the mounting ring's position on the cockpit seat or counter.
2. Ensure that control dimensions **A** and **B** are correct.

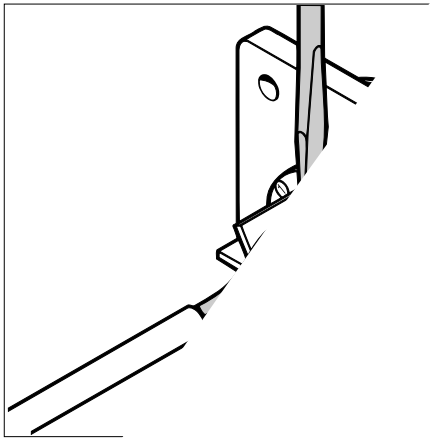
Mounting the socket

Install the tiller pilot socket as follows:



1. Attach the template (provided at the back of this handbook) to the selected bulkhead.
2. Carefully drill a 21 mm ($^{53}/_{64}$ in) clearance hole for the cable boss.
3. Drill 4 pilot holes (2.5 mm or $^{3}/_{32}$ in) for the self-tapping screws.
4. Remove the template.
5. Pass the power cable and any other cables (SeaTalk and NMEA) through the bulkhead and the gasket.
6. Use a small flat-bladed screwdriver to connect the cable(s) to the socket – refer to the illustrations on the following pages to identify the individual connections on the SeaTalk socket. Ensure that the socket is oriented correctly and note the connection numbers in relation to the keyway..

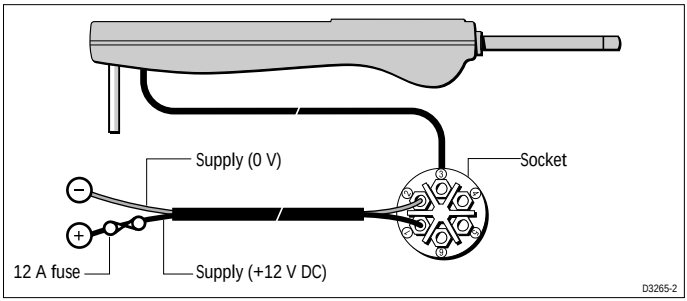




7. Assem
8. Sec
9. S
10

11. The retaining ring is designed as a stop for the plug nut to prevent accidental disassembly. After you have tightened the floating nut, slide the retaining ring back up the plug to retain the nut.

Power supply



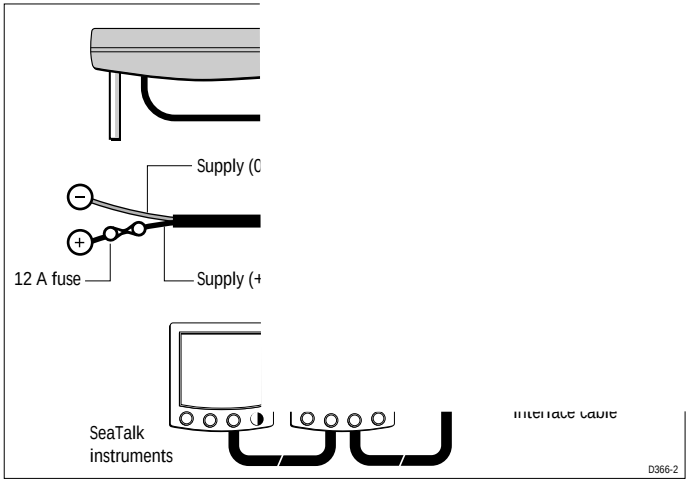
- The tiller pilot requires its own dedicated power supply – it cannot source its power from SeaTalk.
- Power should be taken directly from the boat's central distribution panel and protected with a **12 A fuse** or equivalent circuit breaker.

The following table shows the minimum cable size acceptable for the power supply:

Cable length	Copper area	AWG
Up to 2.5 m (8 ft)	1.5 mm^2	16
Up to 4 m (13 ft)	2.5 mm^2	14

CAUTION:
Correct power cable size is critical for correct autopilot operation. If in doubt, use a heavier gauge cable than specified. A lighter gauge cable might cause a voltage drop between the supply and the autopilot. This will reduce the power at the tiller.

SeaTalk cabling



CAUTION:
Protect the power supply for the SeaTalk 12 V (red) line with a 5 A fuse (or equivalent circuit breaker) fitted as close to the tiller pilot as possible.

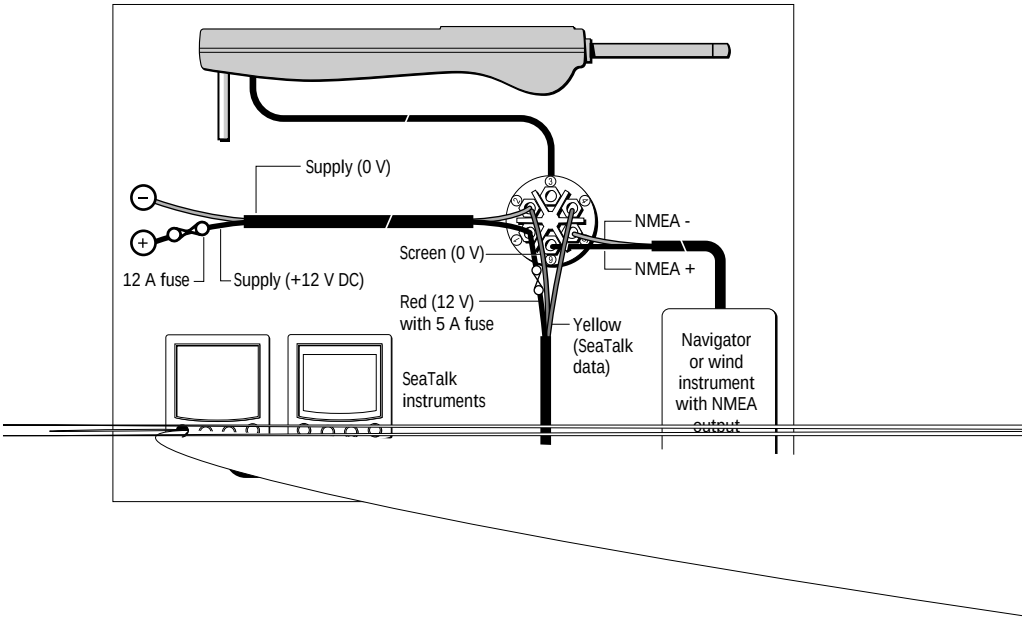
If required, the tiller pilot can be wired to the SeaTalk bus using a suitable SeaTalk interface cable (part numbers: D229 flat moulded plug, D179 male round plug, D181 female round plug).

Connect the SeaTalk cable to the tiller pilot socket as shown below. As well as sharing SeaTalk data, the tiller pilot can also be used to supply power to the SeaTalk instruments.

Raymarine produce a range of SeaTalk accessory cables you can use to connect the tiller pilot to SeaTalk instruments and control units:

- flat plugs for recent SeaTalk equipment (e.g. ST30, ST40, ST60)
- round plugs for older SeaTalk equipment (e.g. ST50)

Connecting NMEA and SeaTalk



Chapter 5: Commissioning the Tiller Pilot

This chapter explains how to commission your tiller pilot after installation. This consists of a number of simple functional tests followed by a short sea trial.

5.1 Functional tests

Switch on

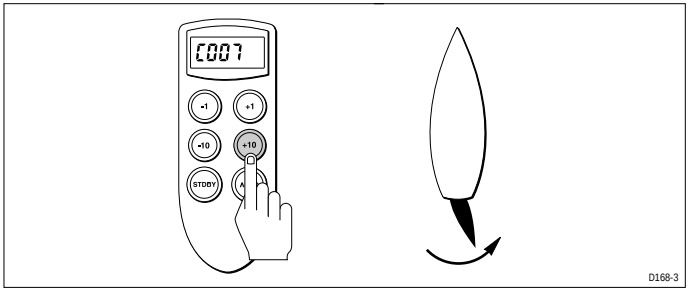
1. Switch on the main power breaker.
2. The autopilot should beep and display the pilot number (ST1000 or ST2000).
3. Within 2 seconds, the display should show a flashing 'C' followed by the compass heading (for example, C 234). This shows the autopilot is active.

Note: *If the tiller pilot does not beep or display the compass heading, please refer to the Fault Finding section (see page 26).*

Operating sense

The operating sense defines the direction the tiller pilot will apply helm when a course change key is pressed or the boat goes off course. To check the operating sense:

1. Place the pushrod end over the tiller pin.
2. Press **+10**.
3. The helm should move to produce a turn to starboard.

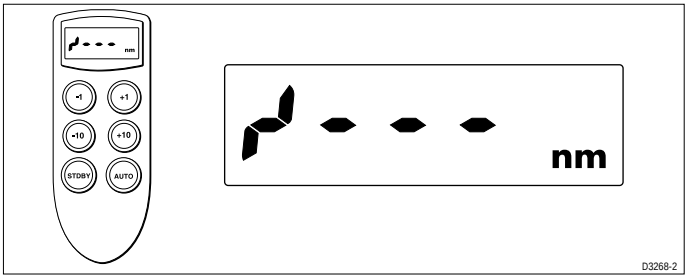


4. If the helm produces a turn to port, refer to the following instructions on reversing the operating sense.

Reversing the operating sense

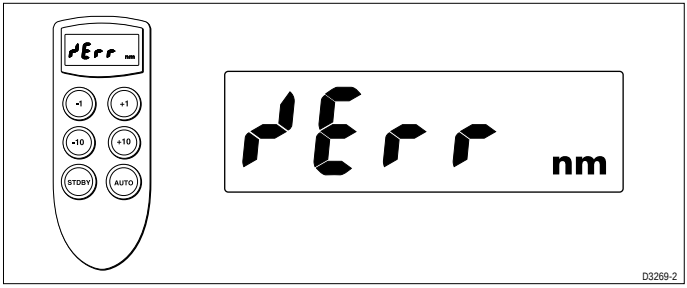
If necessary, reverse the operating sense can be reversed as follows:

Track data not received



This error message indicates that data has not been received. The most likely reason is a cabling error – either open circuit, short circuit or wires reversed.

Track data error

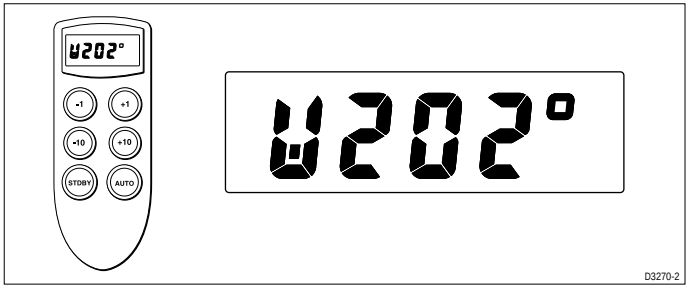


This error message indicates that the navigator has lost its fix. Refer to the navigator handbook for further action.

Checking the wind instrument interface

If you have connected the tiller pilot to a wind instrument, check the data link as follows:

1. Press **standby** and **auto** together.
2. The tiller pilot should display a 'W' followed by the locked heading.

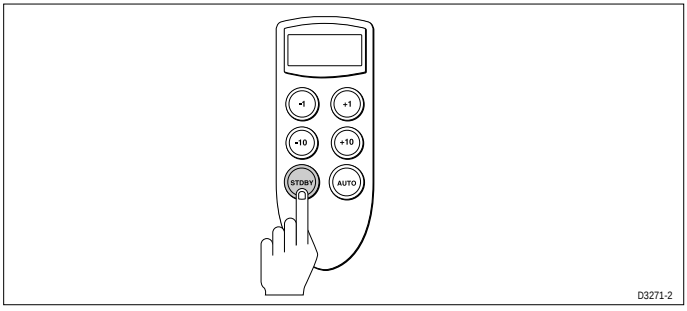


If the display continues to show a flashing 'C' and the current heading, the tiller pilot is not receiving any wind data. The most likely reason is a cabling error – either open circuit, short circuit or wires reversed.

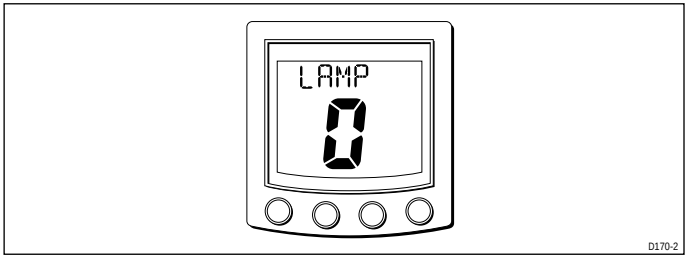
Checking the SeaTalk interface

If you have linked the tiller pilot to other instruments or control units via SeaTalk, check the link as follows:

1. Press **standby**.



2. Select display illumination level 0 (LAMP 0) on any other SeaTalk instrument or autopilot control unit.



3. The tiller pilot should immediately respond by switching off its display illumination. If the illumination does not switch off, there is a cabling fault between the tiller pilot and the instruments or control unit.

5.2 Initial sea trial

CAUTION:
Failure to carry out the sea trial may result in impaired autopilot performance on some compass headings.

When you have checked that the system is operating correctly, you must complete a short sea trial to calibrate the compass.

The tiller pilot has a built-in calibration capability so you can fine-tune it to suit your boat, its steering system and its dynamic steering characteristics.

As supplied from the factory, the autopilot is calibrated to provide safe, stable control for most boats.

- Do not attempt to make any permanent changes to the recommended calibration values until you have completed the sea trial.
- You **must** carry out the initial sea trial in conditions of light wind and calm water – so you can assess the autopilot's performance without the influence of strong winds or large waves.

Before starting the sea trial
Before carrying out the sea trial, you should:

- check the calibration settings and, if necessary, reset them to the default values (see *page 61*)
- check the installation to make sure that it is not affected by radio transmissions, engine starting, etc.

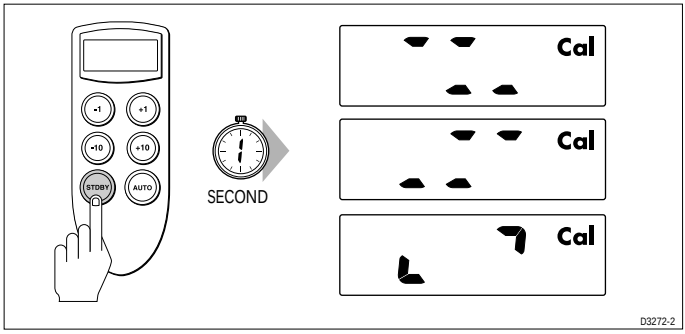
Calibrating the compass

Automatic compass deviation correction

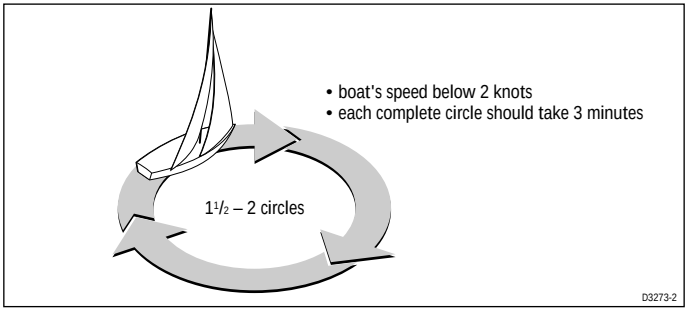
By completing the following compass correction procedure, the tiller pilot can correct its own internal fluxgate compass for most deviating magnetic fields. **You should complete the Compass Deviation Correction at the beginning of your sea trial.**

To complete the compass correction:

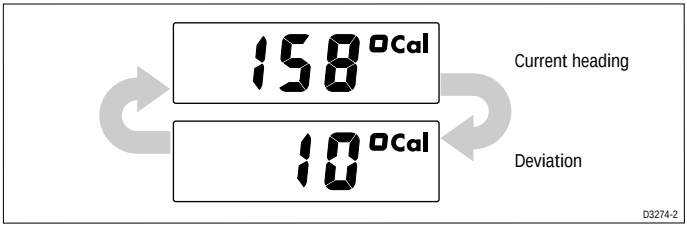
1. Extend or retract the pushrod so you can place the pushrod end onto the tiller pin.
2. Press and hold **standby** for 1 second – a series of dashes will cycle around the display.



3. Keeping boat speed below 2 knots, use the **-10** and **+10** keys to turn the boat in slow circles. You should take at least 3 minutes to complete each 360°.



4. Keep turning your boat until the display changes to show the amount of deviation the autopilot has detected (this should take between $1^1/_2$ t o2 complete circles). The deviation alternates with the autopilot's current heading every second.



Heading alignment

1. Use the **-1** and **+1** keys to increase or decrease the displayed heading until it agrees with the heading on the boat's steering compass, or a known transit bearing.
2. Exit compass linearization and heading alignment and store the compass correction/alignment values as follows:
   - press and hold **standby** for 1 second until the pilot beeps
   - or, to exit without saving any new settings, press **standby** momentarily

Note: *For installations where an ST50 or ST30 Steering Compass instrument is connected to the SeaTalk bus, and the Steering Compass has a fluxgate transducer connected, it is only necessary to carry out the auto deviation correction on the Steering Compass Instrument (refer to Steering Compass handbook instructions).*

Further adjustments to heading alignment

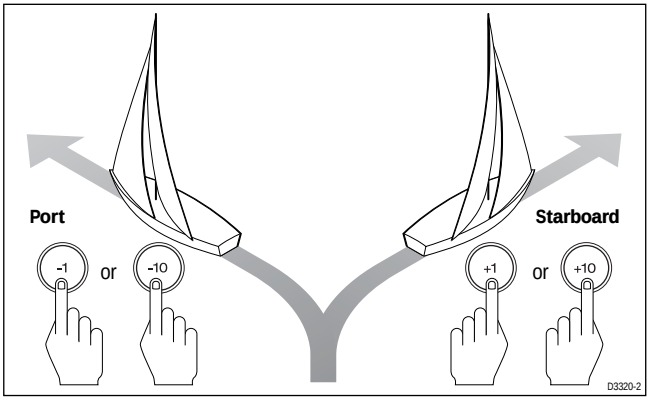
If the heading alignment requires further adjustment, enter Compass Deviation Correction again by pressing **standby** for 1 second.

1. Press **auto** to skip Deviation Correction and proceed to Heading Alignment.
2. Adjust the heading as described above.

Autopilot operation

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

1. Steer onto a compass heading and hold the course steady.
2. Place the pushrod end over the tiller pin.
3. Press **auto** to lock onto the current heading. The tiller pilot should achieve a constant heading in calm sea conditions.
4. Alter course to port or starboard in multiples of 1° and 10°.



5. Press **standby** and remove the pilot to return to hand steering.

5.3 Adjusting autopilot performance

The factory setting for rudder gain provides stable control for initial sea trials. However, different boats can vary widely in their response to the helm and further adjustment to the rudder gain may improve the autopilot's steering characteristics.

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 mode, alter course to starboard by 40° by pressing **+10** four times.
   - At cruising speeds, a course change of 40° should result in a crisp turn followed by an overshoot of no more than 5°.
     If this occurs the rudder gain is set correctly.
   - If rudder gain is too high, the 40° course change will result in a distinct overshoot of more than 5° (A).
     Correct this oversteer by reducing the rudder gain setting.
   - If rudder gain is too low, the boat's steering performance will be sluggish – it will take a long time to make the 40° turn and there will be no overshoot (B).
     Correct this understeer by increasing the rudder gain setting.

Chapter 6: Adjusting Tiller Pilot Settings

6.1 Introduction

The tiller pilot is calibrated at the factory to provide stable performance for most boats. However, you can fine tune many of the calibration features to match your personal preferences, and the type of boat and steering system.

Note: *You should carry out an initial sea trial before adjusting any of the calibration features.*

You might need to adjust the tiller pilot calibration settings if:

- the pilot does not maintain a selected heading
- the rudder activity is too high or the course keeping is not tight enough.
- the boat appears to be unstable on Northerly headings (or Southerly headings in the southern hemisphere)
- you operate in Track Control mode without a speed instrument
- you wish to change the Off Course alarm angle

The calibration menu allows you to adjust the following parameters from their factory default settings:

- rudder gain
- average cruise speed
- off course alarm limit
- variation
- Northerly/Southerly turning error compensation
- boat's current latitude
- rudder damping

Adjusting calibration values

The flow chart on the next page shows how to:

- enter the calibration menu
- scroll through the calibration menu
- adjust the calibration values
- quit calibration

SECONDS

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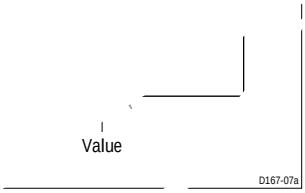
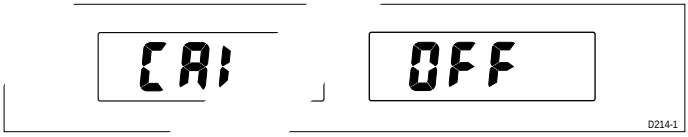
SECONDSQU



…ne calibration fe… …e and the number on
…ed value.

…ation menu to view th… …xisting values without alter-
…ving the value, a mome… …y press of **standby** returns the
…al operating mode with… …affecting the previous settings.

…y shows CAL OFF when … …y to enter calibration, refer to *page*



Default ca… … values

The fo… …ws the default calibration values. These will provide safe
… …l sea trial.

		Default setting	Adjusted values
	…r gain	5	
	…erage cruise speed	8	
	Off course alarm angle	20	
	Local magnetic variation	Off (– –)	
10	North/South turning error correction	Off (0)	
11	Boat's current latitude	0	
13	Rudder damping	3	

Note: *Calibration Levels 2,3,4,7,8 and 12 are not available. If Calibration Level 10 is set to 0, level 11 will also be omitted.*

6.2 Calibrating the tiller pilot

Calibration Level 1: Rudder gain

Use Calibration Level 1 to adjust the rudder gain. This must be set when your boat is under way, as described on *page 53*.

Calibration Level 5: cruise speed

Use Calibration Level 5 to set the boat's normal cruising speed for operation in Track mode.

When interfacing with a navigation system, the tiller pilot uses the boat's average cruising speed to perform track calculations.

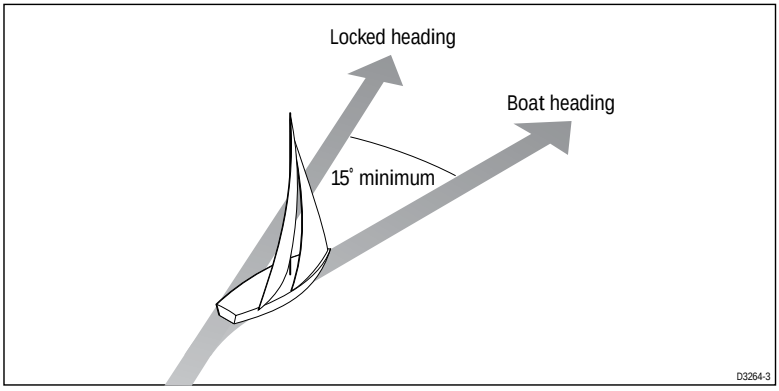
Note: *If a SeaTalk speed instrument is connected, boat speed data will be transmitted directly to the autopilot.*

Calibration Level 6: off course alarm angle

Use Calibration Level 6 to set the off course alarm angle. This alarm warns you if the autopilot is unable to maintain its set course.

The off course alarm operates if the autopilot strays off course, by more than the set value, for more than 20 seconds.

You can set the limit in 1° increments between 15° and 40°.



Calibration Level 9: magnetic variation

Use Calibration Level 9 to input the level of magnetic variation present at the boat's current position.

- -ve variation = west
- +ve variation = east

The tiller pilot transmits this value onto the SeaTalk bus, so it can be picked up by other SeaTalk instruments.

Calibration Level 10: heading error correction

Use Calibration Level 10 to switch on Northerly or Southerly heading error correction:

- 0 = Off
- 1 = Northern Hemisphere, 2 = Southern Hemisphere

You might notice that the autopilot tends to be a little less stable on Northerly headings in the higher latitudes of the Northern hemisphere (or Southerly headings in the Southern hemisphere).

This is caused by the increasing angle of dip of the earth's magnetic field at higher latitudes, which has the effect of amplifying rudder response on Northerly

Calibration Level 11: boat's current latitude

When you have switched on heading error correction (Level 10), you need to use Calibration Level 11 to input the boat's current latitude (to the nearest degree).

Set the latitude using the **-1**, **+1**, **-10** and **+10** keys.

Note: *If the correction is switched off in Calibration Level 10 (i.e. set to* 0 *'),Level 11 will be omitted. When you press the* **auto** *key in Calibration Level 10 you will advance to Level 13.*

Calibration Level 13: rudder damping

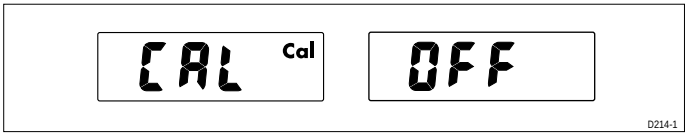
Adjust the value in Calibration Level 13 if the tiller drive 'hunts' when trying to position the rudder.

- you can select 9 stages of rudder damping – initially, this option should be set to 3
- if the autopilot is over-active in calm conditions, increase the damping
- if the course keeping is not tight enough, decrease the damping
- adjust the damping one stage at a time

Controlling access to calibration

You can prevent unauthorized access to calibration as follows:

1. Press and hold **-1** and **standby** together for 10 seconds until the display shows CAL OFF:



2. Toggle the calibration access between On and OFF using the **-1** and **+1** keys.
3. Store the setting by pressing **-1** and **standby** for 10 seconds until the tiller drive returns to normal operation.

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Raymarine World Wide Warranty

Raymarine Inc.

APPLICABLE TO PRODUCTS SOLD THROUGH OFFICIAL RAYMARINE INC. DEALERS, DISTRIBUTORS AND BOAT BUILDERS WITHIN THE AMERICAS AND CARIBBEAN.

Limited warranty

Subject to the terms, conditions and limitations set forth in this U.S. Limited Warranty (hereinafter the 'Warranty'), Raymarine warrants that its products, when properly installed and used, will be free from defects in material and workmanship for a period of twenty-four (24) months (with respect to VHF radios, a period of thirty-six (36) months), from the date of first purchase (the 'Warranty Period').

For the purposes of this warranty, 'date of first purchase' means the date that the product was purchased by the first retail customer; or in the case of a product installed on a new vessel by a certified Raymarine original equipment manufacturer (a 'Raymarine OEM'), the date that such vessel was purchased by the first retail customer.

Raymarine will, at its sole option, repair or replace any defective products or components returned during the Warranty Period in accordance with the terms, conditions and limitations set forth below. **Such repairs or replacement will be the sole remedy of the customer under this Warranty.**

Obtaining Warranty Service

Standard Warranty Service

To qualify for standard warranty service the product must be returned to a Raymarine-certified service agent, or directly to Raymarine in person, or by mail (i) within the Warranty Period, and (ii) within thirty (30) days of the alleged product failure.Any products returned by mail must be securely packaged and sent pre-paid and insured to Raymarine or to a Raymarine-certified service agent. All products, whether returned in person or by mail, must be accompanied by a copy of the original sales receipt, to be eligible for standard warranty service.

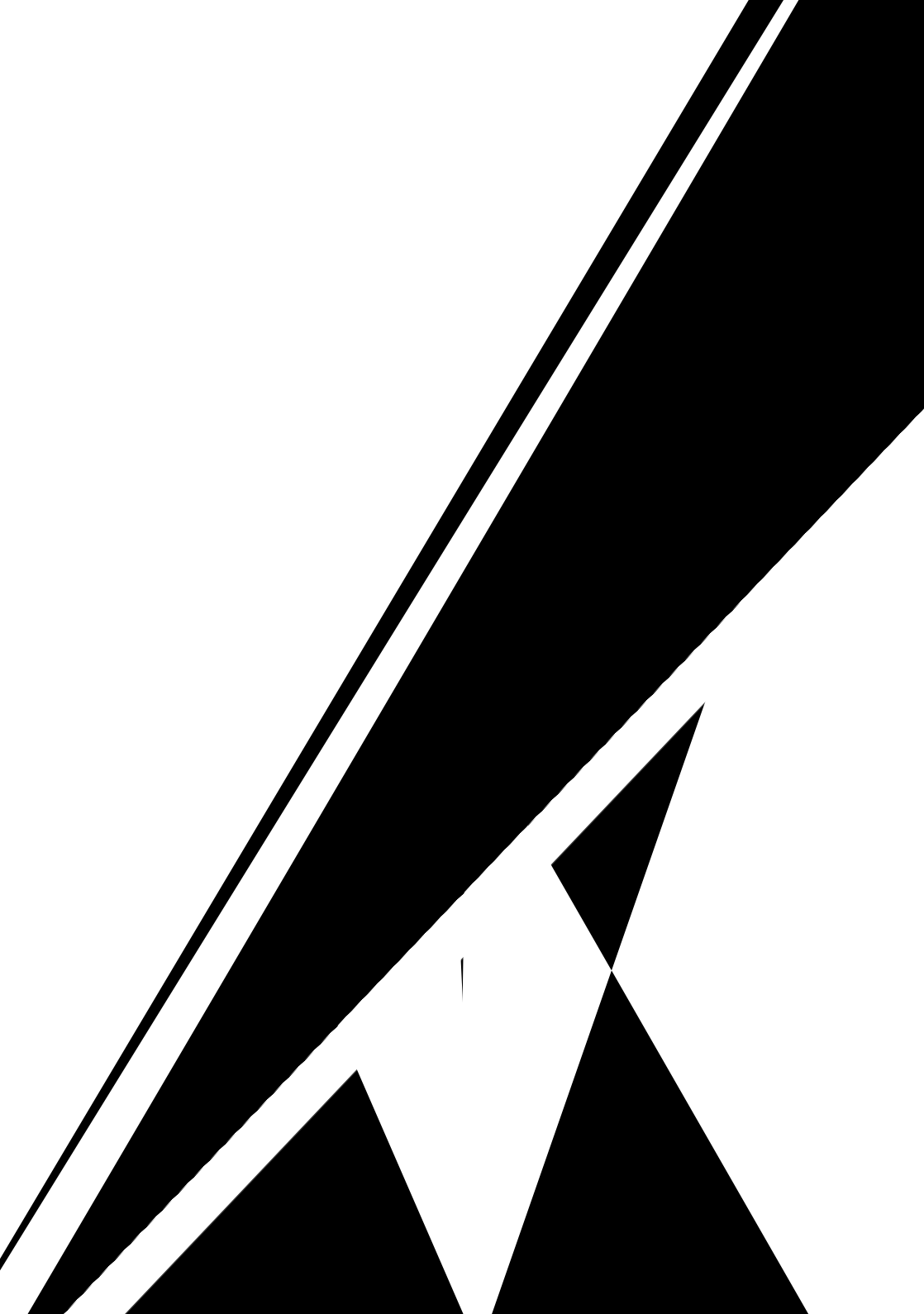
A list of Raymarine-certified service agents is available from Raymarine Technical Support or at **www.raymarine.com**

'On Board' Warranty Service

For any Raymarine product or system that (i) has been installed on your vessel by a Raymarine-certified service agent or by a Raymarine OEM, and (ii) has a MSRP equal to or greater than USD $2,500, you are eligible to receive warranty service by a Raymarine certified service agent on-board your vessel ('On Board Warranty Service') for a period of 12 months from the date of first purchase of such product or system, or the date of first purchase of the vessel on which such product or system has been installed (the 'On Board Warranty Period'). In order to obtain On Board Warranty Service eligible customers **MUST**:

- (i) within the On Board Warranty Period, and (ii) within thirty (30) days from the date of the alleged failure giving rise to the warranty claim for which you are requesting On Board Warranty Service, contact a local Raymarine-certified service agent and request On Board Warranty Service.
- Present to the Raymarine-certified service agent a copy of the original sales receipt for the product, together with proof of the date of installation of the product by a Raymarine-certified service agent. The service agent may at its sole option, accept or deny such proof of purchase and proof of installation as sufficient to qualify you for On Board Warranty Service.

Costs associated with travel, mileage, taxi fares, launch or docking fees, aircraft or vehicle rental, meals, customs, shipping, communication charges, and service agent travel costs are specifically excluded from coverage under this Warranty and are your responsibility. **In addition**, this Warranty does not cover fees associated with hauling, shipping or towing your vessel to a Raymarine-certified agent.



Raymarine UK Ltd.

APPLICABLE TO PRODUCT SOLD THROUGH OFFICIAL RAYMARINE UK LTD. DEALERS, DISTRIBUTORS AND BOAT BUILDERS WITHIN EUROPE, THE MIDDLE AND FAR EAST, AFRICA AND AUSTRALASIA.

Limited Warranty

The Raymarine warranty terms and conditions as described below do not affect the customers legal rights and complies with EU Directive 1999/44/EC.

In order to ensure that the product continues to operate efficiently and reliably, we recommend that, before using the product, the customer carefully reads the Owner's Handbook and follows the advice on the safe and correct operation and use of the product. We recommend that the Raymarine product is installed by a Raymarine certified installer. Installation by persons other than a Raymarine certified installer may invalidate the warranty.

1. Product warranty

1.1 Raymarine warrants each new product to be of good materials and workmanship. Raymarine, or its approved agents, will repair or exchange under warranty any parts or product proven to be defective in material or workmanship under normal use, for a period of 2 years (24 months) from date of sale to end user, subject to the limits contained in this warranty document.

1.2 The Raymarine warranty covers the parts and labour associated with any warranty repair as described above, provided that the product is returned to Raymarine or one of its approved agents.

1.3 Raymarine reserve the right to replace under warranty, not repair, certain Raymarine products subject to the limitations below, provided that they are returned to the nearest Raymarine National Distributor. For details of such products refer to the internet at *www.raymarine.com* or contact your nearest Raymarine National Distributor.

2. Onboard warranty

2.1 In addition to the Product warranty cover as described above, Raymarine will, authorize onboard warranty service by the nearest Raymarine approved service agent, subject to the maximum mileage and other limits referred to in paragraph 4.12 below, on products, where proof of installation, or commission by Raymarine certified installers, can be shown.

2.2 The warranty provides for onboard repair or exchange of the product, by Raymarine or its approved service agents, for a period of 2 years (24 months), subject to the limits contained in this warranty document. In the case of a product installed, by a Raymarine certified OEM installer, on a new boat prior to the sale of the boat to a customer, the 2-year period will begin on the date of the sale of the boat to the customer. In the case of a product installed, by a Raymarine certified installer, on a boat already in the possession of the customer, the 2-year period will begin on the date of the commissioning of the installed product.

2.3 Certain Raymarine products are not covered by onboard warranty unless the products are pre-registered and on board warranty is purchased from the Raymarine certified installer. For details of such products refer to the internet at *www.raymarine.com* or contact your nearest Raymarine National Distributor.

2.4 The Purchaseable onboard warranty is subject to the limitations below.

3.Obtaining warranty service

3.1 In the event of warranty service being required, the customer should contact Raymarine Technical Support or the nearest Raymarine approved service agent - the contact details of Raymarine Technical Support and a full list of the names and details of worldwide service agents are available on the internet at *www.raymarine.com* and in the Owner's Handbook.

3.2 In cases where the customer is requesting a warranty service and a Raymarine certified installer has not installed the product; i.e. Product warranty, the affected product must be returned to the customer's local Raymarine approved service agent or direct to Raymarine with:

3.2.1 proof of purchase showing the date of purchase and the name of the supplier of the product; and

3.2.2 the serial number of the affected product; or

3.2.3 a warranty card completed by the product supplier (which will contain the information required by paragraphs 3.2.1 and 3.2.2).

Subject to the limitations below, the product will be repaired or replaced (at the discretion of Raymarine or a Raymarine Service Agent) at no further cost and promptly returned to the customer.

3.3 In cases where the customer is making a warranty claim and the product has been installed by a Raymarine certified installer, (boat builder, installer, dealer etc.) i.e. Onboard warranty, the nearest Raymarine approved service agent should be contacted and onboard service requested (which will be subject to the limits referred to in paragraph 4.12 below). Before the onboard warranty service is performed, the customer must have available:

3.3.1 proof of purchase showing the date of purchase and the name of the supplier of the product; and

3.3.2 the serial number of the affected product; or

3.3.3 proof of installation of the product by a Raymarine certified installer; or

3.3.4 a warranty card completed by the product supplier (which will contain the information required by paragraphs 3.3.1 and 3.3.3).

3.4 In cases where onboard warranty has been purchased - as described in 2.3; the nearest Raymarine approved service agent should be contacted and onboard service requested, information detailed in 3.3.1 and 3.3.2 is required. Onboard warranty service will only be performed if the product serial number confirms that the onboard warranty service has been purchased and is valid.

4. Warranty limitations

4.1 Raymarine warranty policy does not apply to any product that has been subjected to accident, abuse or misuse, shipping damage, alterations, corrosion, incorrect and/or non-authorized service, or products on which the serial number has been altered, mutilated or removed.

4.2 Certain products do not carry the onboard warranty, as described in section 2 above, unless the onboard warranty cover is purchased at the time of installation. The purchaseable onboard warranty is only available on products purchased in specific territories, for further details refer to the internet at

Raymarine Service Centers

Purchased from | Purchase date

Dealer address

Installed by | Installation date

Commissioned by | Commissioning date

Owners name

Mailing address