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# Rotary Drive Installation Guide

**Drives covered:**

M81135 Type 1 Rotary Drive 12 V

M81136 Type 2 Rotary Drive 12 V

M81137 Type 2 Rotary Drive 24 V

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**Raymarine**  
ON BOARD



## Important information

### 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.

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**

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 commonsense and navigational judgement. Always maintain a permanent watch so you can respond to situations as they develop.

### EMC conformance

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

### Handbook information

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

# Introduction

## Product description

Welcome to the installation guide for the Raymarine rotary drive. This product is intended to operate the boat's steering mechanism as part of a Raymarine autopilot system. It is designed for steering systems that can be driven from the helm position through a chain and sprocket (for example: cable and rod steering systems).

The outstanding design of the Raymarine rotary drive unit provides smooth, powerful autopilot-controlled steering with quiet operation.

The main parts of the drive are:

- a rugged electric motor, that drives a precision epicyclic gearbox via a high tensile drive belt
- an electromagnetic clutch that transmits high torque loads without slipping

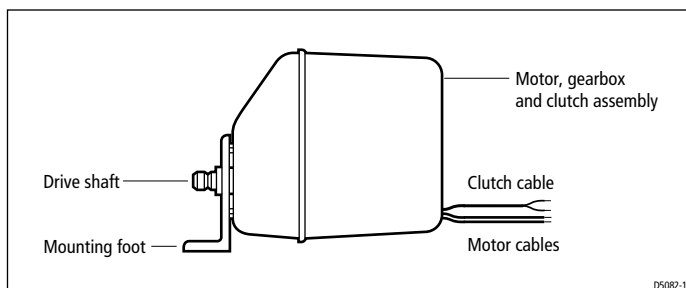


Figure 1: Main parts of the rotary drive

## Contents

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# Specifications

## Drive dimensions

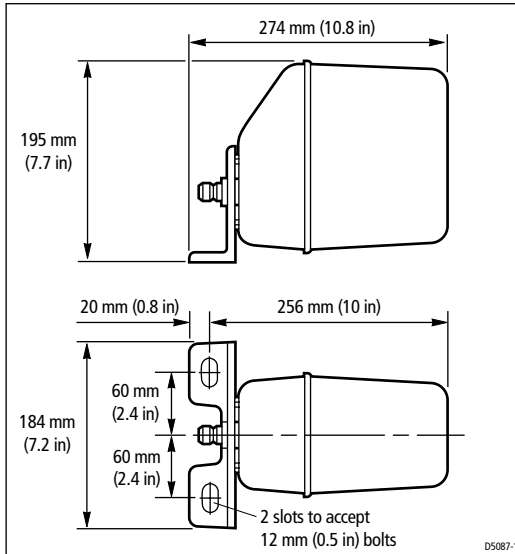


Figure 2: Drive dimensions

## Drive specifications

Table 1: Drive specifications

<b>Performance</b> (at nominal voltage)	<b>Type 1 (T1)</b> M81135 (12 V)	<b>Type 2 (T2)</b> M81136 (12 V) M81137 (24 V)
Maximum boat displacement	10,000 kg (22,000 lb)	20,000 kg (44,000 lb)
Peak output torque	20 Nm (180 lb.in)	34 Nm (300 lb.in)
Maximum shaft speed	33 rpm	33 rpm
Recommended hardover to hardover time (no load)	10 sec	10 sec
Power consumption (typical average)	24-48 W	60-84 W (12 V) 72-120 W (24 V)

Table 1: Drive specifications (contd)

Other information	(applies to Types 1 and 2)
	protected for use in engine compartments
	CE approvals - conforms to: 89/336/EC (EMC), EN60945:1997 94/25/EC (RCD), EN28846:1993

## Installation instructions

### Parts required

To install this drive you will need:

- Parts supplied:
  - rotary drive
  - mounting foot
  - spacing shims (x3)
- Additional parts:
  - suitable securing bolts and lock washers/lock nuts (see *page 9*)
  - suitable sprockets and grub screws for drive and steering system (see *page 9*)
  - thread-locking compound
  - suitable drive chain (see *page 9*)
  - suitable cable and electrical connectors for the drive motor and clutch (see *page 13*)

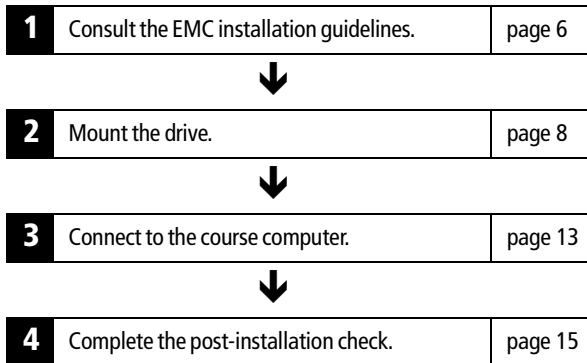
**Note:** *Make sure you have obtained these additional parts before you start installation.*

## 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 rotary drive unit:



## 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

The following illustration shows typical cable suppression ferrites used with Raymarine equipment. Always use the ferrites supplied by Raymarine. This product has ferrites mounted internally.

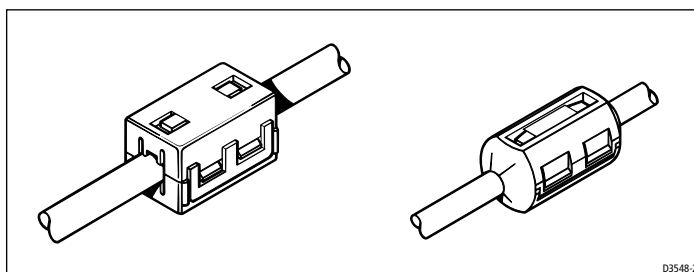


Figure 3: Typical suppression ferrites

## 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

Mounting the drive involves four main steps:

- securing the drive to the boat
- connecting the drive to the steering system
- ensuring correct sprocket alignment and chain tension
- completing a steering check

### Securing the drive

#### Mounting location

Before you secure the drive to your boat, you must first check the suitability of the mounting location.

#### **CAUTION:**

**Consult the boat manufacturer if you have any doubt about the strength or suitability of the mounting location.**

- **Structural strength:**
  - This drive produces a considerable amount of force, so you must mount it on a solid structure (i.e. a substantial frame member) in the boat. In some cases you may need to build a special frame to mount the drive unit.
  - To prevent excess noise and vibration, do not attach this drive to any structures that support cabins.
- **Drive orientation:**
  - The drive can be mounted on a vertical or horizontal surface.
  - If necessary, you can rotate the mounting foot through 90 degrees to provide a more convenient mounting position (as shown in *Figure 7*). To do this: remove the four screws securing the mounting foot to the drive unit, rotate the mounting foot, then replace the screws.
  - Additionally, the drive may face either way as you can correct the steering direction by reversing the polarity of the motor connections at the course computer (see *Figure 8*).
- **General position:**
  - Refer to the EMC installation guidelines (*page 6*)
  - Make sure the drive will be accessible for future servicing.

- **Environment:**

- This drive is not waterproof, so you should mount it in a dry location, clear of any bilge water.

### **Mounting bolts**

Attach the mounting foot with two stainless steel M12 ( $\frac{1}{2}$  inch) bolts and lock nuts/lock washers.

**Note:** *Before finally tightening the bolts you must check sprocket alignment (see page 12) and chain tension (see page 12).*

**Note:** *Always mount the drive as securely as possible to make sure it performs reliably and the chain remains correctly aligned.*

### **Connecting to the steering system**

The rotary drive is connected to the steering system by a chain drive between a sprocket on the drive and a sprocket on the boat's steering shaft.

**Note:** *Most steering gear manufacturers supply special autopilot drive attachments, and many include this as standard. Contact your steering gear manufacturer for more information.*

When you have checked with the steering gear manufacturer about how and where you can attach the autopilot chain to the boat's steering system, you need to:

- determine the sprocket and chain sizes
- attach and align the sprockets and chain
- tension the chain correctly

### **Determining the sprocket and chain sizes**

#### **Chain size**

Recommended chain size: standard  $\frac{3}{8}$  inch pitch.

#### **Sprocket sizes**

To determine the sprocket sizes required at the steering shaft and rotary drive:

- count the number of times the steering shaft turns when you move the rudder from hardover to hardover

- use *Figure 4* to determine the sprocket sizes required at the steering gear shaft (steering sprocket) and at the rotary drive (drive sprocket) by:
  - reading up from the number of steering shaft turns (on the horizontal axis) until you reach the line for Type 1 or Type 2 drive (as appropriate)
  - reading across (to the vertical axis) to identify the appropriate steering and drive sprocket sizes from the table on the left
- for example, if the steering shaft turns twice when the rudder moves from hardover to hardover you will need (as indicated by the dotted lines on *Figure 4*):
  - a 13 tooth drive sprocket and 38 tooth steering sprocket if you have a Type 1 rotary drive
  - a 15 tooth drive sprocket and 57 tooth steering sprocket if you have a Type 2 rotary drive

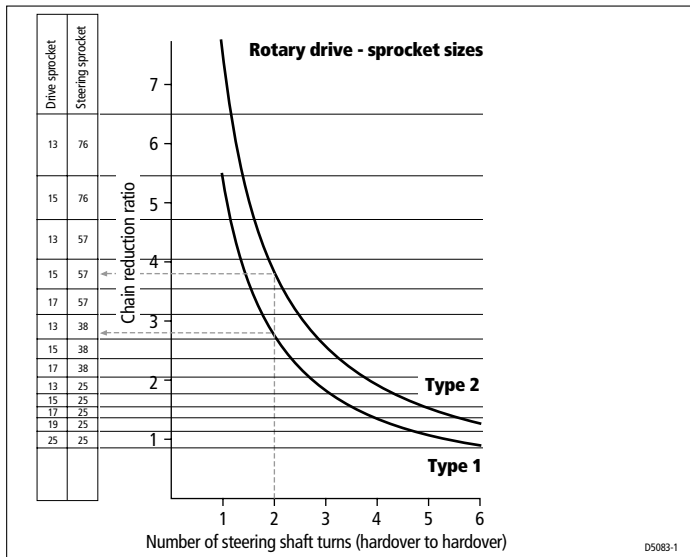


Figure 4: Rotary drive sprocket sizes

**Note:** *The sprocket sizes in Figure 4 provide good steering performance for most boats. If you think your boat may have unusual steering characteristics, contact Raymarine's Technical Services Call Center or an Authorized Service Representative for advice.*

### Obtaining the steering sprocket

Obtain the appropriate sized **steering sprocket** from the steering system manufacturer.

### Obtaining the drive sprocket

Your Raymarine dealer can supply the following **drive sprockets** (suitable for a  $\frac{3}{8}$  inch pitch chain):

- 13 tooth: part number M81182
- 15 tooth: part number M81183
- 17 tooth: part number M81184
- 19 tooth: part number M81185
- 25 tooth: part number M81186

### CAUTION:

To stop the drive sprocket rotating on the drive shaft, the shaft has a  $\frac{1}{8}$  inch square projection (a woodruff key) that fits into a notch (or keyway) at the centre of the sprocket. If you use a non-Raymarine drive sprocket, its bore and keyway dimensions must fall within the ranges specified in *Figure 5* for it to lock correctly to the drive shaft.

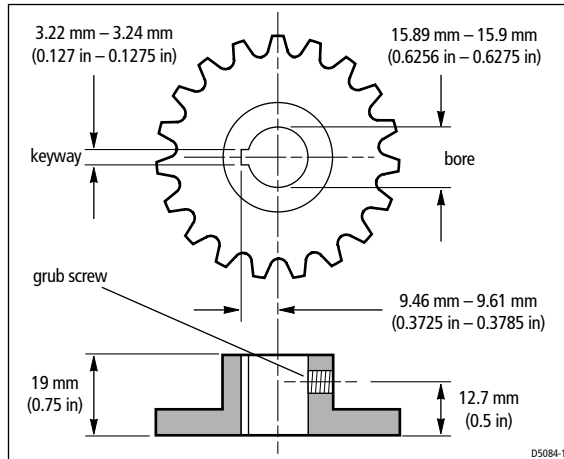


Figure 5: Sprocket bore and keyway dimensions

## Attaching drive and steering sprockets

**Note:** Each sprocket must be keyed and then screwed to the shaft with a grub screw secured with thread-locking compound.

## Checking sprocket alignment and chain tension

### Aligning drive and steering sprockets

Both sprockets must be accurately aligned to run in the same plane when viewed from the side. Check for correct alignment by holding a straight edge between the edge of the sprockets (see *Figure 6*).

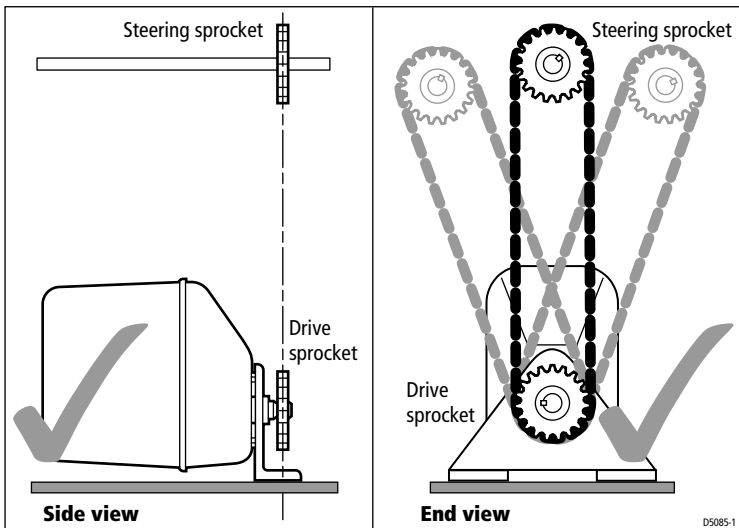


Figure 6: Sprocket alignment

### Adjusting the chain tension

Adjust the chain tension until it is just tight, so there is minimal lost motion between the drive sprocket and the rudder stock.

**Note:** If the chain tension is not set correctly, the resulting lost motion will impair steering performance.

To adjust chain tension:

- Drives mounted horizontally: place as many of the supplied shims as necessary under the mounting foot (see *Figure 7*).
- Drives mounted vertically: use the slots in the mounting foot to move the drive up or down (see *Figure 7*).

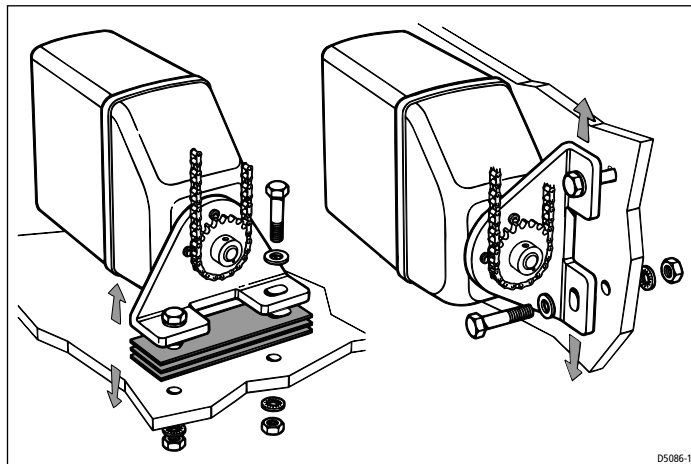


Figure 7: Adjusting chain tension

## Steering check

When you have tensioned the chain correctly, turn the steering wheel from hardover to hardover to check that the chain and sprockets move freely and are correctly aligned.

### **WARNING:**

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

## 3. Connecting to the course computer

### **WARNING: Electrical safety**

**Make sure the power supply is switched off before you make any electrical connections.**

The rotary drive has electrical connections for:

- drive motor: two single-core cables: red and black
- clutch: a two-core cable with red (+) and blue (-) cores

Follow these steps to connect the rotary drive to the course computer:

1. Measure the total distance of cable run from the drive unit to the course computer:
  - use *Table 2* to identify the appropriate motor cable size
  - use at least 1.5 mm<sup>2</sup> (16 AWG) copper cable for the clutch
2. Join these cables to the drive cables using appropriate electrical connectors or junction boxes at the correct power rating.
3. Route the cables back to the course computer, taking into account the EMC installation guidelines (see *page 6*).
4. Connect the cables to the course computer (see *Figure 8*):
  - **CLUTCH** terminals: red core to +ve, blue core to -ve.
  - **MOTOR** terminals: at this stage you can connect either motor cable to either terminal. You will check these connections after installing the rest of the autopilot system.

Table 2: Recommended cable sizes

<b>Cable length</b> (drive to course computer)	<b>Cable gauge</b> (AWG)	<b>Copper area</b> (mm <sup>2</sup> )
<b>Type 1 drive</b>		
up to 3m (10ft)	14	2.5
up to 5m (16ft)	12	4
up to 7m (23ft)	10	6
up to 10m (32ft)	8	10
up to 16m (52ft)	6	16
<b>Type 2 drive 12V</b>		
up to 5m (16ft)	10	6
up to 7m (23ft)	8	10
up to 16m (52ft)	6	16
<b>Type 2 drive 24V</b>		
up to 3m (10ft)	12	4
up to 5m (16ft)	10	6
up to 10m (32ft)	8	10
up to 16m (52ft)	6	16

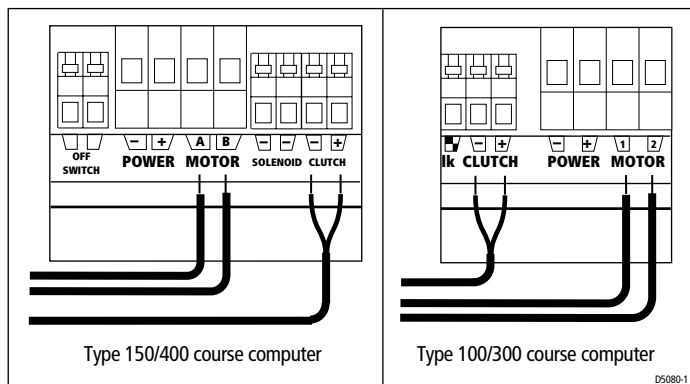


Figure 8: Course computer connections

## 4. Post installation checks

Check the following points after installing the drive:

1. Is the drive secured to a substantial structure on the boat?
2. Have you used suitable steering and drive sprockets for the boat?
3. Are the drive and steering sprockets in line when viewed side-on?
4. Have you securely locked both sprockets to the shafts?
5. Have you tensioned the chain correctly?
6. Are the motor and clutch cables correctly routed and securely connected to the course computer?
7. Complete a hand-steering check: Do the chain and sprockets move freely and in correct alignment from hardover to hardover?

**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 chain and sprockets are correctly aligned and tensioned
- lightly grease sprockets and chain
- check cables for signs of wear or damage

**Note:** If this drive is used heavily, we recommend that it is serviced every two years by a Raymarine Authorized Service Representative.



## EMC servicing and safety guidelines

- Raymarine equipment should be serviced only by authorized Raymarine service technicians. They will ensure that service procedures/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 cables or 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 EMC-related problems 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**.

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