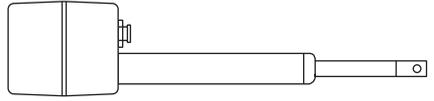


# I/O Drive



M81138: I/O (Stern) Drive 12 V  
E12019: KAD 32 I/O (Stern) Drive 12 V

## Installation instructions

### English

Date: 04-2006

Document number: 81176-5-EN

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## Important information

### Safety notices



#### WARNING

##### Product installation

**This equipment must be installed 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.**

**Because correct performance of the boat's steering is critical for safety, we STRONGLY RECOMMEND that an Authorized Raymarine Service Representative fits this product.**



#### WARNING

##### Navigation aid

**When this product is used within a navigation system, it is only an aid to navigation. It's accuracy can be affected by many factors, including equipment failure or defects, environmental conditions and improper use or handling. It is the user's responsibility to exercise common prudence and navigational judgements. This product should not be relied upon as a substitute for such prudence and judgement. Always maintain a permanent watch so that you can respond to situations as they develop.**

### EMC conformance

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

### Handbook information

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

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## Waste Electrical and Electronic Equipment Directive



The Waste 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 wheellie 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.

## 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 receive full warranty benefits. Alternatively you can register your product on line at:

**[www.raymarine.com](http://www.raymarine.com)**

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# Introduction

## Product description

Welcome to the installation guide for the Raymarine inboard/outboard drive (also known as an I/O or stern drive). This product is intended to operate the boat's steering mechanism as part of a Raymarine autopilot system.

It is designed to drive cable operated, power assisted steering systems. It operates the power steering valve in the same way as the steering cable. When you disengage the autopilot, a clutch disengages the I/O drive so you can steer the boat manually.



### CAUTION

#### Compatibility

**Any attempt to install an I/O drive to a non-compatible engine type may void the warranty on both the drive and the engine.**

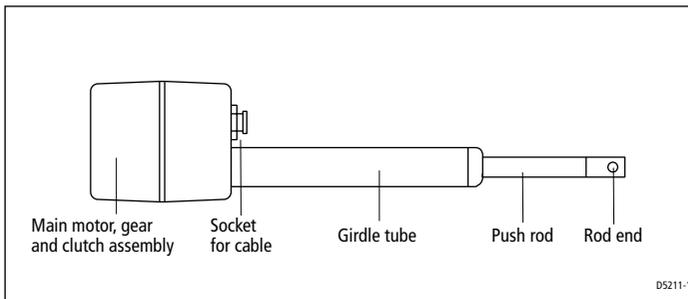


Figure 1: Main parts of the I/O drive

## Contents

This guide contains:

<b>1</b>	Product specifications	<i>page 5</i>
<b>2</b>	Installation instructions	<i>page 6</i>
<b>3</b>	Maintenance information	<i>page 22</i>

## Specifications

### Drive specifications

Table 1-1: Drive specifications

<b>Performance</b> (at nominal voltage)	<b>I/O drive</b> M81138 (12 V) E12019 (KAD 32: 12 V)
Drive method	Electromechanical
Maximum thrust	150 kg (330 lb)
Maximum stroke	214 mm (8.3 in)
Hardover to hardover time	8.8 sec
<b>Other information</b>	
	protected for use in engine compartments
	CE approvals - conforms to: 89/336/EC (EMC), EN60945:1997 94/25/EC (RCD), EN28846:1993

### Drive dimensions

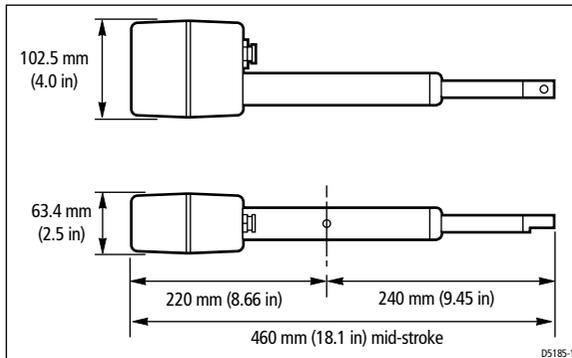


Figure 2: I/O drive dimensions

## Installation instructions

### Parts required

To install the I/O drive the following parts are supplied:

- standard I/O drive unit
- power cable
- appropriate installation kit (see *page 8*)

### Installation steps



## WARNING

### Electrical safety

**Make sure you have switched OFF the power supply before you start installing this product.**

Follow these steps to install your I/O drive unit:

<b>1</b>	Consult the EMC installation guidelines.	<i>page 6</i>
↓		
<b>2</b>	Mount the drive.	<i>page 8</i>
↓		
<b>3</b>	Connect the power cable.	<i>page 20</i>
↓		
<b>4</b>	Complete the post-installation checks.	<i>page 21</i>

## 1. EMC installation guidelines

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

Their design and manufacture conforms to the appropriate Electromagnetic Compatibility (EMC) standards, but correct installation is required to ensure that performance is not compromised. Although every effort has been taken to ensure that they will perform under all

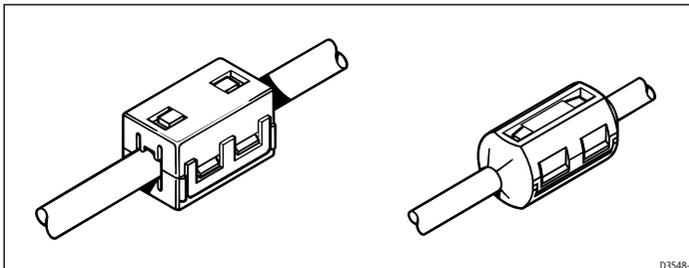
conditions, it is important to understand what factors could affect the operation of the product.

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

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

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

## Suppression ferrites



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

## Connections to other equipment

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

## 2. Mounting the drive



### CAUTION

#### I/O drives

**I/O drives are affected by substantial vibration during use. When installing this I/O drive, make sure that you fully tighten all bolts and use lock washers. Using a suitable thread-locking compound on the threads will help keep the bolts securely tightened.**

Raymarine provide installation kits (see *Figure 3*) so you can fit the drive unit to stern drive systems made by:

- Volvo: see *page 8* for installation instructions
- Mercruiser 93, OMC and Yamaha: see *page 10* for installation instructions
- Mercruiser 95: see *page 13* for installation instructions
- Volvo KAD 32: requires the KAD 32 I/O drive (part number: E12019) see *page 16* for installation instructions

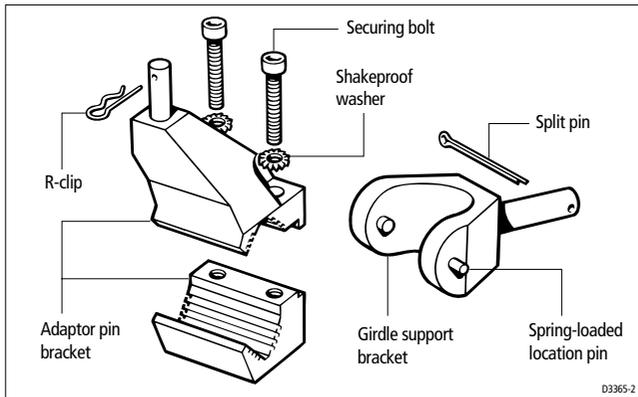


Figure 3: Installation kit parts (Volvo, Mercruiser 93, OMC and Yamaha)

#### Installation for Volvo (after type 872215)

1. Fit the girdle support bracket (supplied in the installation kit) as shown in *Figure 4*:
  - remove the locating pin that attaches the cable rod to the tiller end block
  - replace it with the girdle support bracket
  - secure the assembly with the supplied split pin
  - rotate the girdle support bracket so that the spring-loaded pin faces forward
2. Fit the adaptor pin bracket to the cable end sheath (see *Figure 5*):

- the adaptor pin bracket must sit **against**, but not on, the shoulder on the cable end sheath
- the securing bolts **must** be on the stern (aft) side of the cable end sheath
- make sure the bracket is vertical
- tighten the two securing bolts

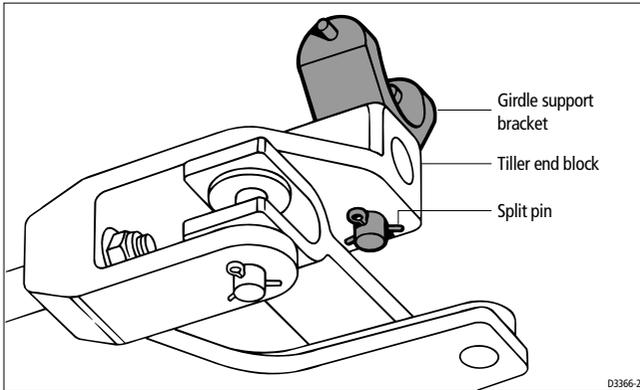


Figure 4: Fitting the girdle support bracket (Volvo)

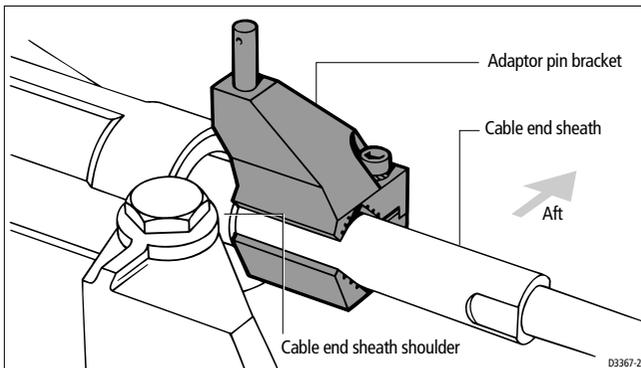


Figure 5: Fitting the adaptor pin bracket (Volvo)

3. Fit the I/O drive into the girdle support bracket (see *Figure 6*):
  - position the I/O drive unit so the fixed support pin (on the bracket) fits into the location hole in the I/O drive girdle tube.
  - twist and lower the I/O drive unit into the bracket until the spring-loaded pin fits into the other location hole.



## CAUTION

### Location pins

**The fixed and spring-loaded location pins must be fully engaged in the I/O drive girdle tube. If they are not the autopilot will fail.**

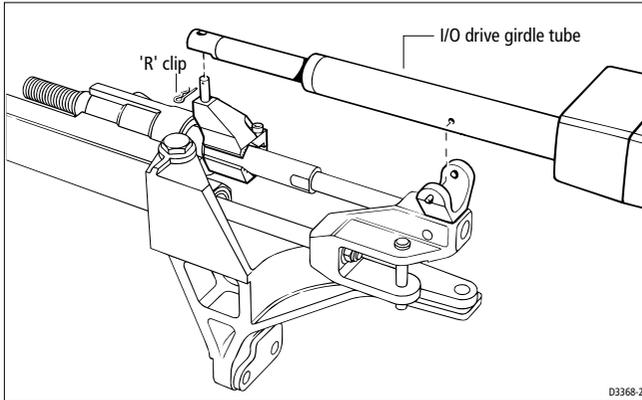


Figure 6: Fitting the I/O drive unit (Volvo)

4. Position the drive unit pushrod end over the top of the adaptor pin and secure with the R-clip.
5. Complete a hardover to hardover check:
  - Slowly turn the steering system from hardover to hardover.
  - Make sure that the drive unit and adaptor pin bracket do not come into contact with any part of the engine, boat or steering system. This includes any engine hoses that may have a passing contact with the I/O drive unit.

**Note:** *If necessary, you can rotate the main body of the drive unit relative to the girdle tube (see Figure 17).*

### Installation for Mercruiser 93/OMC/Yamaha

1. Fit the girdle support bracket as shown in *Figure 7*:
  - remove the locating pin that attaches the cable rod to the tiller end block
  - replace it with the girdle support bracket
  - secure the assembly with the supplied split pin
  - rotate the girdle support bracket so that the spring-loaded pin faces forward

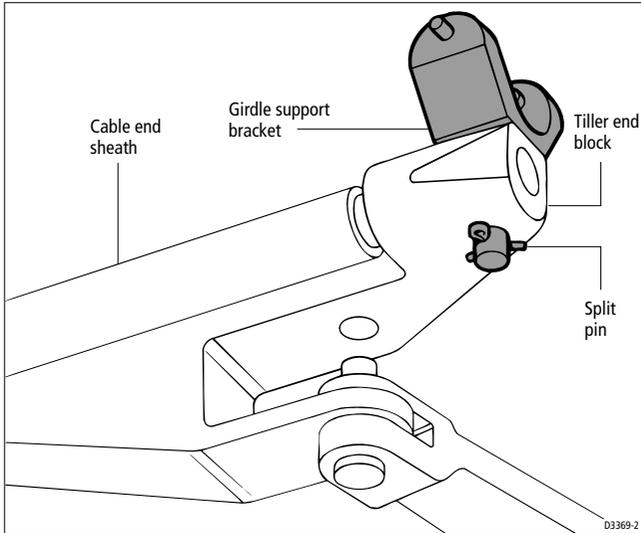


Figure 7: Fitting girdle support bracket (MerCruiser 93/OMC/Yamaha)

2. With the helm turned hard to port:
  - assemble the adaptor pin bracket onto the steering cable end sheath, 165 mm (6.5 in) from the girdle support bracket (as shown in *Figure 8*)
  - make sure that the bracket is vertical and that the securing bolts are on the bow (forward) side of the cable end sheath
  - tighten the two securing bolts on the adaptor pin bracket

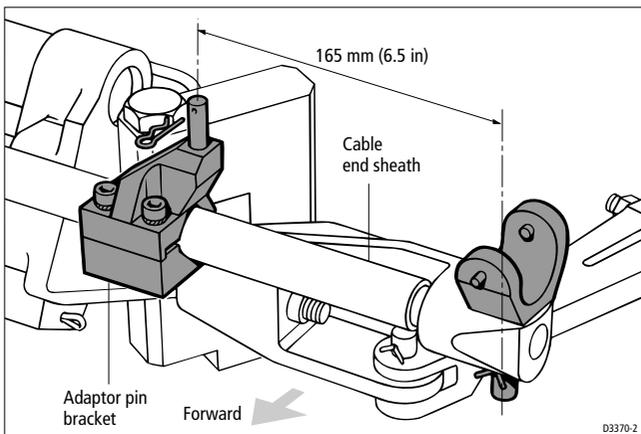


Figure 8: Fitting the adaptor pin bracket (MerCruiser 93/OMC/Yamaha)

3. Fit the I/O drive into the girdle support bracket (see *Figure 9*):

- position the I/O drive unit so the fixed support pin (on the bracket) fits into the location hole in the I/O drive girdle tube.
- twist and lower the I/O drive unit into the bracket until the spring-loaded pin fits into the other location hole

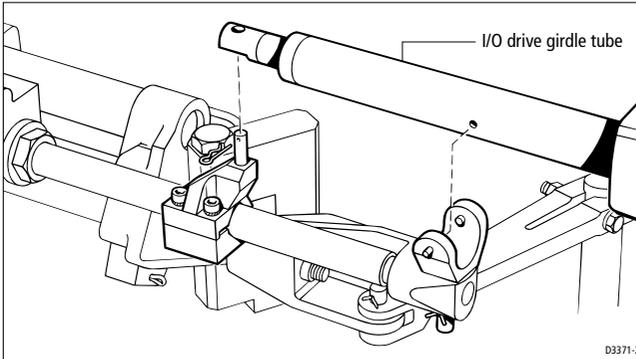


Figure 9: Fitting the I/O drive unit (MerCruiser 93/OMC/Yamaha)



## CAUTION

### Location pins

**The fixed and spring-loaded location pins must be fully engaged in the I/O drive girdle tube. If they are not the autopilot will fail.**

4. Position the drive unit pushrod end over the top of the adaptor pin and secure with the R-clip.
5. Complete a hardover to hardover check:
  - Slowly turn the steering system from hardover to hardover.
  - Make sure that the drive unit and adaptor pin bracket do not come into contact with any part of the engine, boat or steering system. This includes any engine hoses that may have a passing contact with the I/O drive unit.

**Note:** *If necessary, you can rotate the main body of the drive unit relative to the girdle tube (see Figure 17).*

## Installation for Mercuriser 95



### CAUTION

#### Installation

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

Use Raymarine installation kit D309 to install the I/O drive unit to Mercuriser engines manufactured from 1994 onwards.

Install the I/O drive by following these steps:

1. Remove the existing pins securing:
  - the tiller and twin engine connecting bars:
  - the power steering ram to the tiller arm and twin engine connecting bar.
  - the steering cable to the power steering ram.

**Note:** *These pins are retained by split pins that may be hard to remove. You will probably need someone's help to hold the legs of the split-pins together so you can remove them.*

2. Fit the pivot assembly to the steering system as shown in *Figure 10*:
  - use the new retaining pins (supplied with the installation kit)
  - secure these with the split pins (supplied)

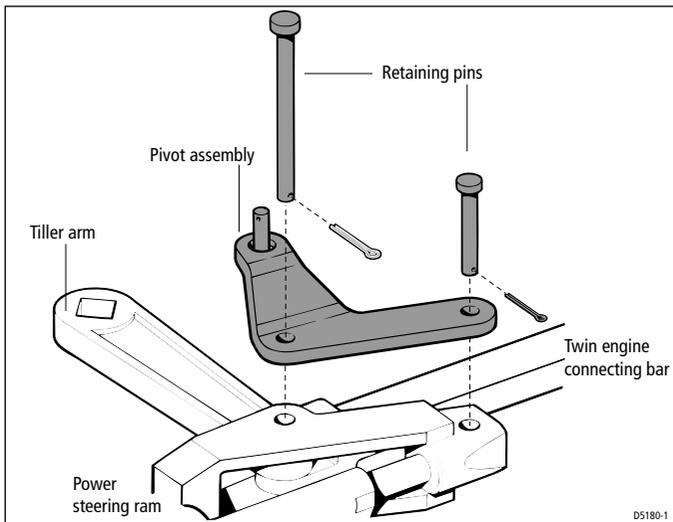


Figure 10: Fitting the pivot assembly (Mercuriser 95)

3. Fit the main support bracket to the spool valve cable connection on the steering system (see *Figure 11*):
  - position the main support bracket behind the spool valve cable connection
  - fit the clamp around the spool valve cable connection
  - put the spring washers on the four securing bolts
  - tighten the bolts to secure the main support bracket

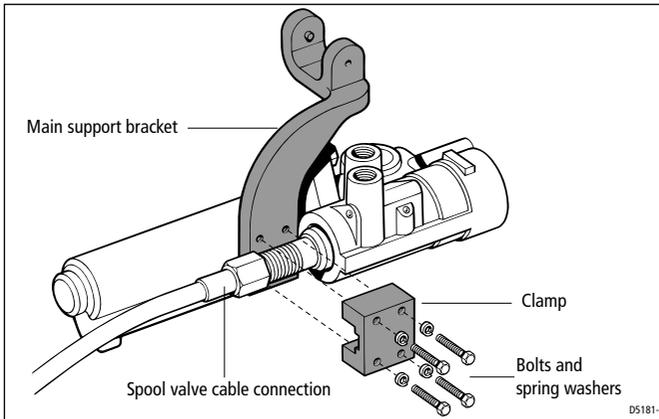


Figure 11: Fitting the main support bracket (MerCruiser 95)

4. Place the I/O drive's pushrod end on the pivot assembly pin – the flat part of the pushrod should rest on top of the pivot assembly.
5. Fit the R-clip to the pivot assembly pin to secure the I/O drive pushrod in place.

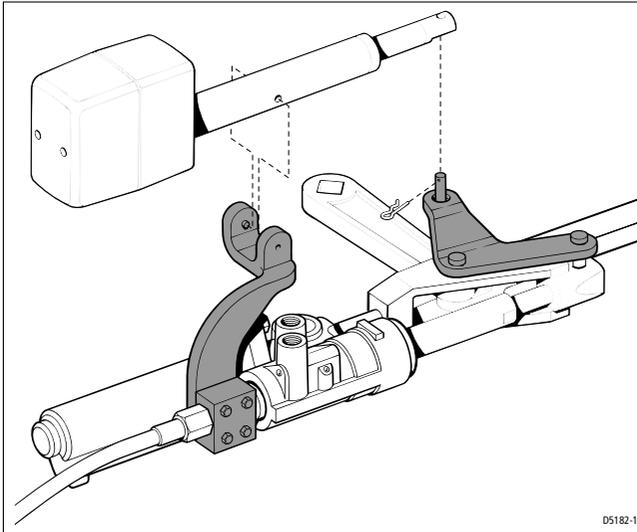


Figure 12: Fitting the I/O drive unit (Mercruiser 95)

6. Lower the I/O drive into the main support bracket (see *Figure 12*), making sure that:
  - the fixed and spring-loaded pins locate in the corresponding holes in the I/O drive's girdle tube
  - the I/O drive's pushrod is parallel with the power steering ram.



## CAUTION

### Location pins

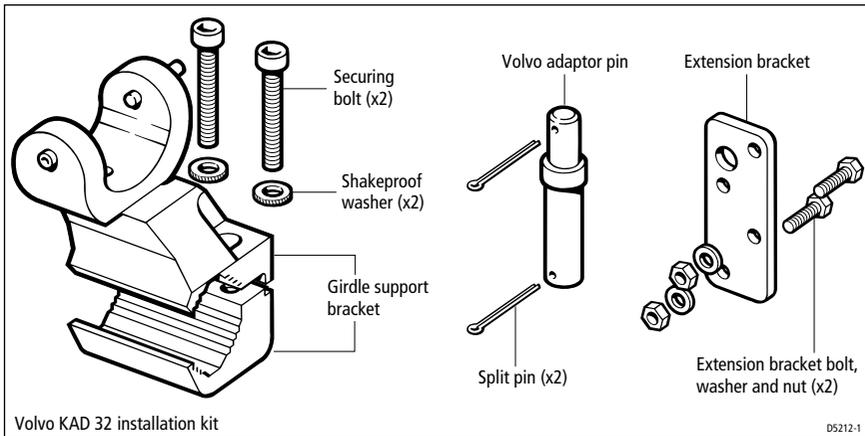
**The fixed and spring-loaded location pins must be fully engaged in the I/O drive girdle tube. If they are not the autopilot will fail.**

7. Complete a hardover to hardover check:
  - Slowly turn the steering system from hardover to hardover.
  - Make sure that the drive unit and adaptor pin bracket do not come into contact with any part of the engine, boat or steering system. This includes any engine hoses that may have a passing contact with the I/O drive unit.

**Note:** *If necessary, you can rotate the main body of the drive unit relative to the girdle tube (see below).*

## Installation for Volvo KAD 32

**Note:** You must use the KAD 32 I/O drive unit (part number E12019) for this system.



When installing the I/O drive unit on a Volvo KAD 32, the first step is to fit an extension bracket to raise the engine filter assembly and provide sufficient space for the drive unit (see *Figure 13*):

1. Remove the KAD 32 bracket bolts
2. Lift the filter/bracket assembly clear of the engine.
3. Remove the filter assembly bolts.
4. Fit the extension bracket (supplied) to the KAD 32 bracket using the extension bracket bolts (supplied)
5. Use the filter assembly bolts to attach the filter assembly to the extension bracket.
6. Make sure the flexible hose is secure.
7. Use the KAD 32 bolts to refit the complete filter/bracket assembly.

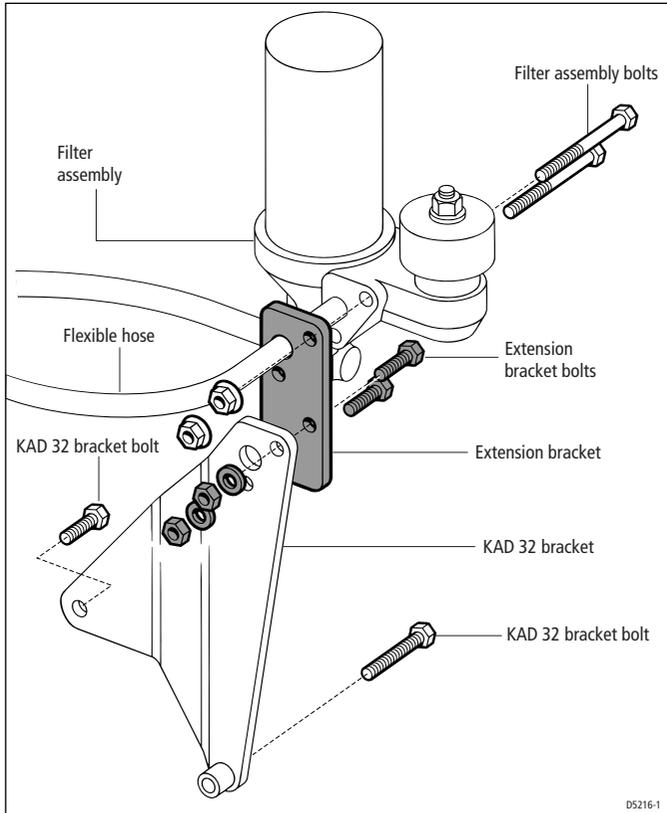


Figure 13: Fitting the extension bracket

When you have fitted the extension bracket:

1. Remove the locating pin that attaches the steering cable rod to the tiller end block.
2. Replace it with the Volvo adaptor pin, using one of the split pins to hold it in place (see *Figure 14*).

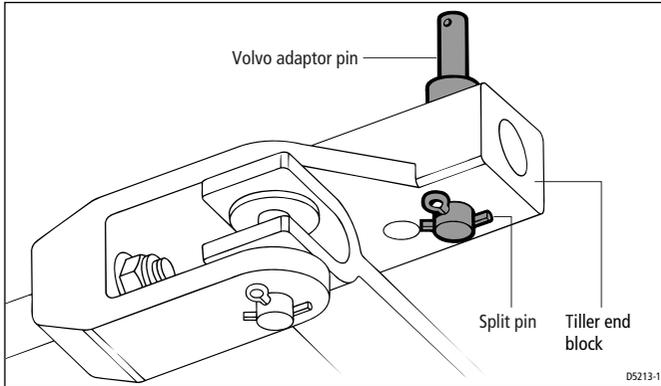


Figure 14: Fitting the Volvo adaptor pin

3. Fit the girdle support bracket onto the spool valve rod:

- the adaptor pin bracket must sit **against**, but not on, the shoulder on the spool valve rod
- the spring-loaded location pin and the securing bolts **must** be on the stern (aft) side of the cable end sheath
- make sure the bracket is vertical, then tighten the two bolts

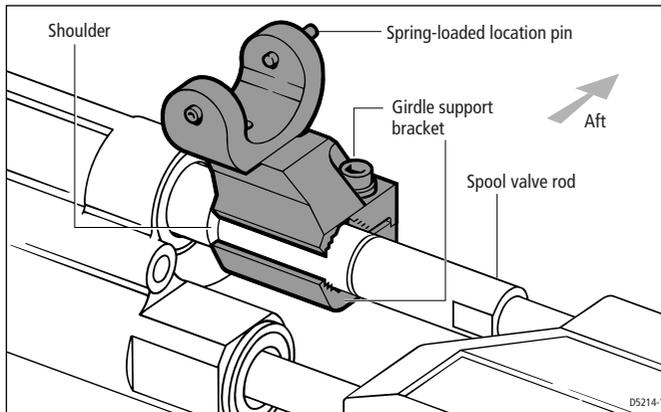


Figure 15: Fitting the girdle support bracket

4. Position the I/O drive unit to align its location holes with the fixed and spring-loaded pins in the girdle support bracket (*Figure 16*).

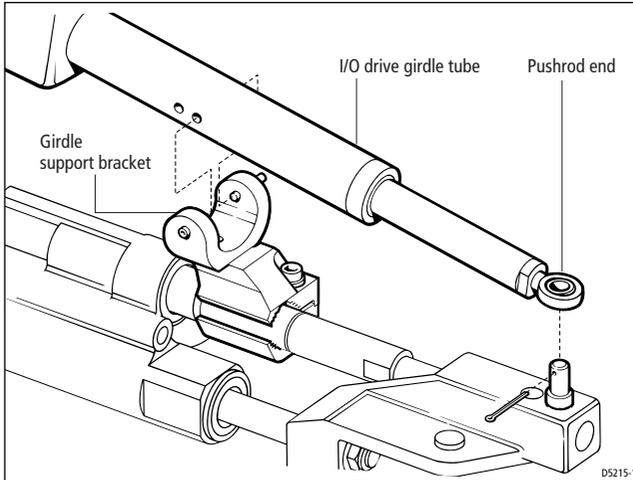


Figure 16: Fitting the I/O drive unit (KAD 32)



## CAUTION

### Location pins

**The fixed and spring-loaded location pins must be fully engaged in the I/O drive girdle tube. If they are not the autopilot will fail.**

5. Fit the pushrod onto the adaptor pin and secure it with the split pin.
6. Complete a hardover to hardover check:
  - Slowly turn the steering system from hardover to hardover.
  - Make sure that the drive unit and adaptor pin bracket do not come into contact with any part of the engine, boat or steering system. This includes any engine hoses that may have a passing contact with the I/O drive unit.

**Note:** *If necessary, you can rotate the main body of the drive unit relative to the girdle tube (see Figure 17).*

### Mounting in a restricted area

If an obstruction prevents you from installing the I/O drive unit as supplied, rotate the main body of the drive relative to the girdle tube as follows:

1. Remove the two fixing screws on the front cover.
2. Carefully slide the cover forwards, making sure you do not pull any of the four cables from the plugs inside the cover.
3. Loosen the lock nut.
4. Rotate the main body as required.

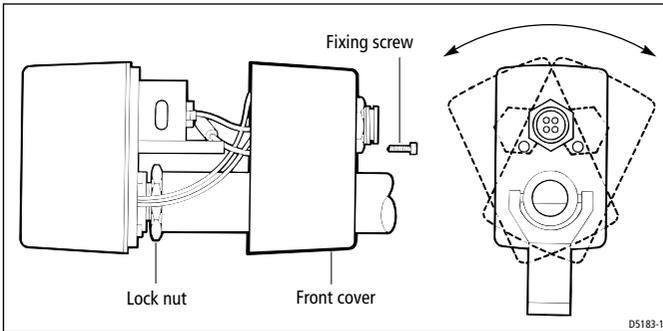


Figure 17: Rotating the main body of the I/O drive unit

5. Tighten the lock nut, making sure it is less than one turn from the start of the thread.
6. Replace the cover, taking care not to trap or pinch the cables.
7. Complete a hardover check:
  - Use the steering wheel to move from hardover to hardover.
  - Make sure that the drive unit and adaptor pin bracket do not come into contact with any part of the engine, boat or steering system. This includes any engine hoses that may have a passing contact with the I/O drive unit.

### 3. Electrical connections



## WARNING

### Electrical safety

**Make sure you have switched OFF the power supply before you start installing this product.**

When you have fitted the I/O drive to the steering system, connect it to the course computer as follows:

1. Plug in the power cable (supplied) into the socket on the drive unit. Lock the connector in place by turning the locking ring clockwise.
2. Route the cable to the course computer, taking into account the EMC installation guidelines (see *page 6*).
3. Connect the motor cables (thicker blue and brown cables) and the clutch cables (thinner red and black cables) to the connections on the course computer as shown in *Figure 18*.
4. Secure the cable close to the I/O drive unit, making sure there is enough free length to allow the drive unit to move.

- Complete another hardover check: use the steering wheel to move the rudder from hardover to hardover, and check that the cable does not catch on any part of the boat or its fittings.

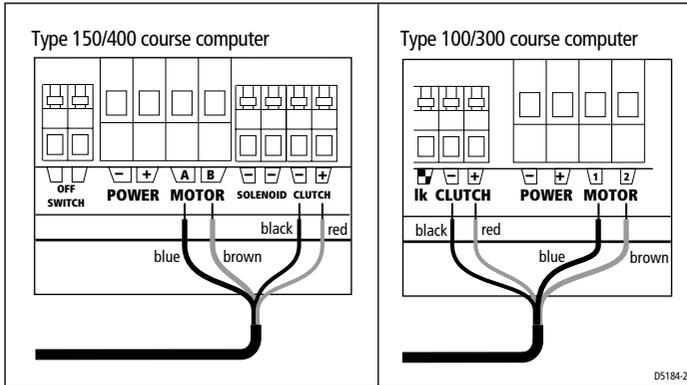


Figure 18: Connections at course computer

## 4. Post-installation check



### WARNING

#### Moving parts

**Keep clear of moving steering systems at all times. Protect moving parts from access during normal use.**

Check the following points after installing the drive:

- Is the drive unit securely attached to the steering system (with all brackets, bolts, split pins, etc. secure)?
- Is the drive unit correctly aligned?
- Are the motor and clutch cables correctly routed and securely connected to the course computer?
- Complete a hand-steering check: Are you sure there is no contact between the drive unit and any part of the engine, steering system or boat's structure when the push rod moves in and out?

**Note:** When you have installed the entire autopilot system, you will need to complete an autopilot steering check. Refer to the control unit handbook for more details.

## Maintenance

On a regular basis:

- check all connections and mountings are secure
- check drive alignment
- check cables for signs of wear or damage

## EMC servicing and safety guidelines

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

## Product support

Raymarine products are supported by a worldwide network of distributors and Authorized Service Representatives. If you encounter any difficulties with this product, please contact either your national distributor, or your service representative, or the **Raymarine Technical Services Call Center**. Refer to the back cover or the Worldwide Distributor List for contact details.

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## **User notes**

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## **User notes**

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## **User notes**



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