ComNav® marine ltd

# 1440/1460 Autopilot Systems

## Installation & Operation Manual



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**PN 29010014** V2.3

ComNav® marine ltd

# 1440/1460 Autopilot Systems

## Installation & Operation Manual

Document PN 29010014 V2.3

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# WELCOME

Congratulations on your purchase of a ComNav Marine 1440/1460 Autopilot Systems! At ComNav, we are dedicated to reliability & quality in all our products, and proud of our prominence as a leader in the design and manufacture of marine autopilot systems. We promise to do our best to ensure your satisfaction with your new Autopilot System.

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## WARRANTY NOTICE

Prior to the installation and/or operation of the equipment, ensure that you read, understand, and accept the conditions of the warranties as detailed in the **Warranty Information** section of this manual.

## OPERATOR'S WARNING

The 1440/1460 Autopilot Systems will steer your vessel, when you activate it.

However, it is only an aid to navigation. Its performance can be affected by many factors including equipment failure, environmental conditions, and improper handling or use. An autopilot system does not reduce your responsibility for the control of the vessel when underway. You must always be in a position to monitor the course, supervise the autopilot, and resume manual control if the need to do so arises.

**Whenever underway, your vessel must be under the control of a qualified and alert person.**

## GENERAL NOTICE

This document, ComNav part number 29010014 Version 2 Revision 2, is the approved Installation and Operation Manual for use with the 1440/1460 Autopilot Systems. Where versions of this manual exist in other languages, the English version shall be considered authoritative.

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# Product Description

ComNav 1440 & 1460 Autopilot Systems are reliable, accurate and easy to use aids to navigation. They feature four operating modes, watertight design, and a built-in navigation interface.

The four operating modes are:

- STANDBY MODE allows manual steering while displaying compass information.
- POWER STEERING MODE features push button steering control, and displays compass or rudder information.
- PILOT MODE steers to a constant Heading.
- NAV MODE steers along a Course line, when the 1440/1460 is connected to an appropriate navigation device.

A Dodge feature is available in both PILOT and NAV MODES.

To steer a constant Heading, the 1440/1460 Autopilot compares the current Compass reading to the Heading (Course) that the operator has selected. If the vessel is not on the correct Heading, the Autopilot calculates the rudder position which will bring the vessel onto the correct Heading.

The Autopilot uses the vessel's steering system (a hydraulic system, or an electric motor, and mechanical linkage) to move the rudder (or outboard motor) to the position it calculates. Information from the Rotary Feedback (or Outboard Feedback) is used to calculate new rudder positions, and to verify that the steering system has followed the Autopilot commands.

When steering along a Course line in NAV MODE, the 1440/1460 use Heading information from the compass, and position information from a a GPS receiver, a chartplotter, or other device, to calculate a Course to Steer which will keep the vessel on the Course line.

1440/1460 Autopilots have a feature called *Ghost Rudder.* Should the Rudder Feedback ever fail, the Autopilot will use its prior knowledge of how the rudder moves to calculate new "virtual rudder" positions. While the *Ghost Rudder* will not allow the Autopilot to steer as well as it can with the Rudder Feedback, it *will* allow the Autopilot to be used until repairs can be made.

1440/1460 Autopilots are protected against many mishaps, including: reverse power connection, output circuitry overload, computer failure, or program error.

**Specifications**

Voltage: 10 VDC - 40 VDC
Steering Outputs: 20 Amperes Maximum

| **Dimensions** | L x W x H or D |
|---|---|
| 1440 Control: | 5.1 x 2.75 x 1.0 inches (13.3 x 7.0 x 2.5 cm) |
| 1460 Control: | 3.1 x 6.0 x 1.0 inches (7.9 x 15.4 x 2.5 cm) |
| Processor: | 15 X 6.3 X 2.7 inches (38.1 x 16.0 x 6.9 cm) |
| Compass: | 5.6 x 3.0 x 4.2 inches (14.2 x 10.7 x 7.6 cm) |
| Pump: | 7.5 x 4.75 x 4 inches (19.0 x 12.2 x 10.2 cm) |

# Before You Start

***Thank you*** for buying the ComNav 1440 or 1460 Autopilot System. It ***will*** make boating safer, easier and more enjoyable for you!

**Please do not forget to complete and send in your warranty card.**

**This will give you 3 years of Warranty protection. We suggest that you do it first!**

Happy boating!

## Unpacking and Identification

Please make sure that you have found and identified all of the components of your Autopilot System, before you begin installation. This manual begins with a parts list, to help you identify the components of your system.

Your system will have either a Rotary Rudder Feedback or an Outboard Motor Feedback. There are separate sections about both Feedback units in this manual.

If you purchased a system without a Hydraulic Pump, you can ignore the sections of the manual dealing with Pumps, and about bleeding the hydraulic system.

Wiring diagrams for connecting to 4 and 5 wire motors and solenoid valves are in the appendixes.

## Manual Conventions

In this manual, the names of the main components are capitalized.

For example: Processor.

Also, the keys on the Control Head are capitalized.

For example: Set Key.

When you are required to perform an action with a key, it is underlined.

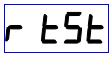
For example: Press the Red Key.

Your ComNav 1440/1460 Autopilot has four operation modes. They will be printed as small capitals.

For example: PILOT MODE, STANDBY MODE.

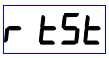
## Display

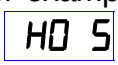
When the text asks you to look for a specific message in the display of the Control Head, the text will show the display in this way:




*The box around the image above represents the frame of the Head's LCD display. Because the display is a "Seven Segment" type, lower case and upper case letters must often be mixed together in the LCD display – and so also in the images in this manual. Sometimes, a drawing of the display will follow the text.*

When a particular display is mentioned in the text, the "normal English" message represented by the display will follow.

For example: 

(rudder test) or 

(hard over Starboard)

## Tools Required

The general tools & other items you will need while installing the system are:

1) Basic Tool Kit

2) Screwdrivers: One Phillips, one slot-head

3) Wire Cutters: a pair of ordinary wire cutters suitable for general electrical work will do

4) Drill and a selection of Drill Bits

5) Small Adjustable Wrench

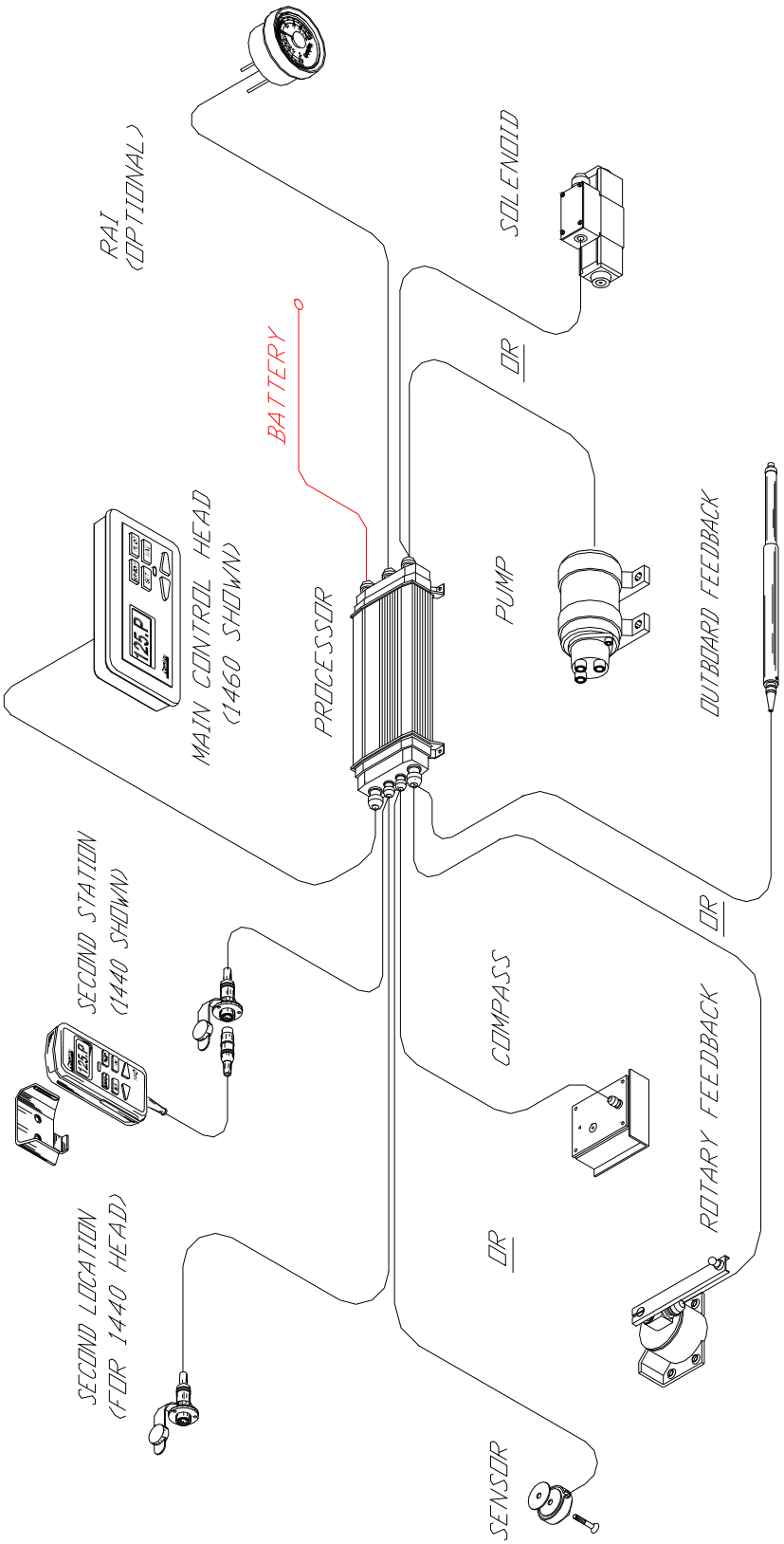
6) Any tools specific to your boat

7) Miscellaneous fasteners & mounting hardware, for mounting components and securing hydraulic lines (see individual "installation" sections, below, for specific suggestions)

8) You may also wish to have a supply of Ty-wraps (aka "zap straps") for securing electrical cables

If you purchased a 1440/1460 with a Hydraulic Reversing Pump, a list of the tools you will require specifically for the installation of the Pump is on page 27.

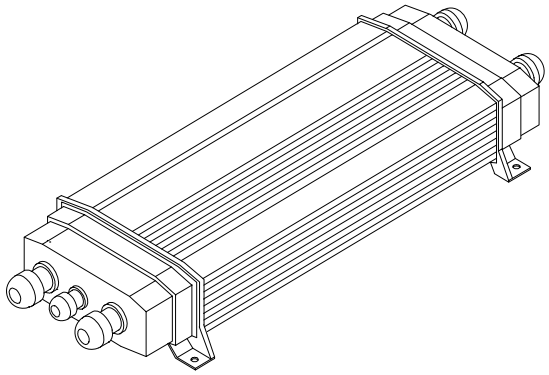
If you purchased a 1440/1460 with a Rotary Rudder Feedback, you may need one stainless steel band clamp, of a size more than large enough to fit around your vessel's rudder post. See page 18.



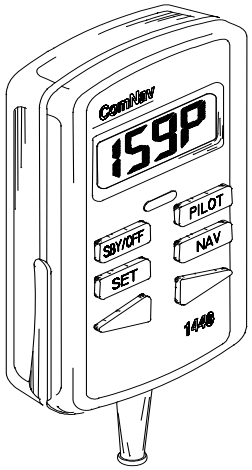

**1460 System Diagram** (with 1440 Second Station)

## Parts List

*Note: Parts are not drawn to any scale.*

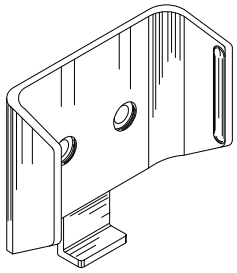


Processor. PN 20080003

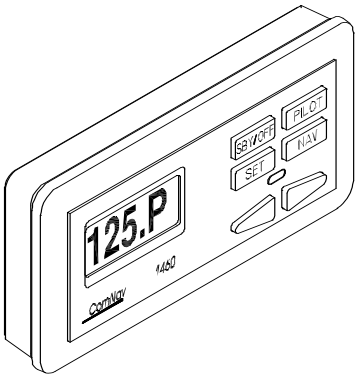



*For 1440 system packages:*

1440 Control Head. PN 20080002. This part includes a flexible curly-cord, with a plug on the far end, wired to it; the cord can stretch to about 5 foot (1.5 m) long.

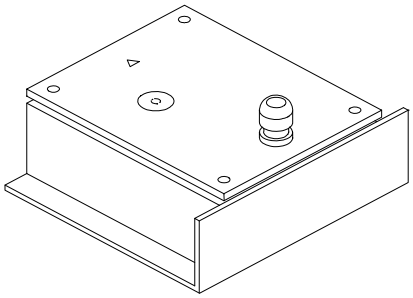


1440 Control Head Mounting Clip. PN 65610010 (this is included in the 1440 Accessory Kit, see page 11).




*For 1460 system packages:*

1460 Control Head. PN 20080004. This part includes a 25 foot (7.7 meter) cable, labelled “1”, wired to it. A Mounting Bracket for it, & fasteners, are included in the 1460 Accessory Kit (see page 11).



ComNav Fluxgate Compass. PN 20320003. This part includes 40 feet (12.2 m) of cable wired to it.

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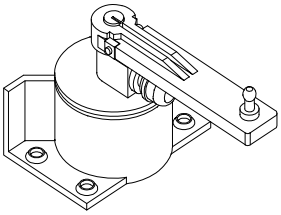
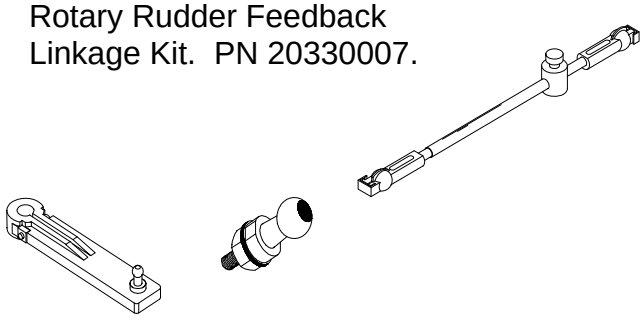
One Feedback unit or the other will be included:



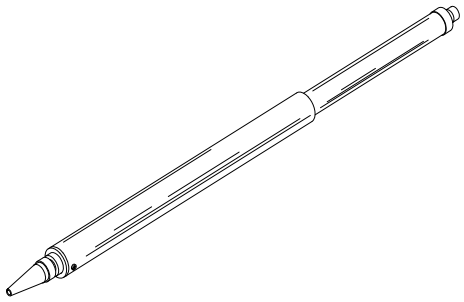
Rotary Rudder Feedback. PN 20330008. This part includes 50 feet (15.2 m) of cable wired to it.

This part always comes with:

Rotary Rudder Feedback Linkage Kit. PN 20330007.



*OR*:



Outboard Feedback. PN 20330002. This part includes 30 feet (9.1 m) of cable wired to it.

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Also included but not shown:

- Power Cable. 7.5 feet (2.3 m) of cable (labelled “5”), for connecting supply voltage to the Processor.
- Accessory Kit. The 1440 kit (PN 20080005) contains a Mounting Clip for the 1440 Control Head, and some lubricant for the Head’s plug. The 1460 kit (PN 20080006) contains a mounting bracket & fasteners for the 1460 Control Head. Both kits contain extra terminal sockets and a cable gland.
- Control Head Interconnection Cable (1440 systems only): 10 feet (3 m) of cable (labelled “1”), with an attached receptacle (with cap) & a mounting washer.
- 1440 & 1460 Installation & Operation Manual (this manual, PN 29010014).

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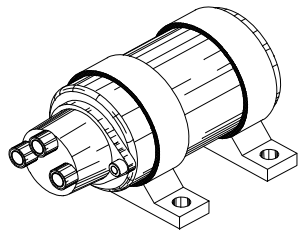
If you purchased a system with a hydraulic pump, one of two models of pump, and at one of two operating voltage ratings, will be included. All pumps look very similar, so inspect the labels carefully.



- 18CI Reversing Pump, 12 VDC. PN 20810016
- 18CI Reversing Pump, 24 VDC. PN 20810031
- 30CI Reversing Pump, 12 VDC. PN 20810018
- 30CI Reversing Pump, 24 VDC. PN 20810035

All pumps have 20 feet (6.1 m) of cable wired to the Pump Motor.

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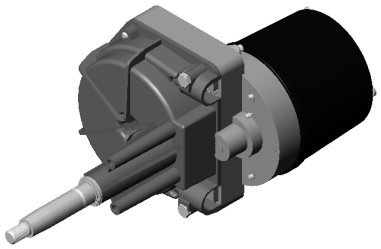
If you purchased a system with a Cable Drive, one of several models will be included. The models vary slightly in appearance, so inspect the labels carefully.



- Type 'S' (Morse Straight Shaft – shown in the figure). PN 20910002
- Type 'MTS' (Morse Tilt Shaft). PN 20910003
- Type 'T' (Teleflex Performance Tilt). PN 20910004
- Type 'TST' (Teleflex Standard Tilt). PN 20910005
- Type 'R' (Remote). PN 20910009

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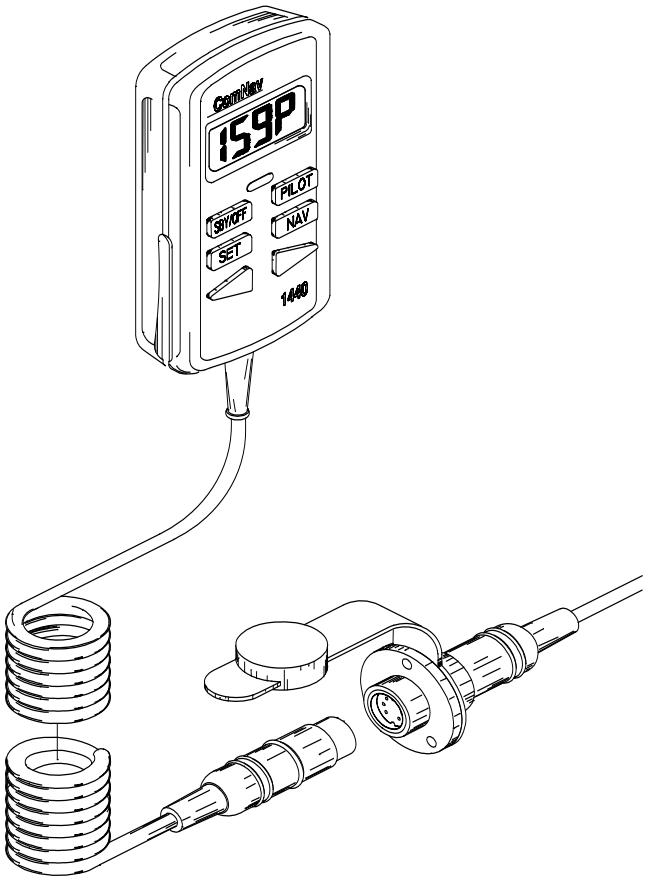
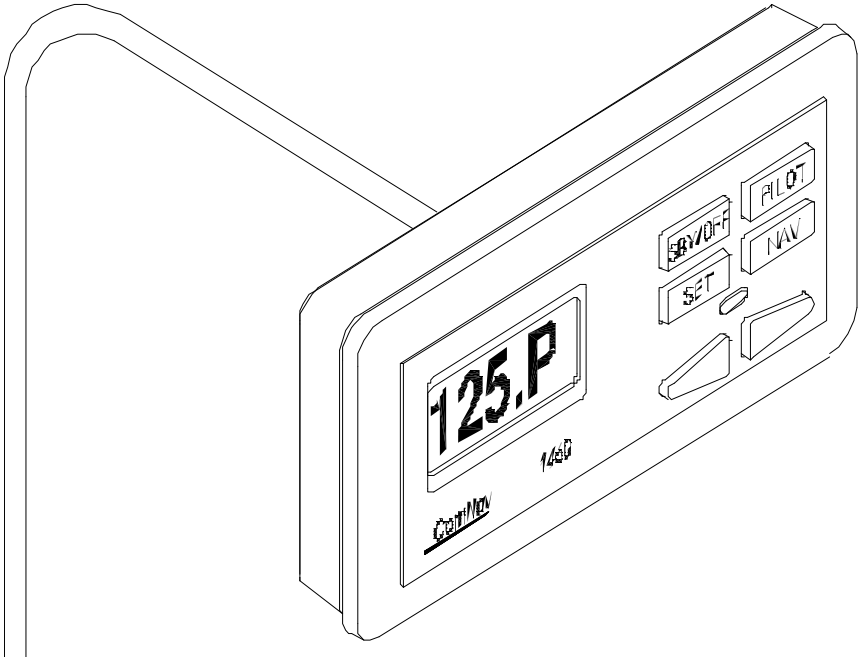



**Plugging the 1440 Control Head curly-cord cable into the socket on Cable #1**




**1460 Control Head with attached Cable #1**

# Installation Instructions

***Caution***

*Using ordinary electric tools near water is* **VERY** *dangerous! To minimize the dangers of electric shock and personal injury, we recommend using cordless rechargeable tools or hand tools.*

## 1440/1460 Autopilot System

### Planning

#### *Processor Location*

In choosing a location for your ComNav 1440 or 1460 Autopilot System, please note that the cable from the Control Head to the Processor (cable #1) should not be cut or extended. Excess cable may be loosely coiled behind a panel.

You will want to have the Control Head near the steering station you use the most. So, you should also note the following, when routing cable #1:

For the 1440:

- Cable #1 is 10 feet (3 m) long, and ends in a socket receptacle.
- the curly-cord cable from the 1440 Control Head has a plug on the end, which is plugged into the socket on the end of Cable #1 (see the figure on the previous page).
- place the 1440 Control Head's Mounting Clip at the most-often used station, so that you have a "normal" position for the Control Head.
- try to position the Processor and Cable #1's socket end so that the 1440 Control Head will also be useable in any other places where you will want to be when using the Autopilot, without over-stretching the curly-cord.

For the 1460:

- cable #1 is 25 feet (7.7 m) long, and is permanently attached to the Control Head. See the figure on the previous page.

Similarly, the cable from the Compass to the Processor (Cable #2), should not be cut or lengthened. Cable #2 is 40 feet (12.2 m) long (excess may be coiled up).

Allow at least a foot (30 cm) of clearance on either end of the Processor in the space where it is to be located.

Do not mount the Processor near heat sources, such as heat radiators, or over engines.

If you can, mount the Processor so that the cooling fins are vertical.

If possible, mount the Processor where you will be able to hear its internal beeper while operating your boat. Although the lights on the Control Head will tell you about the Autopilot's actions, it helps if you can hear the beeper too.

### *Compass Location*

When choosing a location for the Compass, try to locate it as close as possible to the most stable spot on your boat. Usually this spot will be close to the waterline level, in the middle of the boat and two-thirds towards the stern from the bow.

Do not install your Compass near wires or devices carrying large electric currents, such as battery chargers, electric pumps and motors or televisions.

Do not mount your Compass near any iron or steel objects.

### Power Connection

There is 7.5 feet (2.3 m) of power cable included with your Autopilot System. We recommend that you do not lengthen this cable.

However, if you must extend the cable:

- Use the shortest extension length possible; it must be less than 10 feet (3 m) in length.
- Use no less than #10 or 12 AWG conductors. Splice and solder the joints.
- Make the joints watertight by using heat-shrink tubing and silicon, or some other watertight covering.

### *Power Cable*

The Power Cable is labelled with a "5". Connect the Power Cable to a breaker capable of supplying at least 20 Amperes at 12 Volts DC.

The white wire is for Battery Positive from the breaker. The black wire is Battery Negative. The green wire must be wired to the ground point (see below).

Route Cable #5 to the Processor location. Keep the breaker turned off until you have connected the wires to the breaker.

### *Grounding*

The Power Cable also contains a grounding wire. Connecting this wire to a good ground (*see * below*) may reduce static on radios and improve GPS reception.

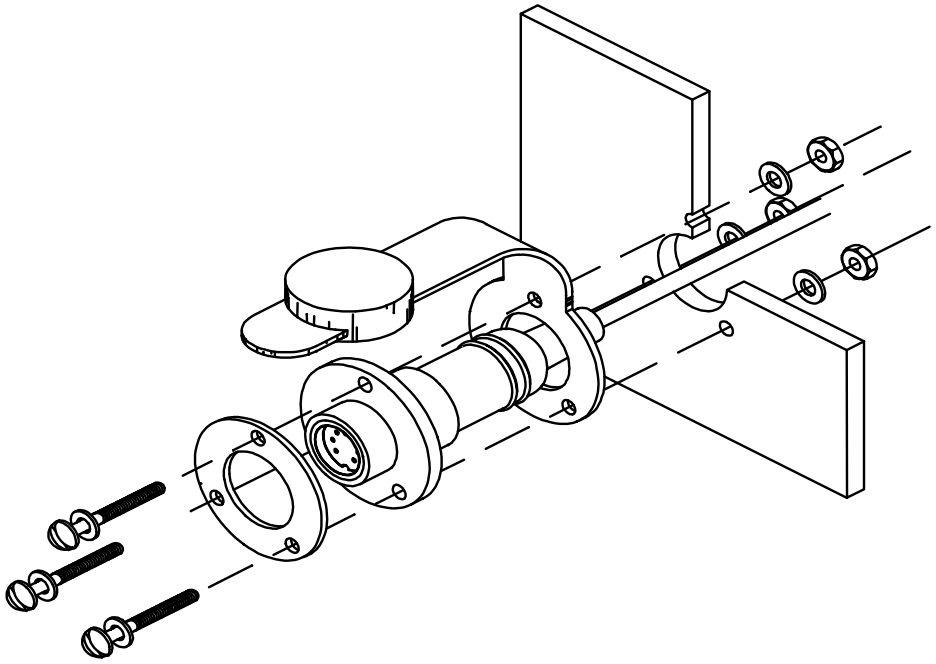
Many different grounding methods can be used:

1. If you have a small vessel, the negative battery post can be used.
    - If you have several electronic instruments, each must be attached to the battery individually. Do not connect one instrument to another and then to the battery post.
2. If you have a ground plane for a radio on your boat, connect the ground wire to that ground plane.

** A proper ground connection point must be at the* **same** *voltage level as battery negative. Any difference in voltage between battery negative & the ground point may indicate a problem in the wiring, and so the ground-point wiring must be re-done, or replaced. Ensure that all ground connection wires are as short as possible, and that all connectors are clean.*

## 1440 Receptacle & Control Head Installation

The receptacle is attached to the Control Head's end of Cable #1. The diagram to the right shows the receptacle mounted in a panel.



Cable 1 Receptacle Installation

Mount the receptacle near your normal steering position. The curly cord on the Control Head lets you move about 5 feet away from the Receptacle.

A stainless steel ring is placed between the bolt heads and the receptacle flange. Do not attempt to seal the receptacle by over-tightening the bolts, since the ring will deform the receptacle and interfere with plug insertion. A proper caulking compound or sealant should be used instead. The three bolts should only be tightened enough to compress the lock-washers, no more. The plug has a tight-fitting seal, and insertion into the receptacle may be stiff, so a lubricant has been included in the Accessory Kit.

- The receptacle body requires a 0.825" (21 mm) clearance hole.
- Flange holes are for a #6 (3 mm) fasteners. Put the receptacle in its hole, and use the holes in its lip to mark the holes for the flange.
- You must supply the flange fasteners; their length depends on the thickness of the mounting panel. Corrosion-resistant fasteners are recommended; if metal, they should be stainless steel, to be compatible with the flange.

### *Mounting Clip Installation*

The Clip is used for mounting the Control Head. The Clip is mounted with two #10 (5 mm) screws or bolts (supplied by you – use a corrosion-resistant type, and a style & length suitable to the mounting surface).

The usual mounting location is on the dashboard, within easy reach when you are steering your vessel.

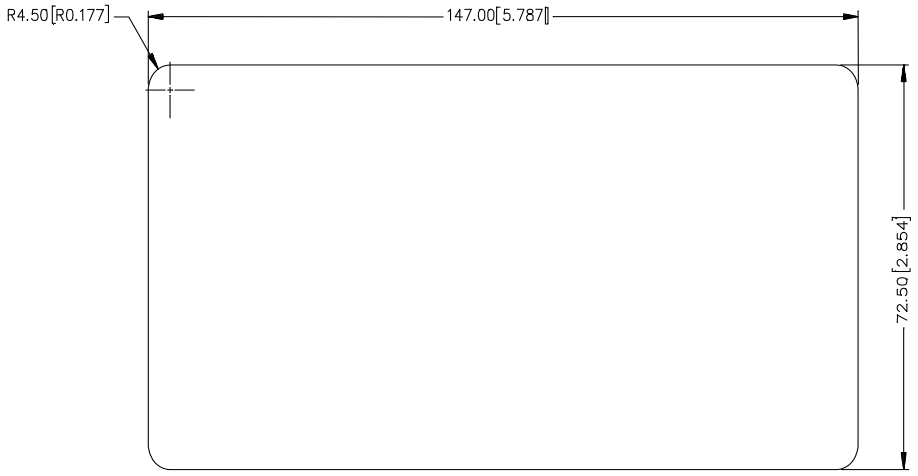
## 1460 Control Head installation

The 1460 Control Head can either be surface-mounted on a suitable flat-surface panel at the main steering station (for example, on the dashboard), or flush-mounted in an opening in the panel. The panel must be less than about ½" (15 mm) thick.

Thread the studs (M5 x 30 mm SS) supplied in the 1460 Accessory Kit into the nut inserts on the back of the Head; use some thread-lock to secure them.

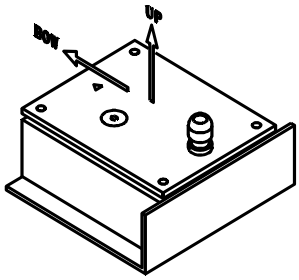
1. Surface mount:
   - Drill 3 holes in the panel, using the flush-mount bracket as a template for the location & size of the holes; the centre hole (9/16", 14 mm) is for the cable, the outer two holes (15/64", 6 mm) are for the fasteners.
   - Route Cable #1 from the Head through the large centre hole you drilled in the panel, and then on to the Processor.
   - Fasten the Head to the panel, from the rear, using the supplied nuts & washers.
2. Flush mount:
   - Carefully cut out an opening the panel, slightly bigger than the back part of the Head but smaller than the outer rim of the Head's face (see the drawing below for dimensions); the cut-out must have straight edges & radiused corners.
   - Route Cable #1 from the Head through the opening, the large hole in the centre of the flush-mount bracket, and then on to the Processor.
   - Fasten the Head to the panel, from the rear, using the bracket and the supplied nuts & washers; the bracket's ears must press against the back of the panel.
   - You should use a suitable sealant when flush mounting the Head. Apply a small bead of the sealant in the groove on the underside of the Head's front lip, or on the edge of the cut-out in the panel.

     ⇒ *Be careful to not cover the small square hole in the middle of the bottom edge of the Head. This hole* **must** *vent to atmosphere!*




**Cut-Out & Radius Dimensions for the 1460 Control Head** *(NOT TO SCALE)*

## Fluxgate Compass Installation




**Fluxgate Compass**

*The fluxgate compass must be correctly positioned or it will not work.*

To correctly position the Fluxgate Compass, mount it so that the top surface (with the cable gland) is up.

On the top surface there is an arrow labelled "bow". The arrow must point in the same direction as the bow of your boat.

In cases where the compass is mounted on a side wall, the bow line arrow will be pointing to Port or Starboard. If so, remove the four screws in the top of the case, rotate the bottom part of the case ± 90 degrees, as needed so that the arrow points to the bow; then re-fasten the top to the bottom with the 4 screws.

**Warning: This compass is designed to be watertight. Be careful with seals and "O" rings, if you remove the case's top to correct for a side-wall mounting.**

Initially, mount your Fluxgate Compass using strong adhesive tape or some other temporary, non-marking fastener. The reason for this is that It may be necessary to relocate your compass after you have done the Setup Routine.

Once the compass setup is completed, the compass's case can be securely fastened down with suitable fasteners.

## Rotary Rudder Feedback Installation

*If you have a 1440 or 1460 System with an Outboard Feedback, please go to page 21.*

Select the following parts from your 1440 or 1460 package:

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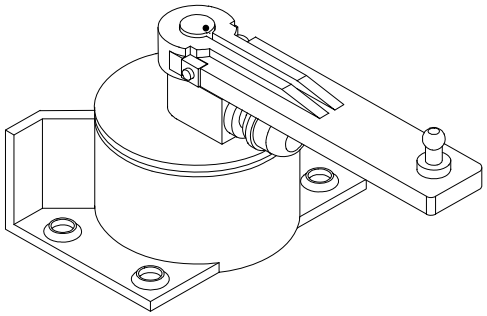
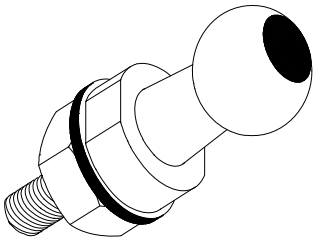
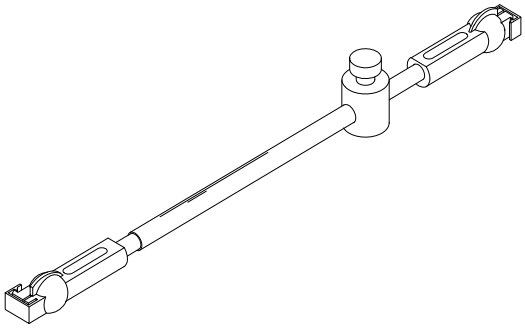


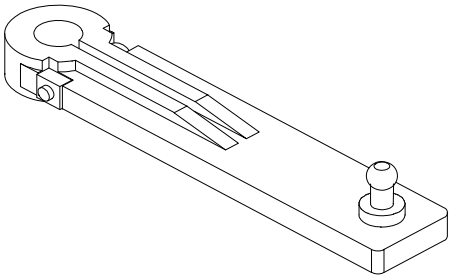
Rudder Feedback
PN 20030008



Brass Ball Joint
*(Included with linkage)*
PN 65520006



Linkage
PN 65520051



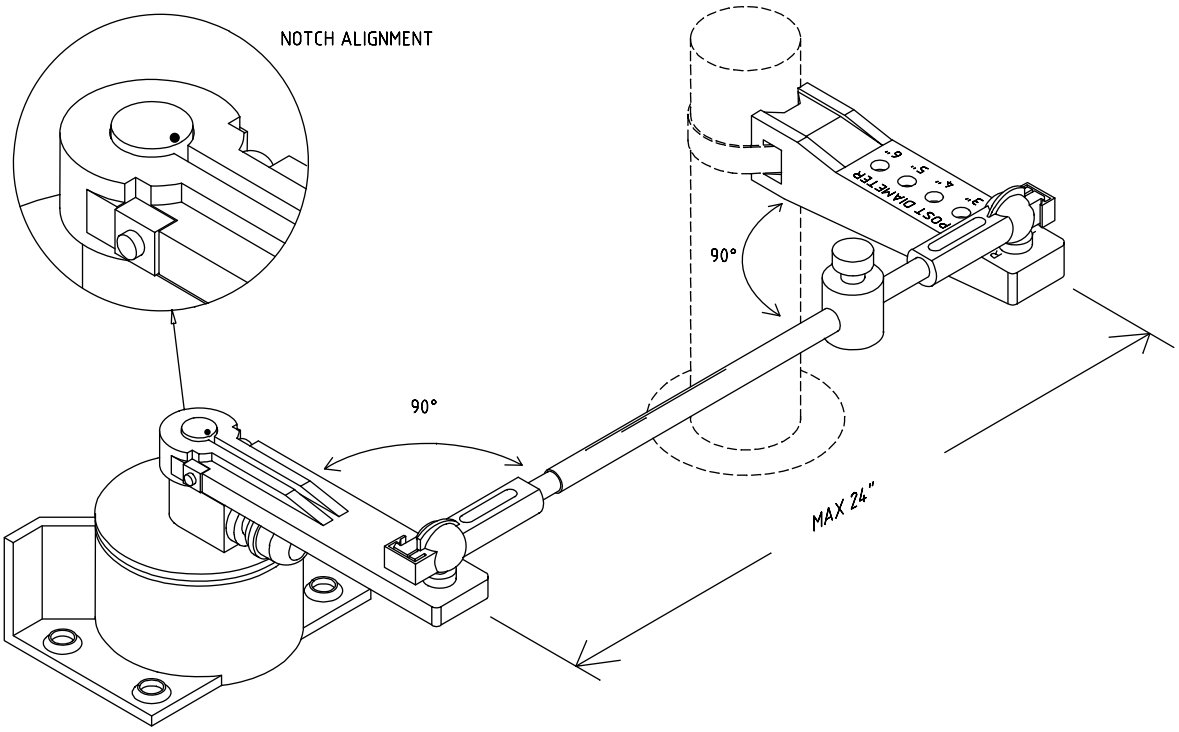
Rudder Post Arm
PN 65520004

---

You may also need:

- one stainless steel band clamp to hold the Rudder Arm to the rudder post
- four screws: #10 size (5 mm), suitable length, to fasten down the Rudder Feedback

Install the Rudder Feedback in the stern of the vessel, close to the rudder post. Place the Rudder Feedback so that it will be protected from objects which may shift position when your boat is moving.




**Mounting the Rudder Feedback**

In the diagram above notice that:

- the Rudder Feedback Arm is above the cable entry gland
- the Linkage sockets are on the top of the ball joints. *Do not mount the ball joints on the underside of the Arms , so that the Linkage would "hang" from the ball joints.*

Mount the Rudder Feedback so that the Rudder Feedback Arm and the Rudder Post Arm:

- are at the same height, and
- are separated by less than 24" (60.9 cm) centre to centre, and
- each makes an angle of 90 degrees with the Linkage.

To align the Rudder Feedback Arm & the Rudder Post Arm correctly, you may need to make a mounting base for the Rudder Feedback. Such a base must be firm. It should not flex when the vessel is moving.

Use the Rudder Feedback as a template to drill holes in the mounting surface. If you must drill new holes in the flange at the back of the Rudder Feedback, drill the Rudder Feedback flange first, and then use it as a template to drill holes in the surface.

Mount the Rudder Feedback using # 10 (5 mm) screws or bolts of suitable length.

**Assembling the Rudder Feedback Arm:**

Measure the approximate diameter of your rudder post in inches.

The Rudder Post Arm has several holes drilled through it. The holes are marked by numbers on the top surface of the arm.

Select the hole on the Rudder Post Arm marked by a number equal to the diameter of your rudder post measured in inches. (1 cm = 0.394")

Bolt the Brass Ball Joint onto the Rudder Post Arm using the selected hole. The ball of the Brass Ball Joint must be on the same side of the Rudder Post Arm as the numbers. Tighten the nut and lock washer securely.

Attach the Rudder Post Arm to the rudder post using a stainless steel band clamp. The Brass Ball Joint must be on top. The Rudder Post Arm must be at the same height as the Rudder Follower.

The Rudder Post Arm must point straight ahead when the rudder is in the straight ahead steering position.

**Attaching the Rudder Feedback Linkage:**

Move the rudder so it is in the straight ahead position.

Move the Rudder Feedback Arm so that it is directly above the point where the cable enters the Rudder Feedback.

Loosen the adjustment block that keeps the two pieces of the Rudder Feedback Linkage from sliding.

Snap the Rudder Feedback Linkage onto the two Brass Balls. Make sure to close the small release clamps on each Plastic Socket.

With the Rudder Feedback Arm directly above the cable gland and the Rudder Post Arm pointing straight ahead, tighten the adjusting block.

***Caution***

Carefully watch the Linkage while you move the rudder through its full range of motion. The Rudder Feedback and the Rudder Feedback Linkage should move easily without binding. The moving parts must not contact any other objects. ***If there are any problems, fix them now.***

Run the Rudder Feedback Cable from the Rudder Feedback to the space where the Processor will be located. Place the Cable so that it is protected from abrasion, stretching and cutting.

You will connect these wires to the Processor when you make all the other wiring connections.

Next, turn to the section on Installing the Rudder Drive (page 25).

## Outboard Feedback Installation

*If you have a Rotary Rudder Feedback, please go to page 18.*

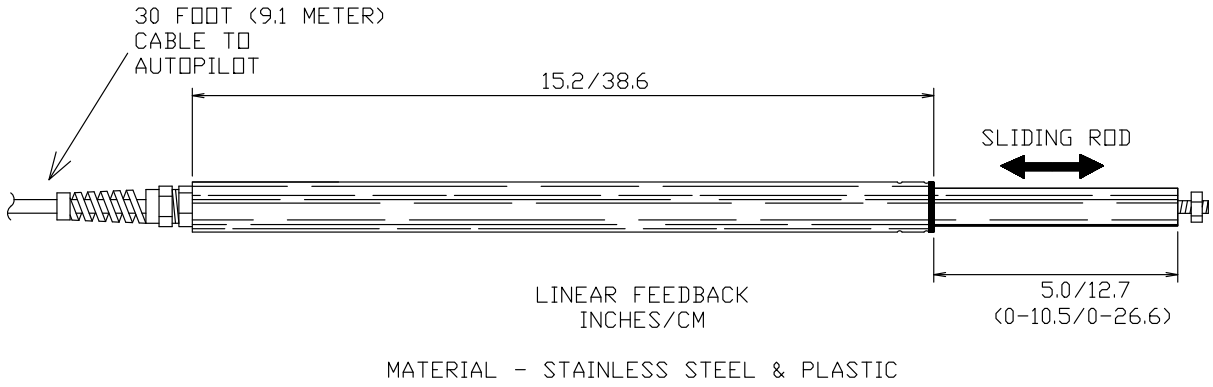
### Introduction

The Outboard Feedback sends information about the rudder or propeller position to the 1440/1460 Autopilot.

The Outboard Feedback can be attached to the hydraulic steering cylinder by using a stainless steel band clamp. A stainless steel bracket attaches one end of the Outboard Feedback to the steering cylinder rod.

The Outboard Feedback is provided with 30 feet (9.1 m) of cable.

The Outboard Feedback can be used with hydraulic cylinders from 1.25 to 2.25" (3.18 to 5.71 cm) in diameter. The cylinder stroke cannot exceed 10" (25.4 cm).

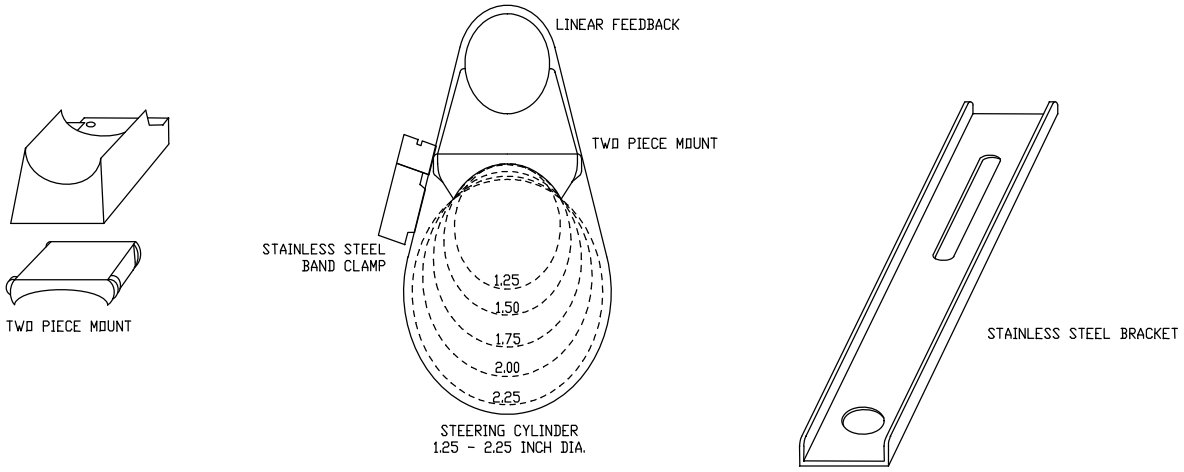



**Outboard Feedback**

***Caution***

*The Outboard Feedback will be damaged if it is extended more than 10 inches. This damage will not be covered by warranty.*

If necessary the extended length of the steering cylinder can be limited using corrosion resistant spacers as shown on page 24.




**Mounting Hardware**

*Mount the Outboard Feedback so that it will not be damaged when the motor is tilted for trailering.*

## Mounting

The Outboard Feedback may be mounted with the sliding rod facing either left or right.

Before you install the Feedback, move the steering gear through its full range of motion from one side to the other. Measure the change in length of the hydraulic steering cylinder rod. If the rod extends or retracts more than 10" (25.4 cm), make spacers to limit the motion of the steering system as shown on page 24.

Turn the motor so that it is centred between the left and right limits of travel.

Use a tape measure or ruler to position the Outboard Feedback rod so that it projects 5.25" (13.3 cm) from the body of the Outboard Feedback.

Loosely clamp the Outboard Feedback to the tube of the hydraulic cylinder using both pieces of the Two Piece Mount and the Stainless Steel Band Clamp. The Clamp should be positioned as close as possible to the tube end where the cable exits.

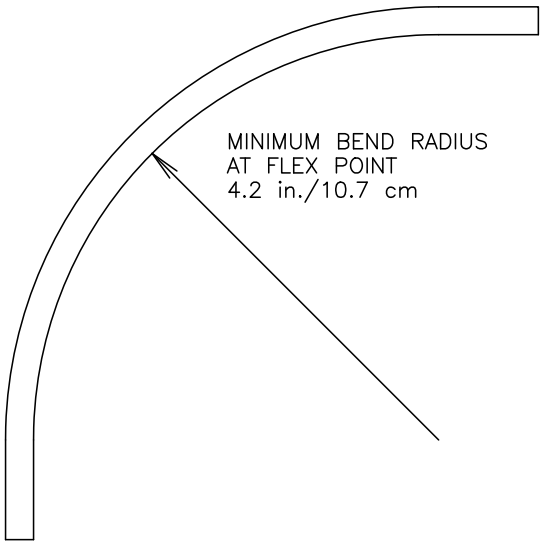
Remove the nut from the end of the rod of the hydraulic cylinder. Place the Stainless Steel Bracket over the threaded end of the rod and replace the nut. Do not completely tighten at this time.

Adjust the position of the Outboard Feedback so that the end of the sliding rod is flush with the Stainless Bracket. Screw the nut onto the threaded rod at the end of the Outboard Feedback.

Adjust the position of the Outboard Feedback so that as nearly as possible it is parallel with the hydraulic cylinder both horizontally and vertically. Tighten the nuts and the stainless steel band clamp securely.

Run the cable forward to the 1440/1460 Processor location. Choose a route for the cable so that the *minimum bend radius in the cable is at least 4.2" (10.7 cm)*. This is especially important in the motor well and other areas where vibration is present.

You will connect these wires to the Processor when you make all the other wiring connections.

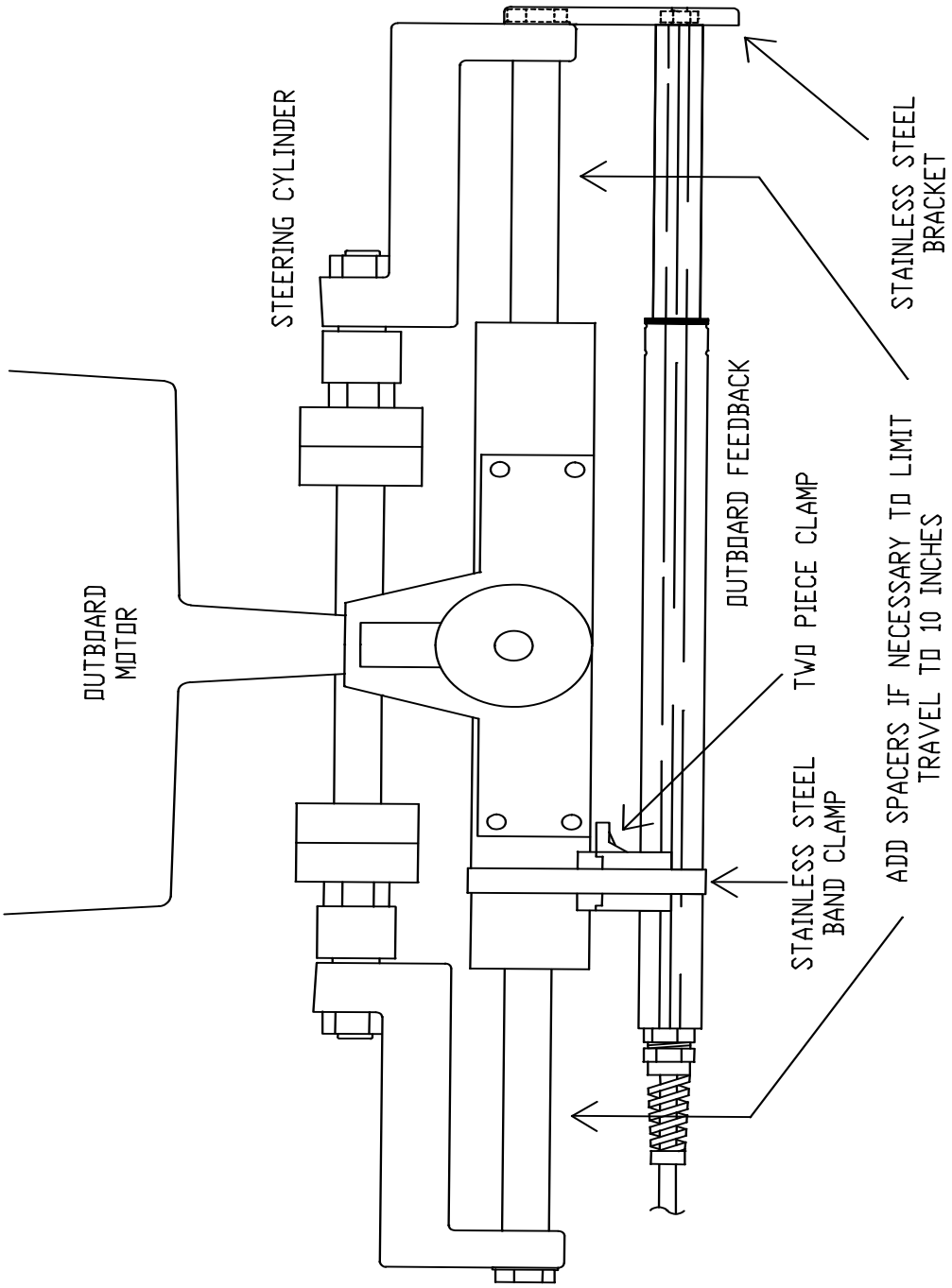



**Minimum Bend Radius**

## Maintenance

Keep the sliding rod clean. Wipe it occasionally so that dirt cannot enter the Linear Feedback. Use a clean, soft rag.

*After trailering your boat*, it is **very** important to clean the sliding rod!




**Outboard Feedback Mounting to Front-Mount Cylinder**

## Rudder Drive

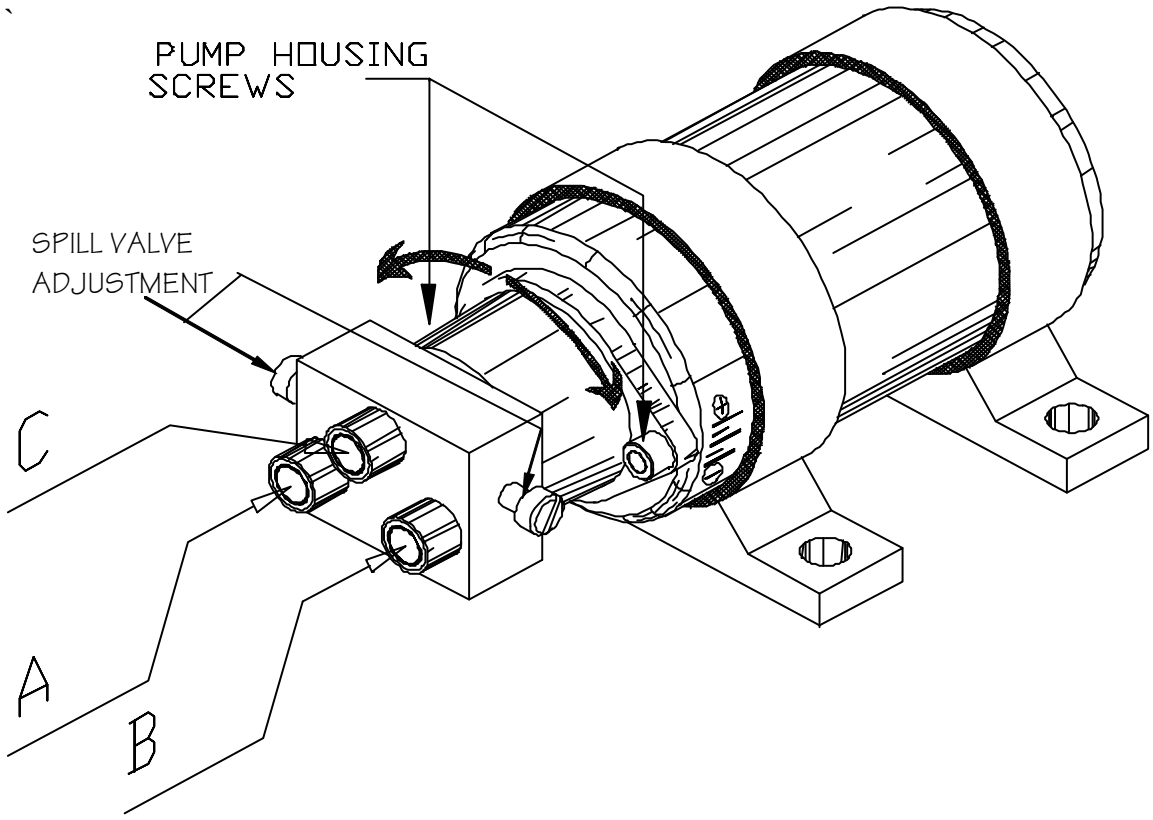
The next step is to install the Rudder Drive.

- If the system you purchased includes a Reversing-Motor Hydraulic Pump, follow the instructions in this section.
- If your system came with a Cable Drive, follow the Installation Instructions that came with that.
- If your system did not come with a Drive System, you will have to adapt the Autopilot's Drive outputs to your vessel's existing Steering System.

### ComNav Reversing-Motor Hydraulic Pump

(PNs 20810016, 20810018, 20810031, 20810035)

The reversing pump consists of a hydraulic pump and a motor. The pump is a piston type, driven by the reversing permanent magnet motor. The pump is designed in such a way that it will keep oil from returning through the pump when is not running or correcting. There is also a bleed-to tank to allow the use of unbalanced cylinders. The pump is compatible with all hydraulic steering systems, including pressurized steering systems such as Hynautic.




To adjust the pump's flow rate, loosen pump housing screws and turn pump housing. Clockwise will decrease flow rate, anti-clockwise increases flow rate.

### *Pump Models & Specifications*

There are two models of ComNav pumps, defined by the maximum size of cylinder they can be used with: 18 $in^3$ or 30 $in^3$. Each model also has a choice for the operating voltage of the pump's motor: 12 or 24 VDC.

1. Model 18CI pumps are suitable for cylinders from 7 $in^3$ to 18 $in^3$ (115 $cm^3$ to 295 $cm^3$) in displacement
2. Model 30CI pumps are suitable for cylinders from 15 $in^3$ to 30 $in^3$ (246 $cm^3$ to 492 $cm^3$) in displacement

| Model Number: | ——— 18CI ——— | | ——— 30CI ——— | |
|---|---|---|---|---|
| Part Number: | 20810016 | 20810031 | 20810018 | 20810035 |
| Operating Voltage: | 12VDC | 24VDC | 12VDC | 24VDC |
| Current @ 200 PSI: | 4.5 Amps | 3.0 Amps | 6.0 Amps | 3.0 Amps |
| Min Displacement: | — 26 $in^3$ (600 $cm^3$) — | | — 61 $in^3$ (1000 $cm^3$) — | |
| Max Displacement @ 200PSI: | — 73 $in^3$ (1200 $cm^3$) — | | — 122 $in^3$ (2000 $cm^3$) — | |
| Max Pressure: | ——— 800 PSI ——— | | ——— 500 PSI ——— | |

### *Specifications Common to All Pumps*

| | |
|---|---|
| Port Sizes: | 3/8" compression fittings supplied |
| Min Stall Pressure: | 1200 PSI (84.0 Bar) (8,268 kPa) |
| Oil Type: | Any approved hydraulic steering fluid |
| Operating Temperature: | 0° to 50° C (32° to 122° F) |
| Adjustable Flow: | Yes |
| Lock valve: | Yes |
| Lock valve Leakage: | Negligible |
| Unbalanced Cylinder: | Yes, up to ¾" (1.9 cm) diameter rod |
| Weight: | 5.0 lbs (2.27 kg) including wire |
| Size: | 10" x 3.75" x 4.75"<br>(25.4 cm x 9.5 cm x 12.1 cm) |
| Shaft Seal: | 100 PSI (6.89 Bar) (689 kPa) minimum |

## Types of Steering Systems

There are two general types of steering systems: Two Line systems, and Three Line systems. The pump connection to the steering system is different for each type. There are separate instructions below for each type (see pages 30 & 31).

If you are installing this pump on a Capilano or Syten steering system, you *probably* have a Three Line steering system. If the helm pump is a Capilano Model 250 or 275 (made by Teleflex), or there is a Uniflow valve mounted close to the steering cylinder, you *definitely* have a Three Line system.

You have a Two Line system if you do not have the above components in your system.

## Tools and Material Required to Install Pump

By following the step-by-step procedure here, and using only the basic tools and materials listed below, you will find the installation easy to do.

***Caution***

*This Pump is not waterproof and is therefore not warranted against water damage.*

*This Pump is also not warranted against damage caused by improper installation.*

1) Pipe Cutter
2) Funnel with Filter (a coffee filter will do)
3) Bucket large enough to hold oil drained from the steering system. A 2 gallon (9 litre) bucket is adequate for most pleasure boars.
4) Rags or Paper Towels
5) 3/8" Electric Drill

***Caution***

*Using ordinary electric tools near water is* **VERY** *dangerous! To minimize the dangers of electric shock and personal injury, we recommend using cordless rechargeable tools or hand tools.*

6) Pipe Fittings *(check with steering gear manufacturer for type & size)* [1]
7) Tubing *(check with steering gear manufacturer for type and size* [2]*)*
8) Hydraulic Oil *(check with steering gear manufacturer for type* [2]*)*
9) Teflon based thread sealer (such as Loctite® PST)
10) Suitable fasteners for mounting the pump and securing lines

[1] Consult with your steering system manufacturer to get detailed information about factory authorized materials. Failure to do so could void your warranty.

## Notes & Cautions

Before beginning to connect the pump to the steering system, review the following points:

- Cap or cover the ends of hoses with a clean rag before pushing them between bulkheads.
- Wipe copper filings off freshly cut and reamed copper tube. Do not blow the filings off.

***Caution***

*CLEANLINESS* **must** *be maintained while making hydraulic connections!*

*Contamination introduced into the steering system fluid can cause steering components to malfunction, possibly resulting in a loss of steering.*

- Teflon based thread sealer must be used on all male pipe threads.
  - ⇒ Do not place thread sealer on the first two threads.
  - ⇒ Do not use a tape-type thread sealer. These can shred and enter the steering system fluid.
  - ⇒ Do not place thread sealer on female pipe threads.
- When tightening fittings into the pump lock valve, hold the lock valve, not the motor. That way, the lock valve will not twist out of alignment with the rest of the pump.
- Connection of the pump lines is most easily made at existing breaks in the steering system lines. For example: at valves, Tee-joints and other fittings.

***Caution***

*Opening your hydraulic steering system will introduce air to your steering system!*

However, this air will be expelled if the steering system is bled properly.

After you refill the system and during the Autopilot Setup Routine, your autopilot can be used for bleeding any trapped air.

Ensure that you follow the Compensating Line installation instructions given below (pages 30 & 31) very carefully, as all air is expelled through this line when bleeding your system. If the Compensating Line does not prime properly and allows fluid to get to the autopilot pump, the pump will not perform properly. The Compensating Line does not have to be a high pressure hose. In fact, even a clear hose can be used allowing for easy visual confirmation of proper Compensating Line operation.

### Installing the Pump

Installation of the pump consists of:

- Finding a mounting location for the pump
- Partially draining the steering system
- Mounting and connecting the pump to the existing steering lines
- Filling and bleeding the steering system.

A suitable mounting location for the pump MUST:

- Be dry
- Be lower than at least one of the helm pumps in the steering system
- Provide a solid mounting base
- Be at least 4 feet (3.1 m) from the vessel's compass.

A mounting location for the pump SHOULD:

- Provide easy access to the pump
- Provide an easy connection point to the steering system
- Minimize the length of the pump hoses
- Minimize the length of the wires to the motor.

A typical mounting location would be in the engine compartment or the steering console.

The pump can be mounted in any orientation except with Port C facing downward. If Port C is facing downward then air will not be able to rise out of the pump and the pump will not have a supply of oil.

There are two ways to connect the pump to the steering system. The first is to leave the system completely filled and be careful not to spill hydraulic fluid. The second is to drain the system of fluid completely before cutting or opening any lines.

If you follow the first method, remember that when you disconnect or cut the steering lines, there will be a constant slow discharge of oil due to gravity draining the system. Have a container ready to catch all excess oil. Do not reuse any oil reclaimed from your system.

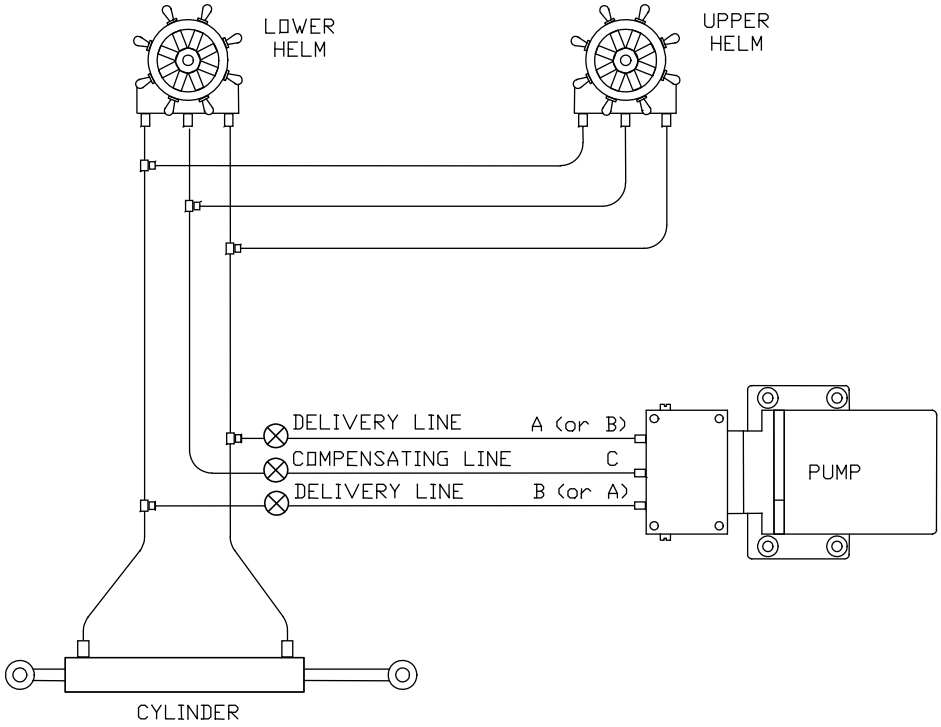
If you wish to follow the second method and drain the system, use the following simple procedure.

1. Have a large container, about 2 gallons, ready.
2. Disconnect the delivery lines at a low point, usually where the lines connect to the steering cylinder.
3. Turn the wheel of the highest helm pump in both directions until no more fluid comes out of the lines.
4. Repeat the previous step on each lower helm pump in turn.

## Hydraulic Connections

Next, make the appropriate hydraulic connections, according to whether you have a Two Line or Three Line Steering System.

### Hydraulic Connections for Two Line Steering Systems




**2 Line Steering System Connections**

***Delivery Lines:***

**Ports A and B** in the diagram above are the input/output ports of the pump and must be connected to the steering lines coming from the steering cylinder. It does not matter which pump port is connected to which steering line.

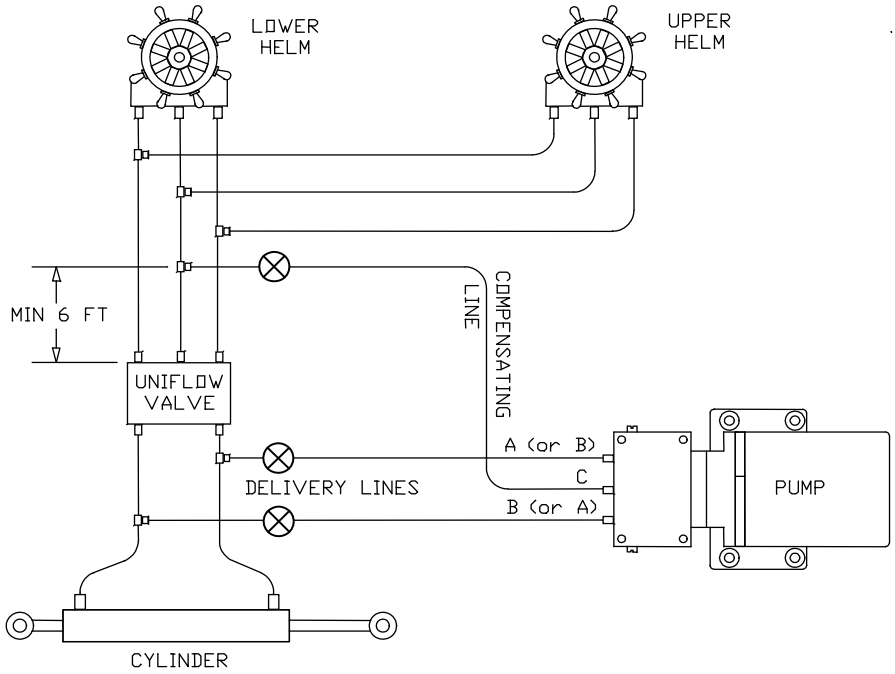
***Compensating Line:***

**Port C** is the compensating or bleed line, and must be connected to the steering system's reservoir. This connection can be made at: a helm pump, the remote reservoir (if there is one), the compensating line connecting two helm pumps, or the compensating line connecting a helm pump to the remote reservoir. If the connection is being made directly to a helm pump, ensure that the bleed line is connected to the **LOWER** helm's bleed port.

The compensating line *MUST* have a gradual rise from the pump to the connection to the steering system. This allows air to rise out of the pump, ensuring a constant supply of oil to the pump.

**INSTALLATION OF SHUT-OFF VALVES IS RECOMMENDED** (shown with ⊗ )

## Hydraulic Connections for Three Line Steering Systems




**3 Line Steering System Connections**

### *Delivery Lines:*

In the above diagram, **Ports A and B** are the input/output ports of the pump, and must be connected to the steering lines between the steering cylinder and the Uniflow valve. The simplest method of doing this is to install a tee in each of the cylinder ports of the Uniflow valve itself, and connect to these tees. It does not matter which pump port is connected to which steering line.

### *Compensating Line:*

**Port C** is the compensating or bleed line, and must be connected to the steering system's reservoir. This connection can be made at a helm pump, the remote reservoir (if there is one), the return line connecting two helm pumps, or the return line between a pump and the Uniflow valve. If the connection is being made directly to a helm pump, ensure that the bleed line is connected to the **LOWER** helm's bleed port.

The connection *MUST* be at least 6 feet (1.83 m) from the Uniflow valve as shown above. If the connection is too close to the Uniflow valve, the manual steering system may not work well.

The compensating line *MUST* have a gradual rise from the pump to the connection to the steering system. This allows air to rise out of the pump, ensuring a constant supply of oil to the pump.

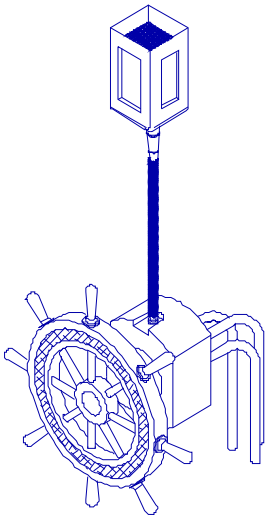
**INSTALLATION OF SHUT-OFF VALVES IS RECOMMENDED** (shown with ⊗ )

## Fill And Bleed

After you have installed your Pump, fill it with hydraulic fluid, and then bleed it. The first part if this procedure can be done right away – but for the rest, the Autopilot must be installed and powered up, so you will be referred back here during Autopilot Setup.

1. Bleed your manual steering system according to the manufacturer's instructions. When you have completed the bleeding, leave the equipment for the bleeding procedure attached to your hydraulic steering system.
2. Fill your highest reservoir completely. Turn the steering wheel just past the stop to press as much oil as is possible into the system.
3. If you can, use a bottle of recommended hydraulic oil and a piece of plastic tubing to add extra capacity to your highest reservoir.
   - *The manufacturer of your system may provide these items when you purchase a bleeding kit for your system.*

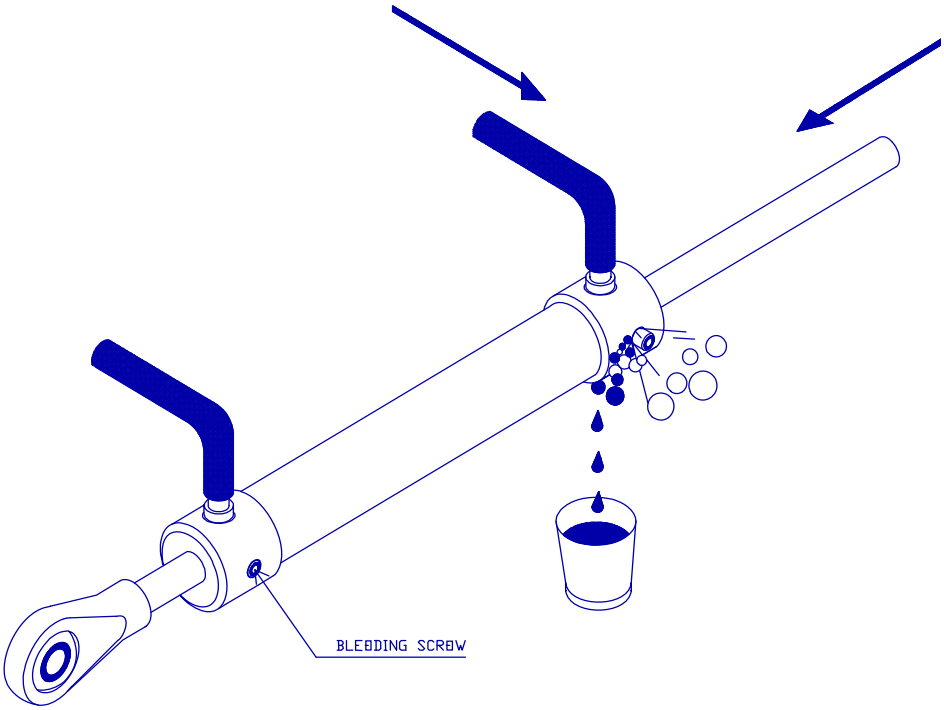
   If you have a helper, have them watch the oil level in the highest reservoir and refill it when necessary.



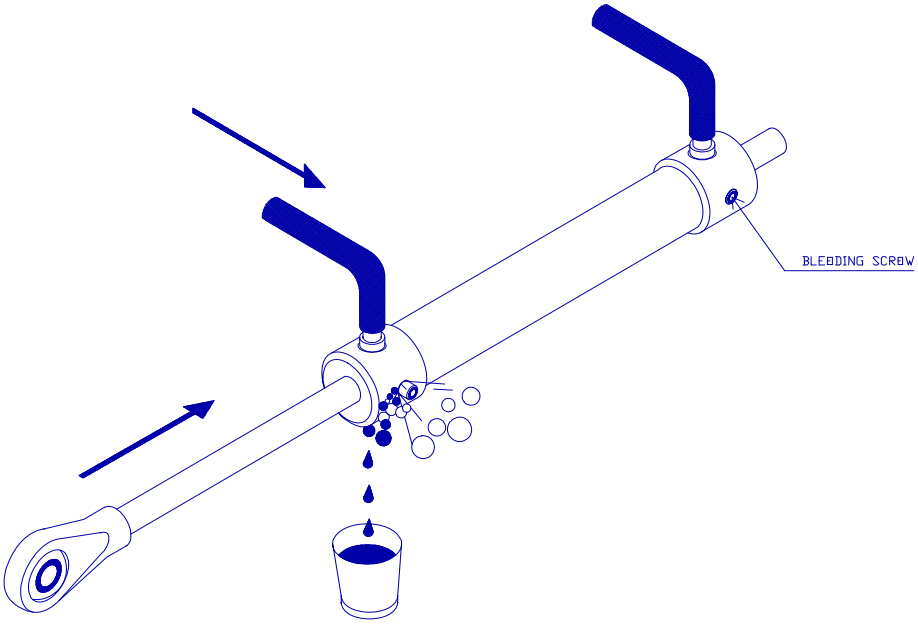
**Adding Capacity**

4. If you started this bleeding procedure right after Step 6 in the Autopilot Setup Procedure (see page 47), the hydraulic cylinder rod will be fully extended in one direction. To bleed the Reversing Pump, you will be extending the cylinder rod in the other direction. Open one and close the other bleeding screw just as you did when bleeding the manual part of your system and you were extending the cylinder arm in this direction. Generally, you close the bleeding screw or nipple closest to the rod which is now retracted. Open the bleeding screw closest to the now extended rod. See the diagrams on the next page.
5. Position yourself so that you can see your hydraulic steering cylinder while operating the Control Head.
6. You will be able to move the steering cylinder rod by pressing the Red Key or the Green Key on the Control Head. When you press the key, the lights will stop blinking and the red or green light will turn on. Extend the rod as far as it will travel in the other direction.
7. If you are using a Reversing Pump, let the Autopilot drive the Reversing Pump until it nearly stops after the rod reaches the end of its travel. This will press as much oil as possible into the system. It will not damage the pump.

   *The 1440 or 1460 will drive the pump past the electronic rudder limit only when the display shows* bLEd.




**Bleeding cylinder, rod moving left**




**Bleeding cylinder, rod moving right.**

8. Refill your steering system from the highest reservoir.

9. Adjust the bleeding screws so that the cylinder will be bled when the rod is extended in the original direction. Generally, you close the bleeding screw or nipple closest to the now retracted rod. Open the bleeding screw closest to the rod that is now extended.

10. Use the Control Head to fully extend the cylinder rod to the other side.

11. Refill the highest reservoir.

12. Repeat Steps 6 to 11 at least 10 times.

13. Close all bleeding screws or nipples. Clean up any oil spills and wipe fittings clean. Remove any buckets or equipment a short distance from the cylinders and fittings.

14. Use the Control Head to extend the rod fully in one direction and then the other.

15. Check for leaks by looking for spilled hydraulic fluid on or near fittings and cylinders.

16. Check that a hard-over to hard-over time of 10 - 15 seconds can be attained with your drive system.

17. Return to Step 7 of the Autopilot Setup Routine.

---

# **** IMPORTANT ****

If you have installed a reversing motor pump, a constant running pump or an engine driven-pump, there are several checks that must be done during the first several weeks of usage, in order to prevent poor – *or even possibly-dangerous* – steering performance.

As a general rule, you should ***always*** regularly monitor the oil level of the reservoir, or in the highest helm pump, in your steering system, and add oil as required. But this is ***especially*** important following the initial installation and bleeding of your system.

***Residual air in your steering system***

Some residual air may remain suspended in the hydraulic fluid. During the first few weeks, this air will gradually bleed out through the header tank, or the highest helm pump, and as a result the oil level may go down. *Check several times and add more oil as required.*

***Leaking fittings or equipment***

If the oil level continues to go down, even after a few weeks (when all the residual air should have it been expelled), it may be an indication of leakage in your steering system. *Carefully check all hydraulic steering fittings and equipment for leakage.*

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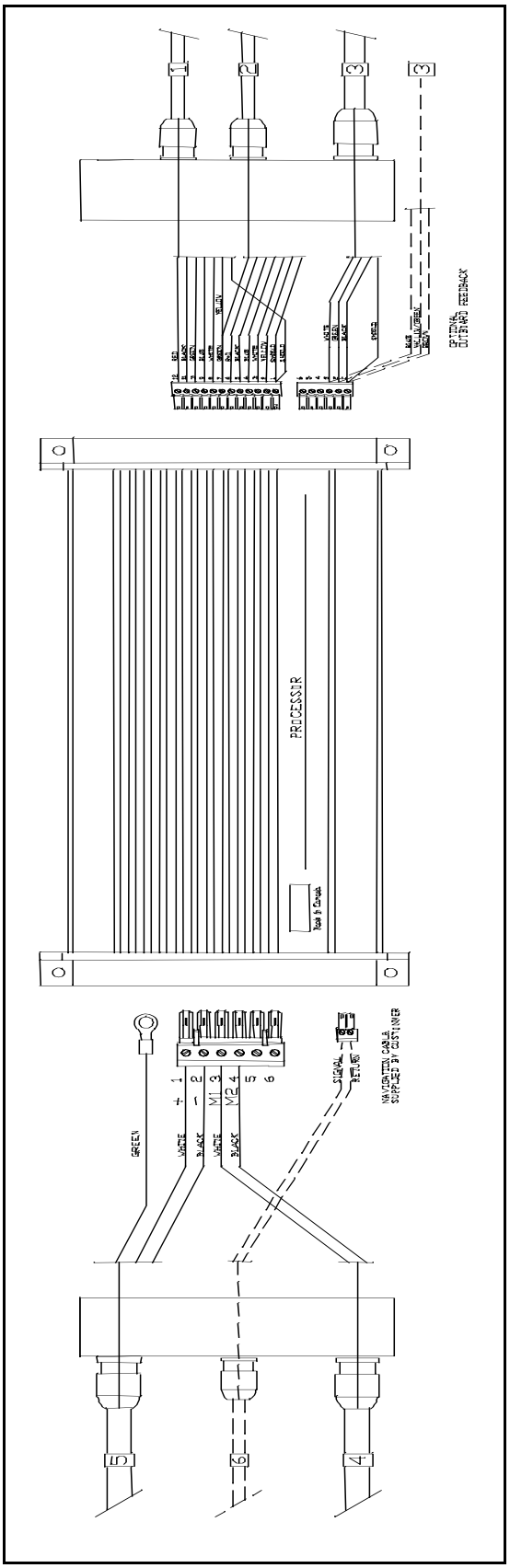
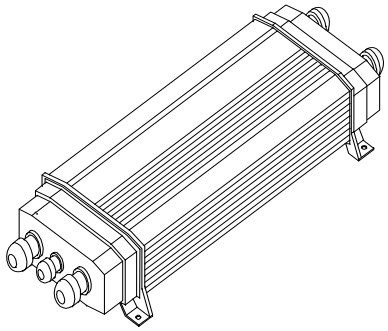


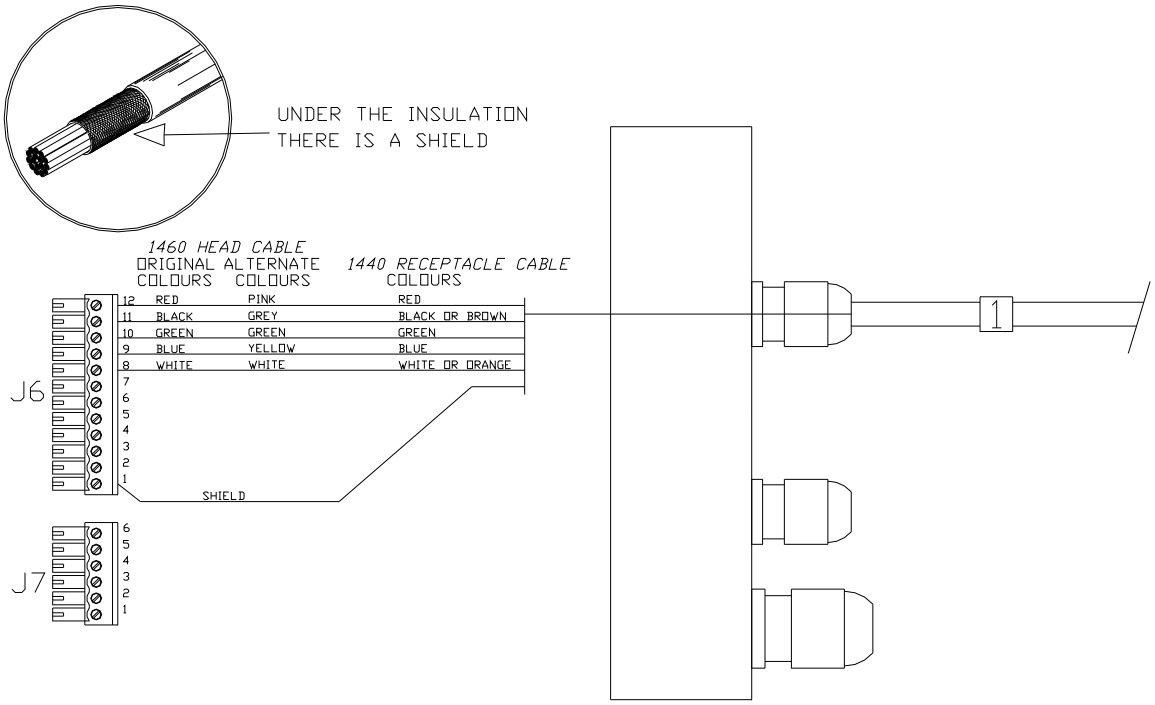

## Wiring The Processor



Place the Processor in front of you with the lettering right side up. Remove the four Phillips screws from each end. Remove the end pieces of the Processor enclosure.

Looking into the open ends of the Processor you will see several green terminal strips. These terminal strips are mounted into sockets. You can remove the terminal strips from the processor by gently pulling them away from the end of the Processor.

The terminal strips are labelled with numbers corresponding to the wiring diagrams on the following pages.




**Right Side, Cable 1 (Control Head) to J6**

*Note: There is an extra wire that is <u>not</u> used, in the Receptacle/Head cables; the wire is yellow on the original cable, brown on the alternate cable.*

## Right Side Connections

Pull all of the terminal strips from the right hand end of the Processor.

Note that there is an empty socket that does not have a terminal strip. When you replace the terminal strips, do not accidentally place one into the empty socket!

Pass the cables numbered "1", "2" and "3" through the watertight glands on the right end cap, and then connect each cable's wires to the terminal strips, as shown in the diagram above & those on the following pages:

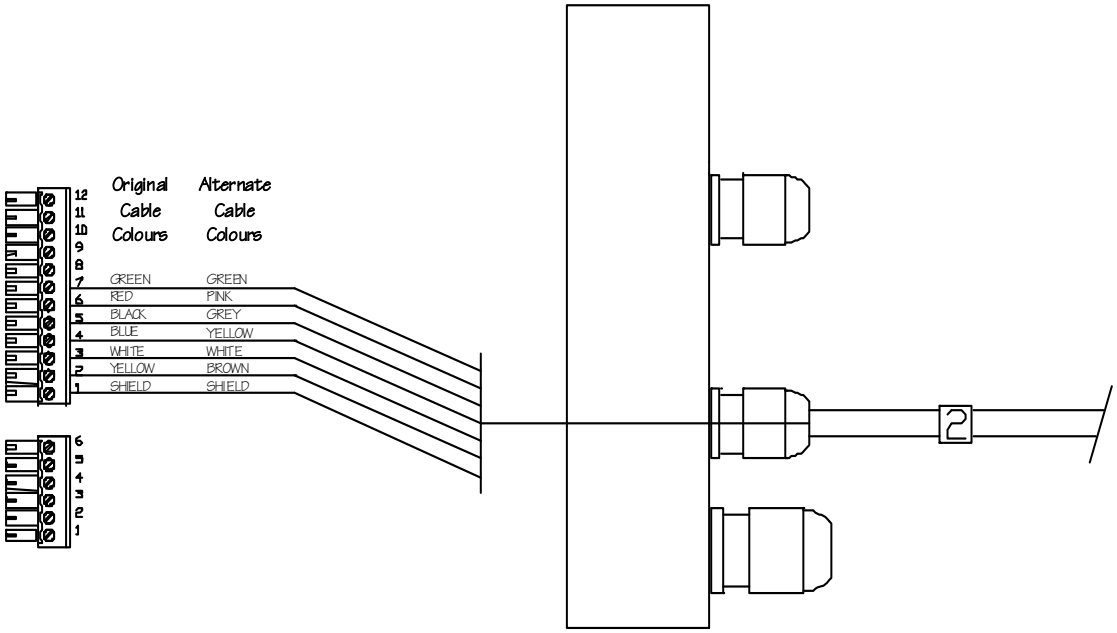
- Right Side, Cable 1 (Control Head) to J6
- Right Side, Cable 2 (Compass) to J6
- Right Side, Cable 3 (Rudder Feedback) to J7

***Caution**: there are some differences in the colour codes of the cable types that can be used for Cable 1 (the 1440 Receptacle, & the 1460 Head), and Cable 2 (the Fluxgate Compass). Pay attention to the colours shown in the wiring diagrams, and in the wiring table on the next page!*

Insert the bared end of the wire into the terminal strip and fasten it there by tightening the screw on the terminal strip. Start from one end of the terminal strip and work to the other in sequence.

Check your work!

Leave the strips unplugged when you are done; they will be plugged back in when you mount the Processor (see page 41)




**Right Side, Cable 2 (Compass) to J6**

***Be Careful***

*The entire stripped end – but no portion of the insulation – of all wires into the terminal strip plugs must be completely inside the plugs. The stripped ends of wire must not be able to touch each other.*

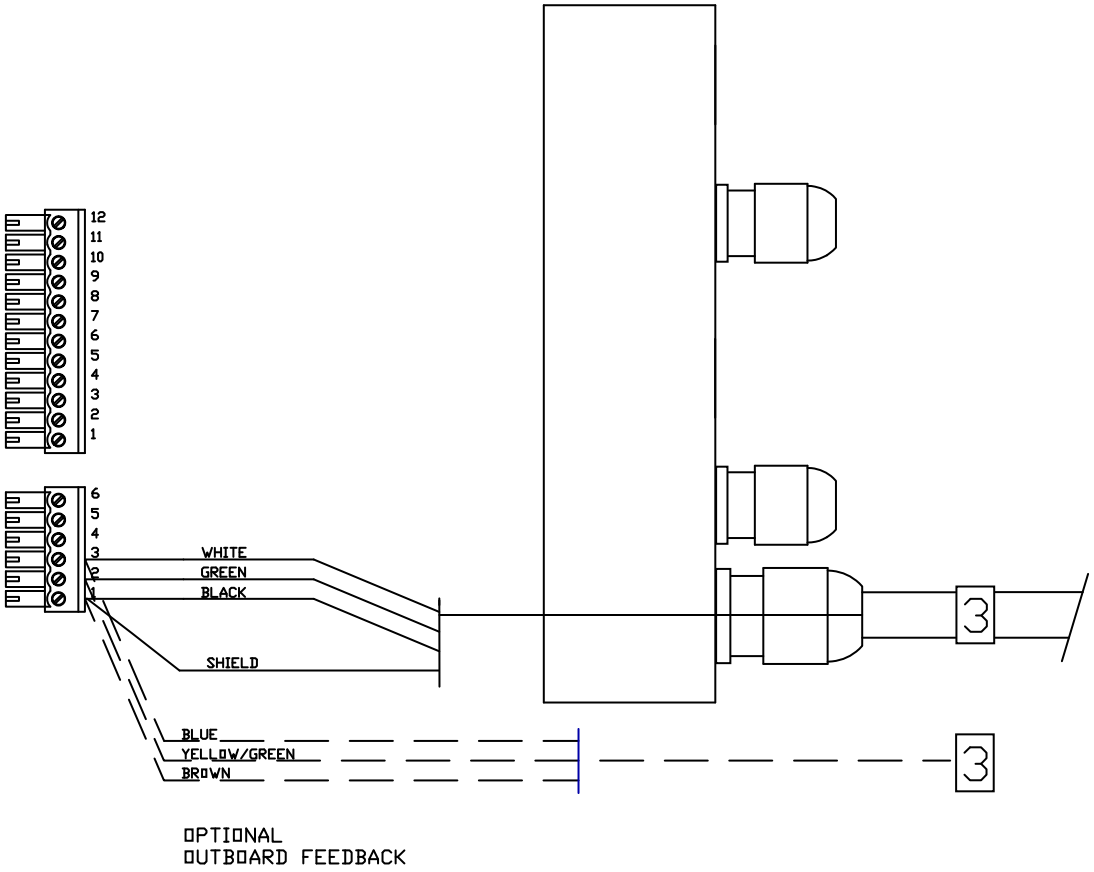
*Every wire must be connected to the correct terminal on its plug!*

**Connections For Fluxgate Compasses**

| J6 PIN | Cable 2 | | Signal Function | |
|---|---|---|---|---|
| | Original Wire Colours | Alternate Wire Colours | ComNav Fluxgate Compass | Other Compass |
| 1 | SHIELD | SHIELD | GROUND | GND |
| 2 | YELLOW | BROWN | COSINE | COSINE * |
| 3 | WHITE | WHITE | REF | REF |
| 4 | BLUE | YELLOW | SINE | SINE * |
| 5 | BLACK | GREY | DRIVE P2 | N/C ** |
| 6 | RED | PINK | DRIVE P1 | N/C ** |
| 7 | GREEN | GREEN | +12V | +12V |

* *If the compass reading is reversed, swap these two wires*

** *These wires must not be connected to non-ComNav compasses*




**Right Side, Cable 3 (Rudder Feedback) to J7**

## Left Side Connections

Next, do the left side wiring. Remove the terminal strips from the left side end piece.

Apply a “4” wire label to the cable from the Pump, and pass it and Cable "5" through the glands in the left side end cap; wire each cable’s wires to the terminal strips, as shown in the diagrams on the following page:

- Left Side, Cable 4 (Pump Motor)
- Left Side, Cable 5 (Power)

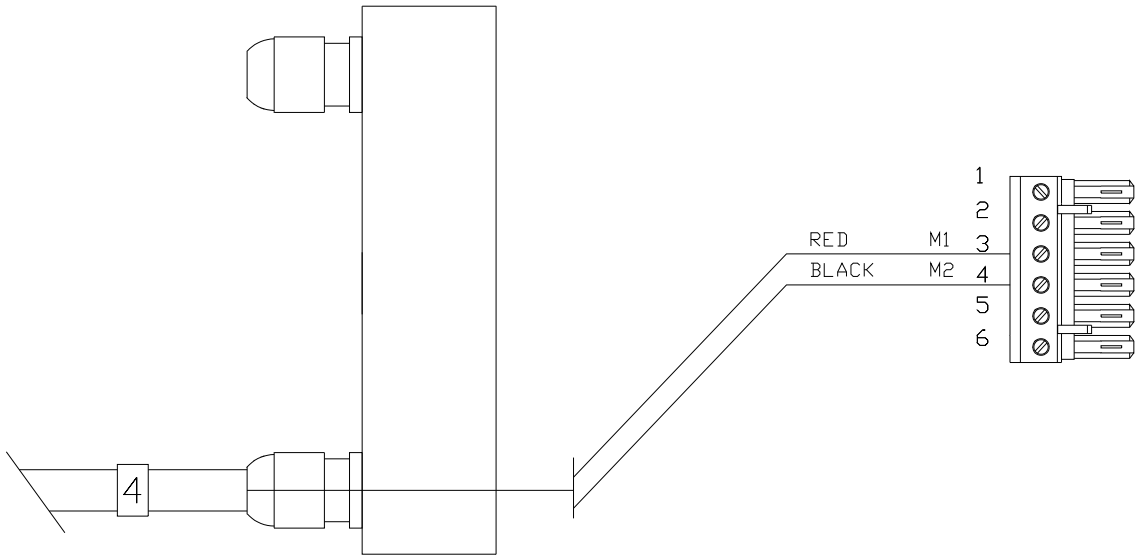
Make sure all stripped wire ends are completely inside the terminal strips.

### *Connecting the Ground Wire*

In the Cable 5 diagram below, the Ground is the green wire. It is connected to the bolt beside the terminal sockets for the power connection.

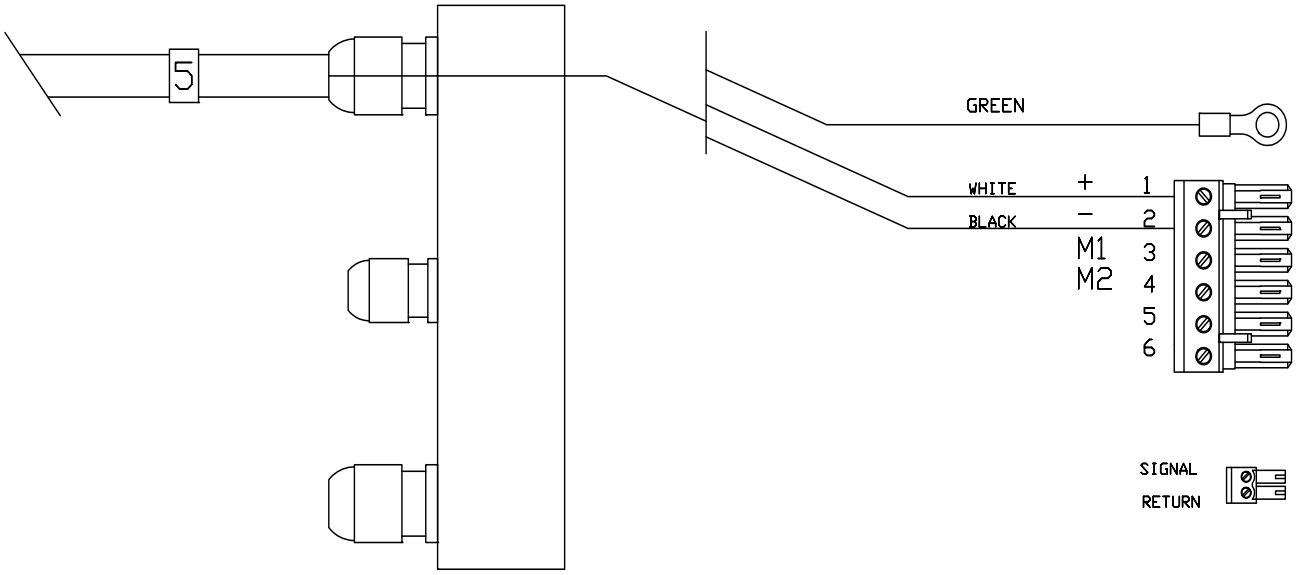
The green wire is connected by removing one of the nuts and the lock washer from the bolt. Place the ring terminal on the end of the green wire over the bolt. Replace the lock washer. Replace the nut and tighten it securely.

The other end of this wire should be connected to the grounding point you have chosen aboard your boat. *See page 14 for more information on suitable grounding points.*

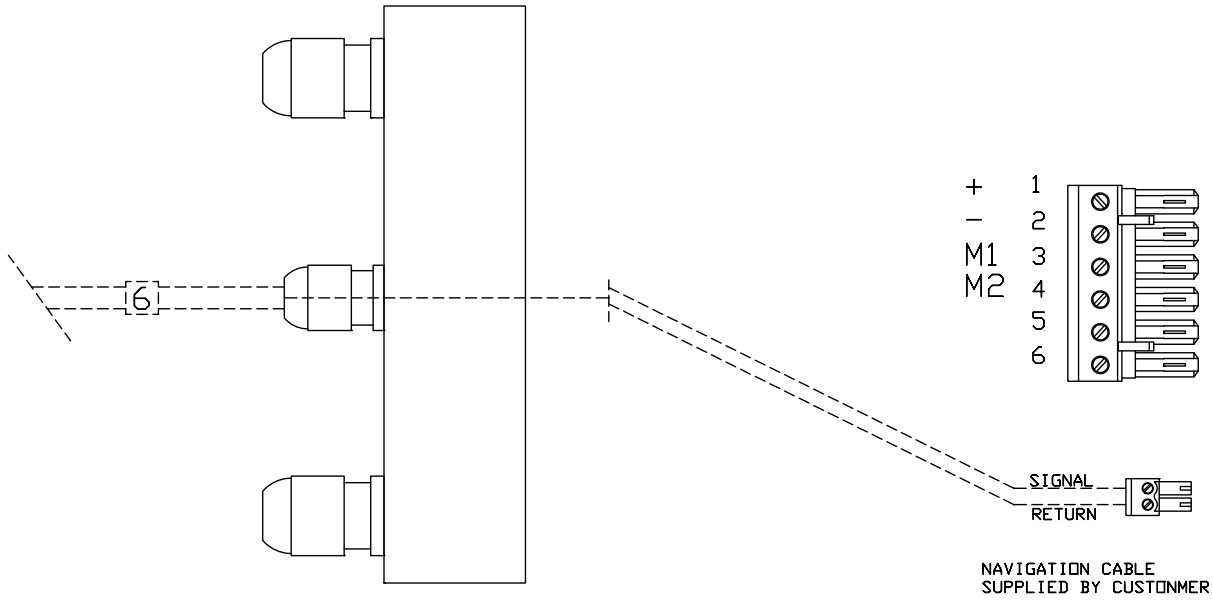



**Left Side, Cable 4 (Pump Motor)**

*Please see the Appendices for wiring to other types of motors, or solenoids.*




**Left Side, Cable 5 (Power)**




**Left Side, Optional Navigation Input Connection**

### *Connecting the Navigation Cable*

The optional navigation data input cable may be connected at this time. Parts for this are in the Accessory Kit. We do not supply the cable for this connection.

First, the gland for this input must be mounted on the end cap. To locate the hole for the gland, look on the inside of the end cap. You will see several places where the plastic has been formed so that a hole may be easily drilled. Drill the hole using a 15/32" (12 mm) drill.

Place the gland from the Accessory Kit in the hole. Fasten it with the supplied plastic nut and tighten securely.

Use the diagram above to wire the navigation input. The terminal strip for this is in the Accessory Kit.

See your GPS receiver, plotter and/or other navigation device manuals for information about wiring connections to & from them.

Note that the cable's shield should be connected only to the Nav device.

## Mounting the Processor

Once you have completed and checked the wiring, you are ready to mount the Processor.

There are two ways this can be done, depending on the amount of space you have. The first method will usually be easier.

1) The first method:
   - Plug the terminal strips into their correct positions on the processor.
   - Attach the end pieces. Do not cut or crimp any wires while tightening the screws. Tighten the nuts on the watertight glands. Tighten these nuts firmly with your hand. If you must use a tool, be very careful. It is very easy to damage the glands by using too much force.
   - Mount the Processor in its location.

2) The second method:
   - Mount the processor in its location.
   - Plug the terminal strips and wires into the correct locations.
   - Attach the end pieces. Do not damage any wires while tightening the screws. Tighten the nuts on the watertight glands firmly with your hands. If you must use a tool, be very careful. It is very easy to damage the glands by using too much force.

During the first year of use, check that the glands are hand-tight, after 6 and after 12 months of operation.

Check yearly thereafter.

## Powering Up the System

Turn on the breaker for the Autopilot or connect the Power cable to the breaker.

**The black wire connects to the negative terminal. The white wire connects to the positive terminal. The green wire is ground.** *See page 14 if you have not already decided on a ground point.*

Congratulations!

The Installation of your Autopilot System is complete. You are now ready to begin the Setup Routine.

## Fuse Replacement

The 1440/1460 Processor is protected against reversed power connection by a fuse. The fuse will blow if the power wiring is reversed; but the fuse will usually not fail otherwise.

So, if you ever do need to replace this fuse, re-check your power supply wiring for correct polarity.

**To replace the fuse:**

1. Turn off the power to the 1440/1460.
2. Loosen the right side watertight glands on the Processor, and remove the end cap. Disconnect the plugs.
3. Remove the 4 Phillips screws holding the inner end cap. Remove the inner end cap.
4. Bend up the copper ground tabs so that they are parallel to the body of the Processor.
5. Loosen the left hand side watertight glands, and remove the outer end cap. Disconnect the plugs.
6. Remove the four Phillips screws holding the inner end cap.
7. Hold the left hand inner end cap. Slide the Processor case to the right. This will expose the circuit board.
8. The fuse is located on the top left hand corner of the board. If it is damaged, replace it with a 20 Ampere AGC fuse.
9. Reassemble the Processor by working through the above Steps in reverse order. **Recheck your power supply polarity before you insert the power connector.**

## Check the Fuse

Do this *before* leaving the dock:

– turn on the Autopilot. Press the Red and Green Keys to move the rudder (or outboard motor).

⇒ *If the new fuse fails at this time, you still have an electrical problem on your boat, or the Autopilot needs repair.*

# Setting Up the Autopilot System

## Setup Routine

The 1440/1460 Autopilot System must be OFF before you begin the Setup Routine.

The first part of this Routine can be done at the dock. If you have a Fluxgate Compass, you will later repeat the first part out on open water.

The 1440/1460 Autopilot will guide you through the Steps of the Setup Routine. You cannot leave the routine without completing it. Turning off the Autopilot will not cause it to exit from the Routine.

Error Messages will appear if the 1440/1460 finds a fault.

***Correct the fault before proceeding to the next Step!***

An explanation of common Error Messages that may appear during the various steps is placed inside a box (like the one below) at the bottom of the page. A full list of all messages that can appear on the display is at the end of this manual.

Both the 1440 & 1460 have the same Steps in their Setup Routines, and show the same information on the Control Head display & key lights, at each Step. The images accompanying the descriptions bellow show both Heads when necessary.

The error message for Steps 1 to 4 is  (redo). Press the Pilot Key to cancel the alarm. Then repeat the Step.

If you cannot perform these Steps without the alarm sounding, check your Rudder Follower Installation and your steering system. Ensure that:

- The steering system can move through its full range of motion.
- The steering system has been bled properly.
- The Rudder Follower Linkage is assembled according to instructions.
- The wire connections going from the Rudder Feedback to the Processor are connected to the correct Processor terminal and terminal numbers.
- The wire connections are mechanically strong and are not becoming intermittent due to loose connections.

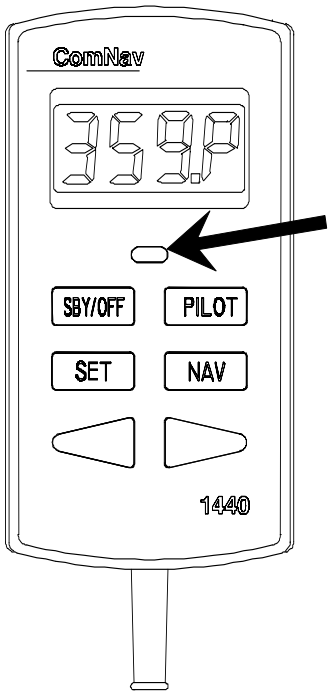
If you have an Outboard Feedback, ensure that:

- The Outboard Feedback travels an equal distance in each direction.

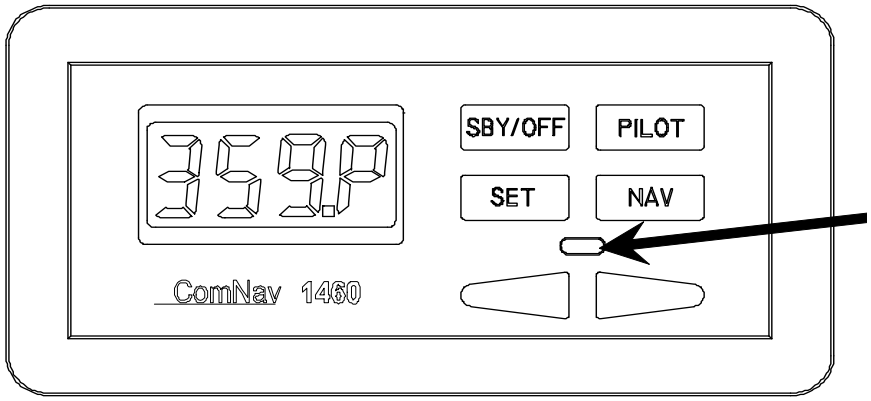
### *Locating the "Flush Key"*

There is a special button used during the Setup Routine – the **Flush Key** (it is called that because it is flush with Control Head's surface, to prevent accidental activation).

The **Flush Key,** on a **1440** Control Head, is located immediately below the LCD display:

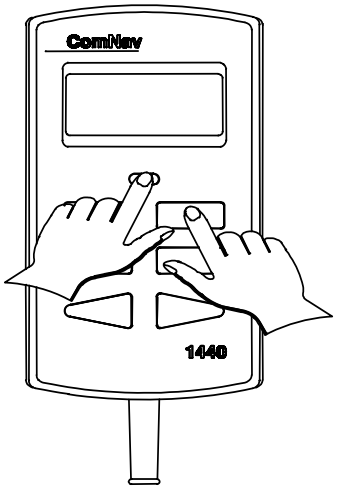


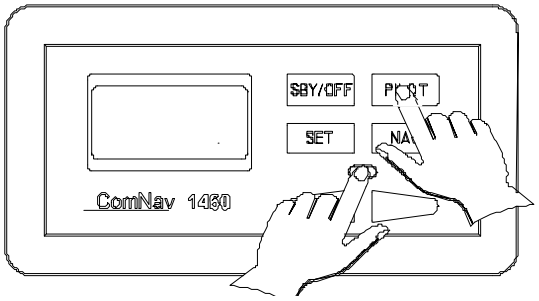

The **Flush Key,** on a **1460** Control Head, is located immediately below the **SET** and **NAV** keys:



### *Setting Up – Step by Step*

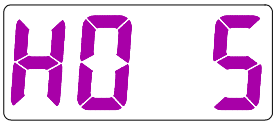
1. Press and hold the Flush Key (see previous page & below). Press and hold the Pilot Key until the display shows FrSt and then HO S (Hard Over to Starboard), then release both keys.



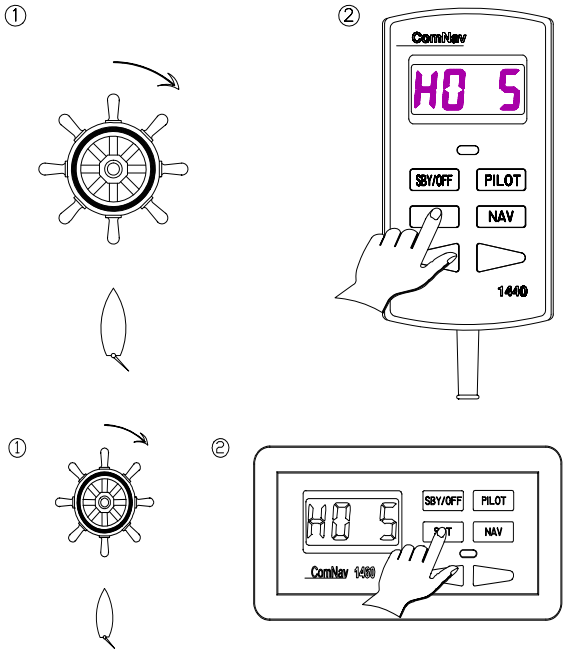




The 1440/1460 will turn ON, and the display will briefly show a few power-up messages (e.g., some firmware version numbers).

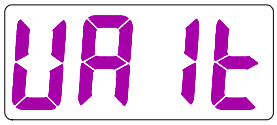
It will then show HO S (Hard Over to Starboard).



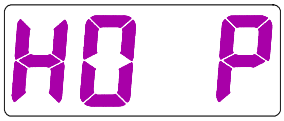

2. Turn the steering wheel fully to Starboard. Press the Set Key.



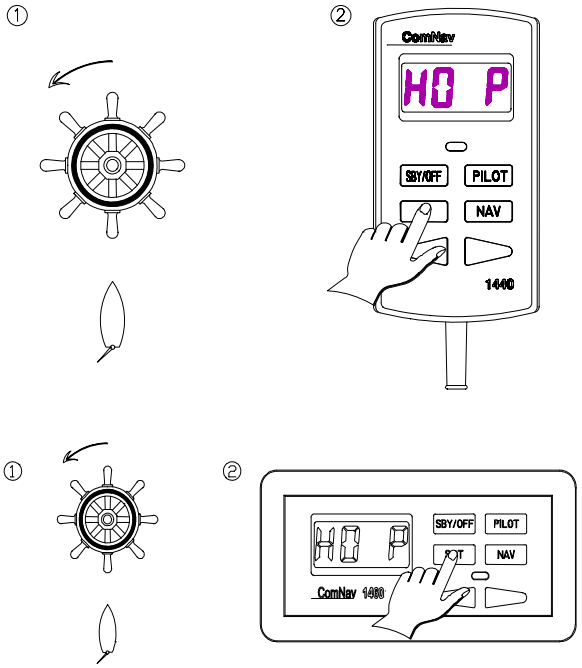

The display will show WAIt (Wait) for a few seconds.



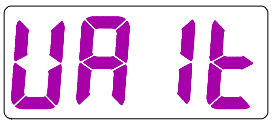

The display will next show HO P (Hard Over to Port).



3. Turn the steering wheel fully to Port. Press the Set Key.

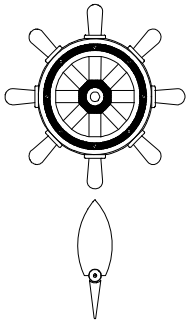



The display will show WAIt (Wait) for a few seconds.




The display will then show Cntr (centre).


4. Move the steering wheel to the mid-ships position.



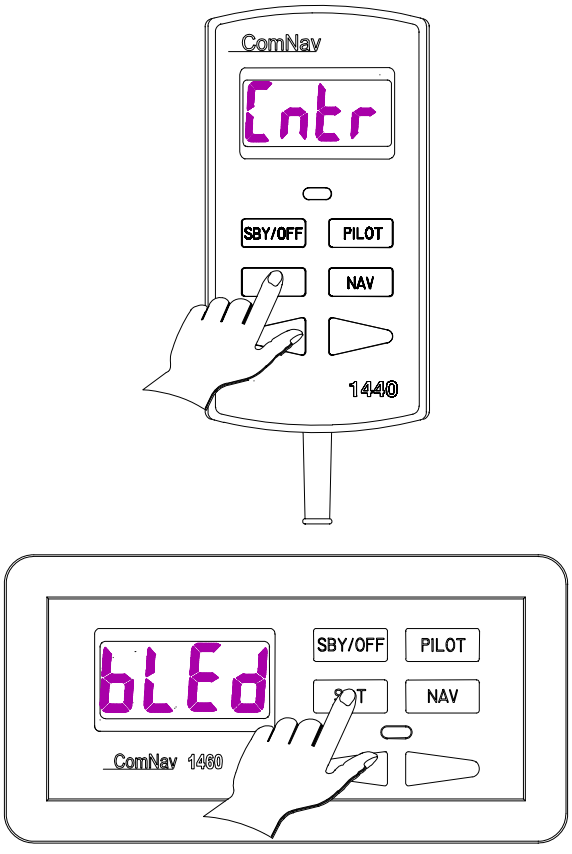
Position the wheel as if you were going Dead Ahead, in a straight line.

**CAUTION**

**In the Step 5, the 1440/1460 will move the steering system through its full range of motion.**

***If you need to stop it, pressing and holding the SBY/OFF KEY will immediately stop the steering movement.***

5. Press the Set Key




The steering gear will move from side to side. As the Autopilot tests the drive system, the display may show d tSt for a short while. Then, as the Autopilot checks the rudder, the display will show r tSt. The Output marks at the top of the display will show the direction of rudder movement. The display may also show timing marks.

6. When the Drive measurements are done, the display will show bLEd (Bleed), indicating that you are now in the Bleed mode.

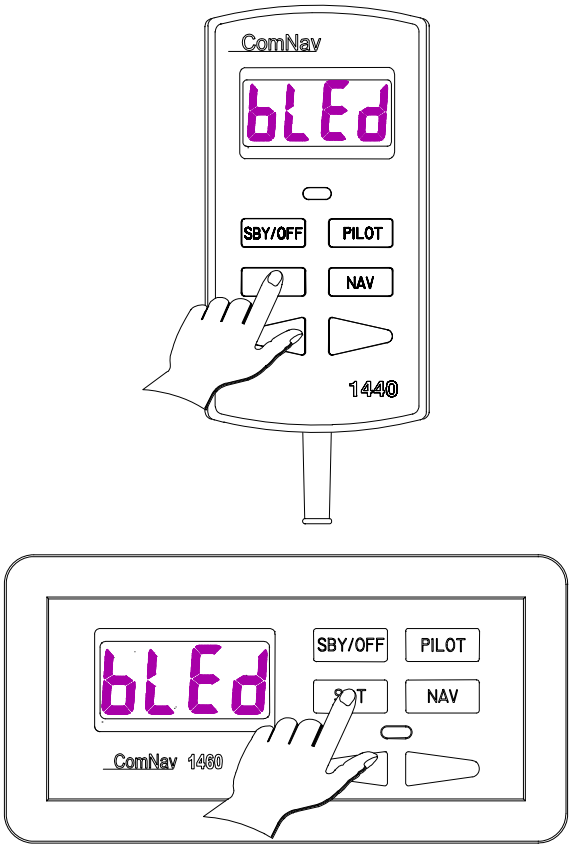

Turn to *Fill And Bleed* on page 32.

Come back here, when done.

*If you did not install a Reversing Pump, or you are not retro-fitting the 1440/1460 on a vessel that already has hydraulic steering, you can skip the hydraulic bleeding work.*

*Go to step 7 instead.*

7. Press the Set Key



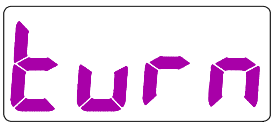

The Autopilot will then display a message showing the type of compass it detected:

- If you have a magnetic compass the display will show nAG (magnetic) for a few seconds.


⇒ *Skip to Step 11.*

- If the compass is a Fluxgate Compass the display will show FLUH for a few seconds.


Next, it will display tUrn (Turn).




8. You must now compensate your compass. However, you must do so out on open water – so for now, you can turn the Autopilot System off.

⇒ *Press the Set Key. The Autopilot will turn off.*

The error message for Step 7 is nCEr ("No Compass" Error).

Press the Pilot Key to clear the alarm, correct the problem, and then try the Step again.

Ensure:

- that the compass cable is connected to the correct Processor terminals.
- that there are no poor or loose connections on the Compass cable.
- (when using a Magnetic Compass Sensor) that the sensor reads the Compass card position properly. Some Magnetic Compasses have magnets so weak that the Sensor will not function properly.

### *Fluxgate Compass Compensation*

In order to complete the setup of a Fluxgate Compass, it is necessary to take a short trip with your boat.

Put your tools and other magnetic objects in storage places away from the Fluxgate Compass.

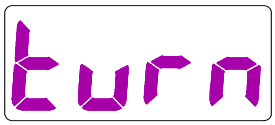
Check your hydraulic installation for any leaks or loose components.

Move your vessel to a location that is:

- Free from other traffic.
- Far away from large magnetic objects.

  ⇒ *Do not attempt to compensate the compass near a steel bridge, a submarine cable, or a steel ship.*

9. Repeat the Setup Routine, starting at Step 1 and continue until the display shows tUrn.




The Autopilot is now ready to measure & compensate for any irregularities in the magnetic field aboard your vessel.

10. Slowly turn the boat in as small a circle as possible. Maintain as steady a rate of turn as you can.

Use a boat speed and rate of turn that results in the turn taking between about one to three minutes to complete.

It should only take slightly more than one full turn to complete the measurements.

⇒ *If the Autopilot will not stop displaying tUrn, you may have such a strong magnetic field aboard your vessel that the compass is not able to sense any motion.*

*If this occurs, try moving the compass some distance away from its present location, and repeat the turn.*

When the Compass compensation is satisfactory, the Autopilot will show nort.


If the Compass measurements can not be done satisfactorily the Autopilot will display:

mouE (Move)

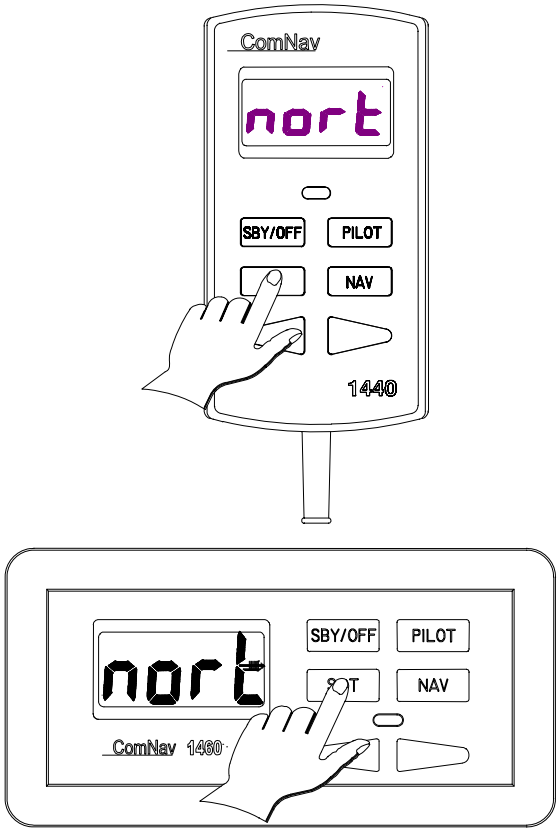
This indicates that the Compass can not be used in the location you have installed it. You must select another location which is further from magnetic materials, and/or power cables. On small vessels the compass location often is a compromise between the most stable position and the position which has the least magnetic interference.

Press the Pilot Key to continue the Setup Routine.

### *Align to Magnetic North*

11. The Autopilot will display nort (North).


***As accurately as possible***, point your vessel to magnetic North, and then press the Set Key.




The Autopilot's Heading display is now aligned to the magnetic direction values sensed by your fluxgate compass, or magnetic sensor.

The Autopilot will turn off.

The Setup Routine is now completed.

*Please be aware that the Autopilot can not adjust for any differences between North, as shown by your compass, and the real direction of Magnetic North.*

*You alone are responsible for the accuracy of your compass in its location.*

### Finishing the Setup

When all is done:

– If you have a magnetic sensor (mounted on your boat's steering, or other, compass, check that the fasteners are secure.

– If you have a fluxgate compass, permanently mount it in its location, using four #10 (5mm) fasteners made of non-magnetic materials such as high quality stainless steel or brass.

Do a final check of your hydraulic installation for any leaks or loose components.

# Piloting with the 1440 or 1460 Autopilot

This section will introduce you to your ComNav Autopilot.

Learn its operations step by step; you will find it is one of the simplest things on your boat!

### Turning ON the 1440/1460 Autopilot:

To turn the Autopilot ON, press the Pilot Key.

The Autopilot will first display some "power on" messages (e.g., the firmware version number).

Then, the current Course ("nnn") followed by a capital letter "P" will be displayed. nnnP.

The autopilot always powers up in PILOT MODE (see below) and is "steering" your boat by the compass.

### Turning the Autopilot OFF

If you wish to turn off the Autopilot, press and hold the SBY/OFF Key for 2 seconds. Immediately after pressing this key, you will have manual vessel steering control.

### Autopilot Modes

The very first thing to learn about your 1440/1460 Autopilot is the various modes it can be used in.

#### STANDBY MODE

Press the SBY/OFF Key briefly. The Autopilot is now in STANDBY MODE. This is indicated by the small mark in the top right corner of the display. nnn '

You can manually steer your vessel, with the Steering Wheel at any helm station, in STANDBY MODE. In this mode, the autopilot will only display the Compass Heading of the boat.

#### POWER STEER MODE

***CAUTION***

If you have a mechanical steering system, activation of either the Red or Green Key while in the POWER STEER MODE, will cause your steering wheel to move.

Pressing the Red or Green Key in STANDBY MODE switches the Autopilot to POWER STEER MODE. The display will have a degree symbol in the top right corner nnn°. You can now use the Red and Green Keys to steer.

To turn to Starboard, press the Green Key. To turn to Port, press the Red Key.

To return to STANDBY MODE and manual steering control, press the SBY/OFF Key briefly.

In POWER STEER MODE, the rudder angle and the rate of turn will increase as long as you hold the Red or Green Key down. When you release the key, your vessel will continue to turn at a constant rate. To decrease the rate of turn, or to go straight, press the other key.

Each time you press the Red or Green Key:

- output indicators appear at the top of the display
- the rudder angle is displayed for two seconds.

If you wish to always see the rudder angle, press the Set Key. The rudder angle display will be locked on.

To return to the Compass Heading display, press the Set Key.

### PILOT MODE

Press the Pilot Key to place your Autopilot in PILOT MODE. The Autopilot will now steer by the Compass.

In PILOT MODE the Autopilot display will show the commanded Course and a capital "P" at the right-hand side  .

PILOT MODE will probably be the mode you use the most often. Setting it up & using it are fully described in the next part of this section.

### NAV MODE

This mode is described on page 61.

## Steering Control Settings

In the PILOT & NAV MODES, the 1404/1460 Autopilot has a wide range of steering control settings:

- Four Response settings.
- Ten Sensitivity steps for each Response setting.

Each Response setting controls the steering in a very different way. The four Response settings are:

- for Slow Speed:
  - –Rudder Response
  - –Counter-Rudder Response
- for Fast Speed:
  - –Rudder Response
  - –Fast Counter-Rudder Response

The 10 Sensitivity steps are numbered zero to nine ("0" to "9")[2].

In this section, you will learn how to:

- Use your Autopilot to steer a Compass Course
- Select between the "fast" and the "slow" boat speed Rudder & Counter-Rudder Responses
- Determine the correct Sensitivity to use for each Response

After you have learned how to do this, experiment with your boat to find the combination of Rudder and Counter-Rudder Response settings that works the best for your vessel.

⇒ *Some vessels may not use all of the Rudder & Counter-Rudder Response settings.*

[2] Zero is a valid setting value – i.e., the lowest setting – and does not mean "off".

## What is Good Steering Control?

When your ComNav Autopilot is working properly, it will steer your vessel in a straight line. The boat will not wander back and forth across the Course line, nor make any sudden turns unless you command them.

When you do make turns, they will be smooth and quick, but without a lot of overshoot & corrections as the boat settles on the new Course.

Please look at page 58 for a diagram showing what “good steering” – and also “poor steering” – looks like.

### *Slow Boat Speed Response*

Some vessels always require large amounts of steering wheel movement to start and stop a turn. These might get the best steering performance by using only the Slow Speed Rudder Response setting for all speeds. When the boat speed varies, change the Sensitivity of the Slow Speed Rudder Response by a few steps. This may be all that is required.

### *Fast Boat Speed Response*

Some vessels always respond quickly to a small movement of the steering wheel, regardless of the boat speed. These boats might get the best steering control by always using the Fast setting. When the boat speed varies, change the sensitivity of the Fast Speed Rudder Response by a few steps. This might give you better steering performance than using the Slow Speed Rudder Response setting.

## Determining the Response Settings

Move your boat to an open area of water away from docks and other boats.

> *Your vessel will normally make many turns, while you are setting the Responses. Make sure that you (and your passengers!) are braced for any unexpected motions!*

These adjustments are much easier to do if the water is calm and there is little wind.

### Setting the Slow Speed Rudder & Counter-Rudder Response Sensitivities

It is best to set the Slow Speed Sensitivities first.

Adjust your throttle so that your boat is moving at the “slow” speed which you normally use. For example, if you often go fishing, this would be your trolling speed.

Bring your boat onto a Course.

Turn the Autopilot ON: press the Pilot Key.

The current Course (“nnn”) followed by a capital letter “P” will be displayed  .

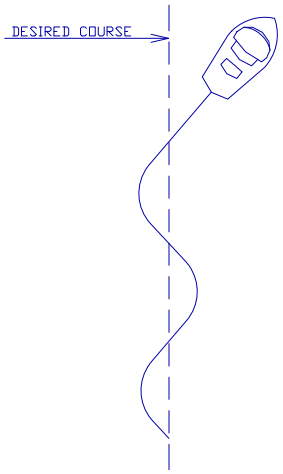
The Autopilot will now begin to steer the boat along the displayed Course. The Autopilot is in PILOT MODE, and is steering by the Compass.

Press the Set Key. For a five second interval, the display will read either FASt (fast) or SLOU (slow). This is the Rudder Response setting that your Autopilot is currently using.

If the display is reading FASt, press the Green Key during the five second interval to change the display to SLOU. Your vessel is now using the Slow Speed Rudder Response settings.

Allow the Autopilot to steer your boat for a few minutes, so you can observe its performance.

⇒ *If your vessel is swinging back and forth across the Course line, like this:*




– *… the Rudder Response Sensitivity is set too high, and/or the Counter-Rudder is too low. The swinging occurs because the Autopilot is overcorrecting for Course errors.*

⇒ *You must decrease the Slow Speed Rudder Response Sensitivity, and/or increase the Counter-Rudder.*

But that's easy to do – and the 10 Sensitivity levels mean you can find one that suits your vessel.

**To decrease the Rudder Response Sensitivity:**

Press the Set Key. The display will show SLOU for five seconds. During this five second interval, press the Set Key again and the Autopilot will display the Rudder Response Sensitivity setting.

Press the Red Key once; the Rudder Response Sensitivity decreases by one step.

Wait for half a minute to let the vessel settle. To see how straight a course the Autopilot is steering, watch the wake of your boat behind you.

If the new Rudder Response setting is still not suitable, decrease it by another step, or increase the Counter-Rudder Sensitivity (see below). Continue this process until your vessel is steering well.

**To increase the Counter-Rudder Response Sensitivity:**

Press the Set Key. The display will show SLOU for five seconds. During this five second interval, press the Set Key two more times to display the Counter-Rudder Sensitivity setting.

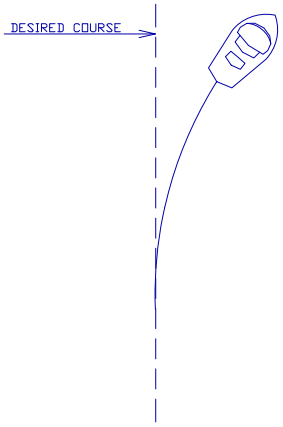
Press the Green Key once; the Counter-Rudder Sensitivity increases by one step.

Again, wait for half a minute to let the vessel settle.

If the new Counter-Rudder setting is still not suitable, try increasing it another step, or decreasing the Rudder Response Sensitivity another step.

Continue this process until your vessel is steering well.

⇒ *If your vessel is gradually falling away from the Course line, like this:*




– *… the Rudder Response Sensitivity is set too low, and/or the Counter-Rudder is too high. The fall-off occurs because the Autopilot does not use enough Rudder movement, for long enough, to correct for the increasing Course error.*

⇒ *You must increase the Slow Speed Rudder Response Sensitivity, and/or increase the Counter-Rudder.*

**To increase the Rudder Response Sensitivity:**

Press the Set Key. The display will show SLOU for five seconds. During this five second interval, press the Set Key again and the Autopilot will display the Rudder sensitivity setting.

Press the Green Key once; the Rudder Response Sensitivity decreases by one step.

Wait for half a minute to see if this is suitable.

If your vessel still does not hold the course, increase the Rudder Response by another step, or decrease the Counter-Rudder (see below).

**To decrease the Counter-Rudder Response Sensitivity:**

Press the Set Key. The display will show SLOU for five seconds. During the five second interval, press the Set Key two more times to display the Counter-Rudder sensitivity setting.

Press the Red Key once; the Counter-Rudder Sensitivity decreases by one step.

Again, wait for half a minute to let the vessel settle. If the new Counter-Rudder setting is still not suitable, try decreasing it another step, or increasing the Rudder Response Sensitivity another step.

Continue this process until your vessel is steering well.

## Turns and Changing Course

At this point – while still moving slowly in PILOT MODE, and with the Responses set properly – it's a good time to learn about how to make turns.

- **Small Course Change**

To make a one degree course change to Starboard, briefly press the Green Key.

To make a one degree course change to Port, briefly press the Red Key.

The display will show your new Course.

- **Large Course Change**

There are several ways to make large changes in Course:

1. Press the Red or Green Key until your see that the vessel is heading on the new Course. Press the Pilot Key.

   While turning, the vessel's actual Heading usually falls behind the Autopilot's new Course. After you release the Red or Green Key the vessel will continue to turn until it reaches the Autopilot's new commanded Course, as displayed.

   When your vessel has settled on its new Course, you often may wish to make fine Course adjustments using the Red and Green Keys.

2. First estimate or chart the difference in degrees between your new course and your present course. Press either the Red Key or the Green Key until the Course to Steer shown on the display is the same as your new Course. Press the Pilot Key. Your vessel will turn to the new course.

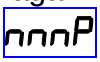
   *The speed of the turn* will be governed by the Autopilot. The Autopilot will turn the vessel at 5º per second if it is set to the Slow Speed Response setting.

3. A third way to make large course changes is to press the SBY/OFF Key. The Autopilot will go to STANDBY MODE. Press the Red or Green Key to enter POWER STEER MODE and make your course change. When your heading is correct, press the Pilot Key. The 1440/1460 will steer along the new Course.

4. Press the SBY/OFF Key. The Autopilot will go to STANDBY MODE. Use the steering wheel to set a new Course. Press the Pilot Key again, and the Autopilot will steer your boat along your new Course.

- **Dodge**

To dodge around an object in the water, press and hold either the Green (or Red) Key, until you will pass clear of the object.

The letter at the right-hand side of the display will change to a "d"  . The current Course will be displayed, and will change as long as you hold down the Green or (or Red) Key. The Autopilot will turn your vessel to Starboard (or Port), and continue to turn it until the key is released – whereupon it will turn back the other way, until you are back on Course[3]. The display will again show the Course, with a capital P  on the right-hand side.

[3] But you will not be on the same ***Track***, rather on a Track parallel to the one you were on before the Dodge.

### Setting the Fast Speed Rudder Response & Counter- Rudder Sensitivities

Press the Pilot Key to steer a course by compass. Advance the throttle so that your vessel is moving at a "fast" speed (for example, your normal Cruising speed).

Press the Set Key. For a 5 second interval the display will show either SLOU (slow) or FASt (fast).

If the display is reading SLOU, press the Green Key during the 5 second interval to change the display to the FASt (fast) setting. Your vessel is now using the Fast Speed Rudder Response settings.

Adjusting the Fast Speed Responses is done in the same way as the Slow Speed Responses.

⇒ *If your vessel is turning back and forth across the course line, the Fast Speed Rudder Response Sensitivity is set too high, and/or the Counter-Rudder is set too low.*

⇒ *If your vessel falls away from the Course line, the Fast Speed Rudder Response Sensitivity is set too low, and/or the Counter-Rudder is set too high.*

⇒ *Adjust the Sensitivity of each Fast Speed Response as required.*

⇒ *Wait for half a minute to let the vessel settle. To see how straight a course the autopilot is steering, watch the wake of your vessel behind you. Repeat until your vessel is steering well.*

### Fast Speed Turns and Course Changes

All the Autopilot's Turn, Course Change and Dodge features described above for the Slow Speed Rudder Response also work when Fast Speed Response is selected.

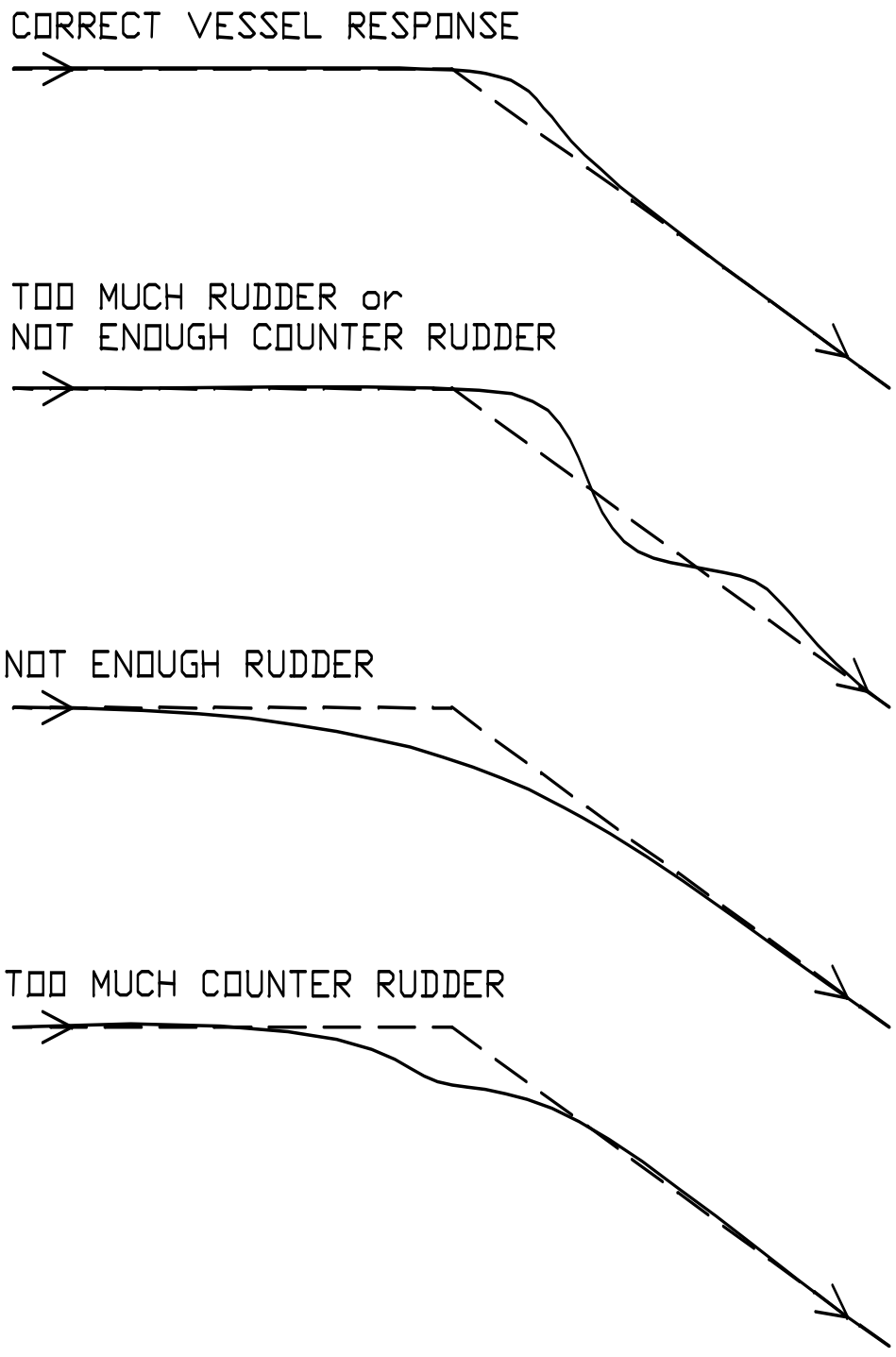
***But!***

Your vessel ***will*** turn more quickly than it does when you are using the Slow Speed Rudder Response.

Experiment with Turns, etc. at Fast Speed Response, so that you will be familiar with the effects.

All commands in the Fast Speed Rudder Response setting work as they did in the Slow Speed Response setting.

*A table of all Autopilot commands is provided at the end of this manual (see page 65).*




**Correct Vessel Response During a Course Change**

## Adjusting the Digital Rudder Angle Indicator (RAI)

The 1440/1460 also provides an electronic Rudder Angle Indicator.

You can adjust the RAI so that it accurately reflects your rudder movements.

For this adjustment, you should have your boat out on the water, and away from traffic lanes. If you have power assisted steering, start with your motor idling so that you can use your power steering.

Press the Pilot Key to turn on the autopilot. Briefly press the SBY/OFF Key.

With the Autopilot in STANDBY MODE, use manual steering to move the steering gear from the Port-side mechanical limit to the Starboard-side limit. Watch the motor or rudder. Estimate in degrees the size of the arc from Port to Starboard.

This must be done manually, as the Autopilot will not move the steering gear so far that the steering strikes a mechanical limit. The Autopilot sets these electronic limits during the Set-up Routine, to save wear on your steering system.

Press the Green Key once and then press the Flush Key twice. The display now shows the total degrees of travel of your steering system. Press the Red and Green Keys to adjust the number until it is the same as your estimation of the actual arc.

A short interval after you have completed your adjustment, the Autopilot will return to its previous display.

### RAI Offset

Many vessels always need the rudder positioned to Port or Starboard by a small amount. This slightly offset rudder position is needed to correct for the turning effect of a single propeller. To the Helmsman, it feels that this Offset Position is the straight-ahead position, or the “0 degree” position.

To avoid confusion, the RAI can be calibrated so that it will show zero degrees when the vessel is travelling straight ahead, even if the rudder is slightly offset.

While travelling straight ahead at cruising speed with the Autopilot in POWER STEER, press the Flush Key. Press the Red and Green Keys to adjust the RAI to show zero degrees.

The Autopilot will return to its previous display when you have finished.

## The Navigation Interface

The 1440/1460 Autopilot can use navigation data information sent to it from a navigation device (such as a GPS receiver or a chartplotter) in NMEA 0183 format.

*See page 40 for navigation input connection instructions.*

By using the vessel's current Heading information (from a fluxgate compass or magnetic sensor), and the data from the navigation device, the Autopilot can steer your vessel along a Course line to a Waypoint. The Autopilot can also steer your vessel through a series of Waypoints which the navigation device has grouped together as a Route.

**NOTE: the Autopilot can *NOT* steer by the information from the navigation device alone!**

### NMEA 0183

The 1440/1460 can receive information from GPS, plotters, and/or other devices, in the *National Marine Electronics Association's* NMEA 0183 language.

Below is the list of the NMEA 0183 data sentences from which the Autopilot can obtain navigation data, and the order of priority in which the 1440/1460 can use these sentences.

1. **R RMB + RMC**
2. **RMB + RMA**
3. **APB**
4. **APA**
5. **XTE + BOD**
6. **XTE + HSC**
7. **VBW**
8. **VHW**
9. **VTG**

*Note: ComNav Autopilots fully conform to the syntax of the NMEA 0183 Standard's language.*

*However, not all models & types of "navigation equipment" do in fact conform to the NMEA standard (especially older models).*

*It sometimes happens that statements in the data sheets, brochures, etc. of a given GPS, plotter, etc. that it "provides navigation data" only mean that the data is provided in the manufacturer's own (non-NMEA, and often proprietary) language.*

*So, if you are purchasing a GPS, plotter, etc., make sure that it does transmit enough of the NMEA 0183 data sentences listed here that the 1440/1460 has sufficient, useable "navigation data".*

If you have further questions about the purchase of a navigation device, or if you experience difficulties using the NAV MODE of your 1440/1460 Autopilot, please contact your ComNav Dealer.

## Using the Navigation Interface

To be safe, learn to use your Navigation Interface at slow speeds, away from other vessels.

**Turn on the navigation device**.

This could be a GPS, plotter, or other device. Give it time to find its position accurately and turn off its warning indicators.

**Enter a Waypoint into the navigation device**.

With some navigation devices, it is necessary to tell them to send information to the Autopilot. Make sure that it is sending information in the correct NMEA 0183 format.

**Turn the Autopilot System on & Press the Nav Key.**

The autopilot is now in NAV MODE. The Autopilot will display HHHn. The "HHH" is the current Heading, and the "n" at the right side of the display shows that the Autopilot is in NAV MODE.

When the 1440/1460 receives the data for the next Waypoint from your navigation device, the display will show the Course changing towards the bearing to the Waypoint. The Autopilot will bring your boat onto the new Course, and steer towards the Waypoint using the information from the Nav device and the Compass.

⇒ *If the boat seems to steer away from the Course line, or back to its starting point, see the discussion on* Cross Track Error*, on page 62.*

### Incorrect or No Navigation Data

If the autopilot consistently beeps every five seconds and displays nDAt (No Data) then it is not receiving usable data from the navigation device. The Autopilot will stay in the NAV MODE, but will continue to steer on the present Heading, using only the Compass information.

Please remember that <u>all</u> ComNav 1440 and 1460 Autopilots are tested at the factory, so the first things to check are your wiring and your navigation device.

Read the owner's manual for the navigation device to make sure that it is sending out correctly-formatted NMEA 0183 sentences..

If the Autopilot intermittently displays FdAt (Faulty Data), then it is receiving a warning signal from the navigation device.

**<u>Caution</u>**

It is strongly recommended that you do not continue to use the NAV MODE if FdAt is displayed.

This signal indicates that the navigation information may not be accurate. Check your navigation device for warning indicators such as a flashing light or message.

For a complete listing of Navigation Sentences used by the 1440/1460 see the previous page.

## Cross Track Error

Cross track error is a measure of the distance your boat has fallen away from the Course line.

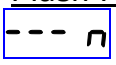
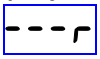
Cross track error is measured as the length of a line drawn from the Course line to your position, at right angles to the Course line.

Cross track error also has a left or right hand direction. For example: the boat can be ½ mile to the left of the Course line.

Different manufacturers have defined the direction of the "cross track" differently. There is no agreement on whether a "left-hand" cross track error means that the boat is to the left of the Course line, or that the line is to the left of the boat.

Because of this, ComNav Autopilots let you change the way they interpret the direction of cross track error.

To change the Cross Track Error direction:

In NAV MODE, press the Flush Key. The display will show either  (normal) or  (reversed).

Use the Green Key to change the setting.

- ⇒ *Your cross track error direction is correct if the Autopilot **is** following the Course line.*
- ⇒ *If the Autopilot is steering away from the Course line while the Navigation Interface is on, then* **the cross track error direction may be incorrect!**

If necessary, change the direction of cross track error. If the Autopilot begins steering towards the Course line, you have solved the problem.

If the problem persists, , re-check your navigation device's settings, and the wiring.

## NAV MODE Display

- **Cross-track quality**

The first 2 digits (XXx) denote the source of the cross track data (if any) and are used as a relative priority. The higher the value, the better the data source. The first digit (Xxx) is used to indicate the source of the sentence, as follows:

D: RMB
C: APB
B: APA
A: XTE
1: No data source

The second digit (xXx) denotes the field used, if more than one source exists within a sentence. Currently this feature is not used in searching for cross track data.

The last digit (xxX) shows the quality timer for the cross track data. When a cross track sentence is accepted, the timer is reset to A and will count down once per second. If the timer should reach 0 the pilot assumes the data source has disappeared and will reset the quality to 10, indicating no data. This will allow the pilot to start searching for the next best source of cross track information.

- **Track quality**

Same basic format as for cross track quality. The first 2 digits are denoted as follows

D0: RMB
C2: APB – Track heading field
C1: APB – Heading to steer field
C0: APB – Bearing
B0: APA – Track heading
91: BOD – Track heading - magnetic
90: BOD – Track heading - true
81: HSC – Track heading - magnetic
80: HSC – Track heading - true
10: No data source

- **Speed quality**

Same basic format as for cross track quality. The first 2 digits are denoted as follows.

F0: RMC
E0: RMA

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# Operation Commands

| COMMAND | ACTION | RESULT |
|---|---|---|
| Steer by compass | 1440/1460 is off or in STANDBY MODE.<br>Point bow and press Pilot Key. | Boat will settle on course.<br>Display will show nnnP |
| Turn OFF | Press and hold SBY/OFF Key for two seconds. | Immediately upon pressing the SBY/OFF Key you will have manual steering control. The Autopilot will turn off in two seconds. |
| Course Change:<br>small, to Port | 1440/1460 in PILOT MODE.<br>Press Red Key Once. | One degree course change to Port. |
| Course Change:<br>small, to Starboard | 1440/1460 in PILOT MODE.<br>Press Green Key once. | One degree course change to Starboard. |
| Course Change:<br>large, to Port | 1440/1460 in PILOT MODE.<br>Press and hold Red Key.<br>Display will show: nnnd<br>Displayed course will decrease. When it reaches your desired heading release the key, & press the Pilot Key.<br>Actual vessel heading will likely lag behind displayed course. | Boat will settle on new heading.<br>Display will show: nnnP |
| Course change:<br>large, to Starboard. | 1440/1460 in PILOT MODE.<br>Press and hold Green Key.<br>Display will show: nnnd<br>Displayed course will increase. When it reaches your desired heading release the key, & press the Pilot Key.<br>Actual vessel heading will likely lag behind displayed course. | Boat will settle on new heading.<br>Display will show: nnnP |

| COMMAND | ACTION | RESULT |
|---|---|---|
| Dodge: left | In PILOT or NAV MODE.<br>Press and hold Red Key.<br>Display will show: nnnd<br>Release Red Key to return to PILOT or NAV MODE. | Vessel turns left.<br>When key is released, the PILOT/NAV MODE display returns and vessel returns to original course. |
| Dodge: right | In PILOT or NAV MODE.<br>Press and hold Green Key.<br>Display will show: nnnd<br>Release Red Key to return to PILOT or NAV MODE. | Vessel turns right.<br>When key released, the PILOT/NAV MODE display returns and vessel returns to original course. |
| Rudder response: change | In PILOT MODE.<br>Press Set Key once.<br>Display will show either:<br>FASt or SLOU<br>Press Red or Green Key. | Autopilot will switch to the other set of rudder response adjustments. |
| Steer by GPS, plotter, etc. | Select Waypoint.<br>Press Nav Key. | Display will show HHHn<br>Pilot will steer by compass and NMEA data received. If no NMEA data received, pilot will remain in NAV MODE, but will steer by compass. |
| Dim or brighten lights on Control Head. | In STANDBY MODE:<br>Press Set Key once.<br>Press Green Key to increase or Red Key to decrease brightness. | Control Head's backlight will move through eight levels of brightness. |
| Change from Compass display to permanent rudder angle display. | In POWER STEER MODE, press the Set Key. | The 1440/1460 will constantly display the rudder angle while in STANDBY MODE. Pressing the Set Key again will return to the Compass display. |

# Adjustment Commands

| COMMAND | ACTION | RESULT |
|---|---|---|
| Rudder sensitivity: increase | In PILOT or NAV MODE:<br>Press Set Key twice.<br>Press Green Key. | Autopilot will steer with a “harder” turn to correct course deviations, causing a shorter correction, but more overshoot of the intended course. Changes will only affect the current speed (fast or slow) sensitivity setting. |
| Rudder sensitivity: decrease | In PILOT or NAV MODE:<br>Press Set Key twice.<br>Press Red Key. | Autopilot will steer with a “softer” turn to correct course deviations, causing a longer correction distance but less overshoot of the intended course. Changes only affect the current speed (fast or slow) sensitivity setting). |
| Counter-Rudder sensitivity: decrease | In PILOT or NAV MODE:<br>Press Set Key three times.<br>Press the Red Key. | Autopilot will steer with a “harder” turn to correct course deviations, causing a shorter correction, but more overshoot of the intended course. Changes will only affect the current speed (fast or slow) sensitivity setting. |
| Counter-Rudder sensitivity: increase | In PILOT or NAV MODE:<br>Press Set Key three times then Press the Green Key | Autopilot will steer with a “softer” turn to correct course deviations, causing a longer correction distance but less overshoot of the intended course. Changes only affect the current speed (fast or slow) sensitivity setting. |
| Cross Track Error Sense: change | In NAV MODE:<br>Press Flush Key, then Press Green Key | Autopilot will steer properly along course line when Cross Track Error Sense is correct. See page 62 for more information. |
| Set-up Routine | Pilot is OFF.<br>Press and hold Flush Key, & press and hold Pilot Key. | Set-up Procedure begins. |

# 1440 & 1460 Control Head Messages

| Message | Description |
|---|---|
| bLEd | Bleed mode. See Setup section. |
| Cntr | Center the rudder |
| dtSt | Drive Test Display |
| EEPr | Faulty EEPROM. The autopilot will not function. The processor has failed. Have your autopilot serviced by a ComNav dealer. |
| FASt | Momentarily indicates that Fast Speed Rudder Response has been selected |
| FC (digit)(digit) | Fast Speed Rudder Response: counter rudder value |
| FCmP | The fluxgate or the magnetic compass sensor is faulty and must be serviced. Contact your nearest ComNav dealer. |
| FdAt | The autopilot is in NAV MODE. The navigation device is sending the autopilot a warning signal indicating that the navigation data may be faulty.<br>**CHECK:** The navigation device (GPS, etc.) for warning signals such as a flashing display, a blinking light, or a warning message. You may be able to correct the problem using information from the owner's manual for the device.<br>*It is strongly recommended that you do not continue to operate the 1440 or 1460 Autopilot in NAV MODE while it is displaying this error message.* |
| FLUH | Fluxgate compass detected. |
| Fr (digit)(digit) | Fast Speed Rudder Response: rudder value |
| FrSt | Full reset. The 1440 or 1460 requires that the Set-up Routine be repeated. After the Set-up Routine is done, the problem should be fixed. If this error message continues to occur, take your Autopilot to a ComNav dealer for servicing. |
| GHrd | Ghost Rudder active. The Rudder Feedback has failed and the Ghost Rudder feature is in operation. Your Autopilot will still work, but the quality of steering control will not be as good.<br>**CHECK**: The Rudder Feedback wiring at the Processor.<br>Cancel the alarm using the Pilot Key. The message will reappear whenever the 1440 or 1460 is in PILOT MODE. The digital and analog RAI will not work. |
| HB | The battery voltage is more than 40 volts. If this problem is not fixed, the Processor could be damaged. You could damage your battery if you do not fix this problem.<br>**CHECK**: Your battery fluid levels and the regulator in your generating system. |

| Message | Description |
|---|---|
| HEAd | Faulty Head |
| HEYS | Stuck key in the control head. |
| HO P | Request Rudder Hard Over Port. |
| HO S | Request Rudder Hard Over Starboard. |
| HOt | The Processor is too hot. This is usually due to a very high demand for electrical power from the reversing pump. It could also indicate a failure inside the Processor.<br>Check: The Processor and the Processor space for heat sources. Should the temperature rise still higher, the 1440 or 1460 will turn off the steering outputs. When the temperature falls, the steering outputs will turn back on. We recommend that you have the Autopilot serviced by a ComNav dealer before it is used again. |
| LbAt | The supply voltage is less than 9.5 Volts. The Autopilot cannot operate reliably.<br>Check: Your batteries fluid level and the regulator in your generating system. |
| LOAd | This warning indicates that the 1440 or 1460 has been producing a larger than normal output current for a period of time. This might be due to increased mechanical resistance in your steering system.<br>If this warning appears after an extended period of use, try to think of something that might have changed after the Autopilot was installed. Has the rudder struck any submerged objects? Are there any bearings that need grease? Is the rudder fouled?<br>If this warning appears when you first use your Autopilot, check that your steering gear moves easily.<br>Check: Your wiring is correct. Look for any connections which allow a short circuit. If you have an electric motor in your steering system, look for burned or shorted windings. |
| Lt (digit)(digit) | Light intensity. |
| nAG | Indicates magnetic compass detected. |

| Message | Description |
|---|---|
| nCEr | No compass error during Dockside Set-up.<br>Check:<br>• The compass cable is connected to the correct Processor terminals.<br>• There are no poor or loose connections on the Compass cable.<br>• When using a Magnetic Compass Sensor, the sensor reads the Compass card position properly. Some Magnetic Compasses have magnets so weak that the Sensor will not function properly.<br>Press the Pilot Key to clear the alarm. |
| nCnP | Magnetic/fluxgate compass fault |
| ndAt | Not receiving NAV Data |
| nOrt | North (see Dockside Set-up) |
| nOUE | Move. Unsatisfactory compass adjustment (see page 49). |
| OCur | The Reversing Pump or the mechanical steering is drawing too much current from the Processor.<br>This may be caused by a defective motor or perhaps because the rudder is stuck. You must take control of the vessel. If you cannot find an obvious reason for the problem, have the autopilot serviced before you use it again. |
| OFF COrS | Off course error. Vessel has fallen off course more than 20 degrees for over 30 seconds. |
| P (digit)(digit) | Port Rudder indicator |
| PrOn | EPROM Error. This indicates a failure in the Processor. Take the Autopilot to a ComNav service center. |
| rAn | Ram Error. This indicates a failure in the Processor. Take the Autopilot to a ComNav service center |
| rEdO | Occurs during Set up Routine. See page 43. |
| rFU | Rudder Feedback failure. This message will appear ONLY in PILOT or NAV MODES. Digital and analog RAIs will not work.<br>Check: The Rudder Feedback. |
| rudr | The rudder is not moving according to the Autopilot's commands.<br>Check: The rudder mechanism and the Rudder Feedback. |
| rt (digit)(digit) | Rudder travel for calibrating the digital rudder angle reading. |
| rtSt | Rudder test message |
| S (digit)(digit) | Starboard Rudder indicator. |
| SC (digit)(digit) | Slow Speed Rudder Response: counter rudder value. |

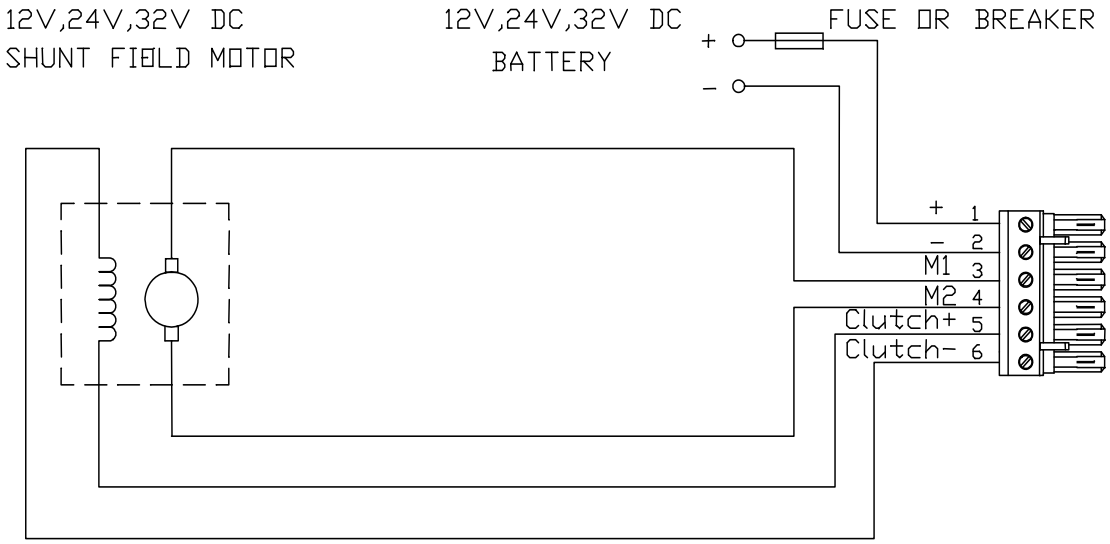
| Message | Description |
|---|---|
| SLOU | Momentarily indicates that Slow Speed Rudder Response has been selected |
| - 14- | Sign-on message |
| Sr (digit)(digit) | Slow Speed Rudder Response: rudder value |
| turn | While adjusting compass, if the autopilot will not stop displaying turn, you may have such a strong magnetic field aboard your vessel that the compass is not able to sense any motion. If this occurs, try moving the compass far away from it's present location. |
| WAIt | Wait. |

# Problems without an Error Code

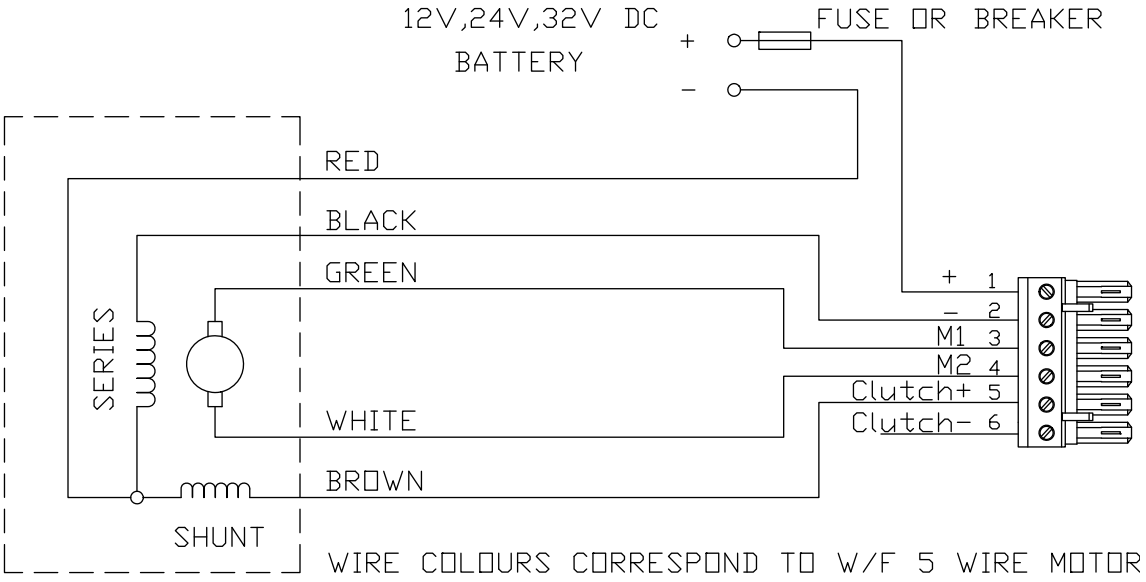
| | |
|---|---|
| The Autopilot will not turn on. | You have one of the following problems:<br><br>1. The battery is dead or the battery connections are faulty.<br><br>2. The computer is faulty.<br><br>3. The program is faulty.<br><br>4. The fuse is faulty and must be replaced. See page 42.<br><br>5. A short on the +5V line. Check RFU cable for short between 1 & 3. |
| The Autopilot starts the Set-up Routine. The display shows  | The Autopilot detected an error in its memory and then erased the defective memory. You must now do the Set-up Routine. You will not have to bleed your hydraulic system unless you have opened the hydraulic lines or run out of hydraulic fluid.<br><br>The random occurrence of this problem is possible but unlikely. If this problem occurs twice, your Autopilot may need servicing. Contact your ComNav dealer. |
| The Autopilot starts, the Control Head display goes blank, the Autopilot ceases steering and you have manual control. | The 1440 or 1460 Control Head may be disconnected. For safety reasons, should the Control Head inadvertently be disconnected, the Autopilot will automatically switch off.<br><br>+5V may be shorted due to a short in the Rudder Feedback Pot or cable. |

# Appendix A

## Connections to 4 and 5 Wire Motors



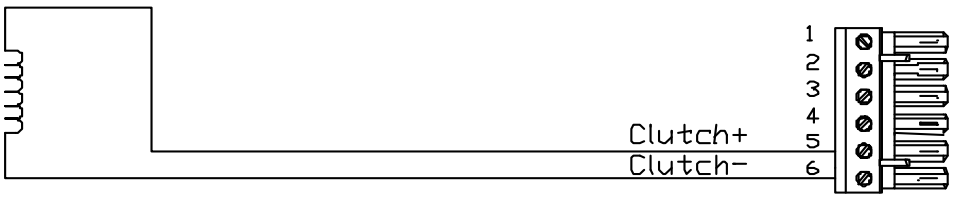

4 – WIRE MOTOR HOOKUP




5 – WIRE MOTOR HOOKUP

# Appendix B

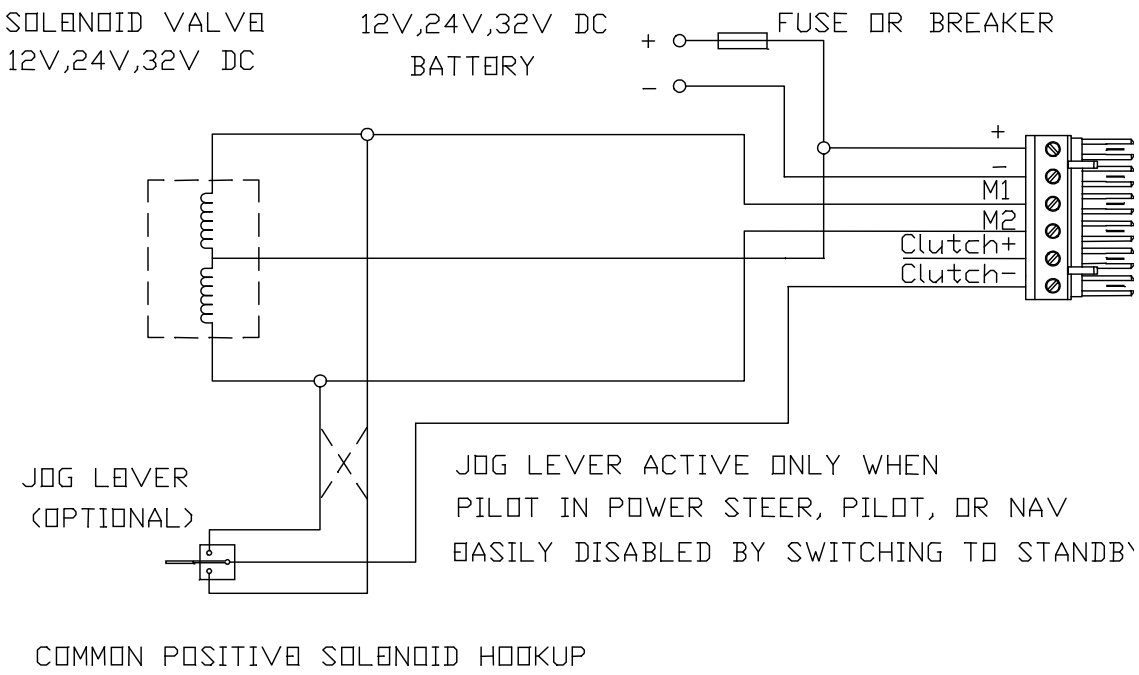
## Connections to 4 and 5 Wire Motors (using a clutch or lockup valve)




CLUTCH OF ROTARY DRIVE OR LOCKUP VALVE OF LINEAR ACTIVATOR

# Appendix C

## Connections to Solenoid Valves




COMMON POSITIVE SOLENOID HOOKUP

# Appendix D

## Remote Operation

It is possible to operate your 1440/1460 Autopilot System from a “remote” location:

- The optional Second Station Kit allows you to connect two fully functional Control Heads at different locations. Only one of the two Control Heads can be “in command” at a time, but transferring command from one to the other is as simple as holding down the Red & Green Dodge Keys for 2 seconds.

The Second Station Kit (1440: PN 10080016; 1460: PN 10080029) contains all the items you will require:

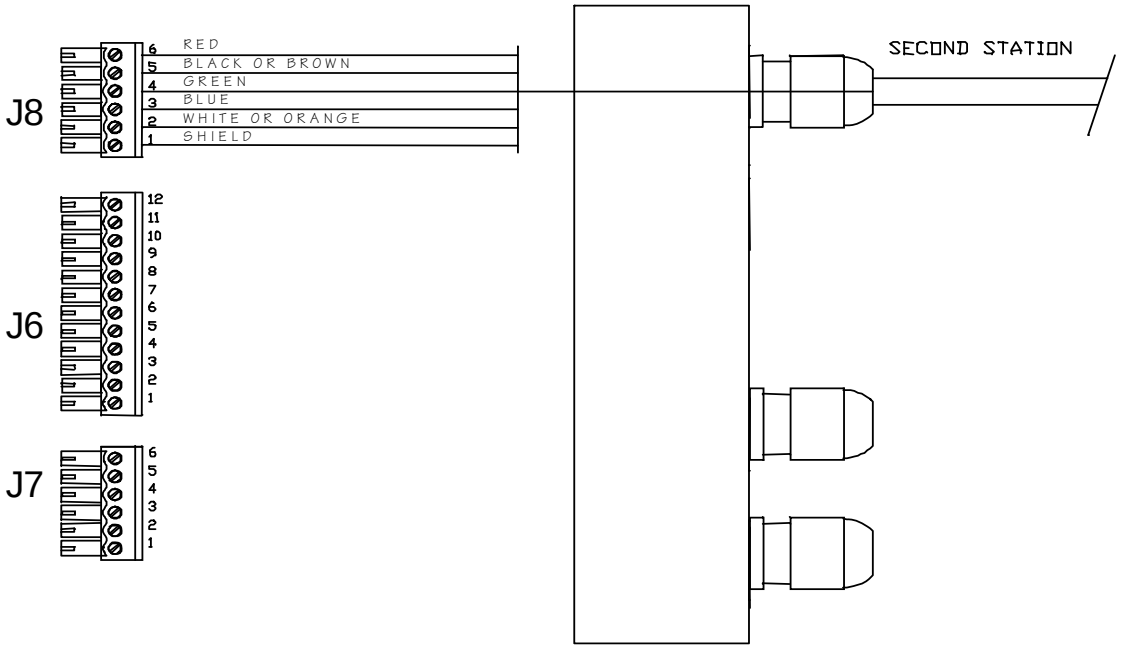
- 1440 Control Head with Mounting Clip, or 1460 Control Head with Mounting Bracket Kit
- Cable Gland & Nut
- Receptacle w/ Cap & 30 foot cable (1440 only – the cable for the 1460 Head is attached to it)
- Mounting hardware
- 6 pin plug (to mate with connector on Processor)

You can also install one or more 1440 Second Location Kits (PN 10080015). This allows you to connect and use a 1440 Control Head at several locations. The Kit contains the same parts as in a 1440 Second Location Kit, except the 1440 Head.

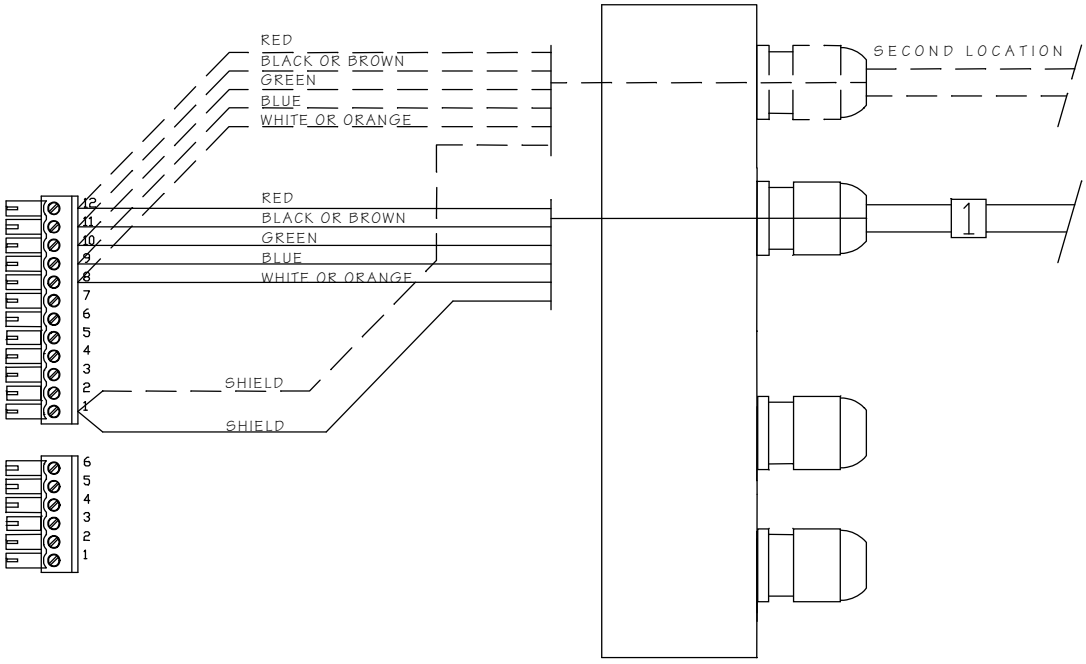
It is important to note that only one 1440 Control Head can be connected to the Main or Second Location socket(s) at any given time. That’s because the Kit only provides a “tee” connection to the Processor’s Control Head connector (J6) – and so all you do is move your one Control Head from one location to another.

It is also possible to mix the types of Control Heads on a 1440 or 1460 System; a 1460 Second Station Kit may be used on a 1440 System, and either or both of the 1440 Kits may be used on a 1460 System. This is possible because the 1440 & 1460 Control Heads are electrically identical, and the Processor is the same in both systems.

To install a Kit, please refer to the instructions that come with it (also refer to pages 15 & 16, and the wiring diagrams on the next page - note the two possible colour codes) in this manual).




**Right Side, Optional Second Station Connections (J8)**

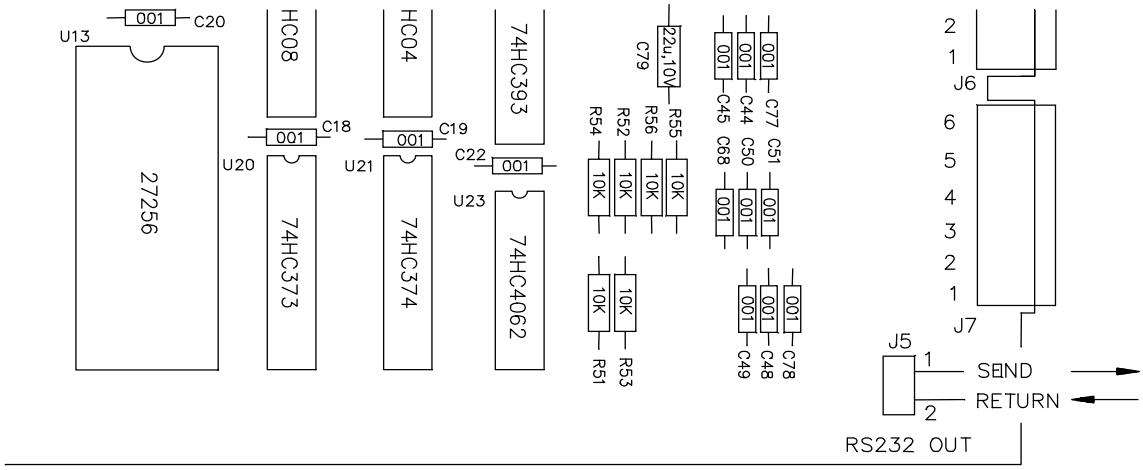



Note: Yellow wire NOT used.

**Right Side, Optional 1440 Second Location Connections (J6)**

# Appendix E

## Connecting the NMEA 0183 Heading Output



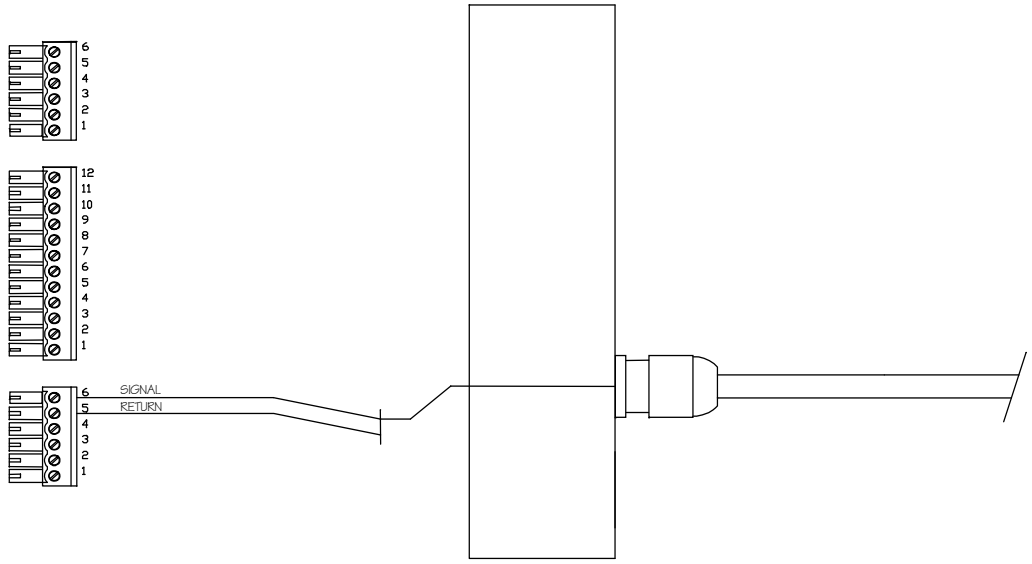

**Location of terminal strip J5**

The 1440/1460 Autopilot has a connector that outputs NMEA 0183 heading information, for use by external devices such as Radars. Heading data is transmitted once per second, using two NMEA sentences: HDM (magnetic heading) and HDG (magnetic heading, deviation & variation). The serial data rate is 4800 Baud. The output signal has enough drive capability for up to six NMEA 0183 Listeners.

The NMEA 0183 data output format is a two-wire signal. One wire (the 'A' signal) connects to pin 1 of terminal strip J5 and the other wire (the 'B' or 'return' signal) connects to pin 2 of terminal strip J5. Terminal strip J5 is located in the lower right side of the Processor circuit board (see above). The two pin connector required for connecting to the heading output is included in the Accessory Kit.

# Appendix F

## Connecting a Rudder Angle Indicator




**Right Side, Optional RAI connection**

The cable gland for a rudder angle indicator is in your Accessory Bag. We **do not** supply a cable for this installation but recommend a 22 AWG, two-conductor cable; the cable must be **round** in order to make a water-tight seal. The outer diameter of this cable must not exceed ¼" (6.5mm) or be less than 5/32" (4mm). The gland for this input must be mounted on the end cap. To locate the hole for the gland, look on the inside of the end cap. You will see several places where the plastic has been formed so that a hole may be easily drilled. Drill the hole using a 15/32" (12mm) drill. Place the gland from the accessory kit in the hole. Fasten it with the supplied plastic nut and tighten securely.

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# WARRANTY INFORMATION

## Limited Warranty Agreement

Congratulations! You have purchased sophisticated and sensitive marine equipment (the "Equipment") manufactured by ComNav Marine Ltd. of #15 13511 Crestwood Place, Richmond, British Columbia, Canada, V6V 2GI ("ComNav").

### LIMITED ONE YEAR WARRANTY

ComNav warrants to the Purchaser, provided that the recommended installation and maintenance procedures set forth in the manual that has been provided with the Equipment (the "Manual") have been followed, and subject always to the other provisions of this Agreement, that the Equipment is free from defects in workmanship and materials under normal use and service and will perform substantially in accordance with the specifications set forth in the Manual for a period of one (1) year from the date of purchase of the Equipment by the Purchaser.

### EXTENDED THREE YEAR LIMITED WARRANTY

If;

a) the Equipment is installed:
   i. by an authorized ComNav Dealer; or
   ii. by someone other than an authorized ComNav Dealer, and such installation has been inspected by an Authorized ComNav Dealer;

and

b) the Limited Warranty Registration Card has been returned to ComNav within 14 days of the date of purchase of the Equipment by the Purchaser with Part I thereof having been completed by the Purchaser, and with the Extended Limited Warranty Card having been completed and signed by an authorized ComNav Dealer and returned to ComNav within 14 days of that inspection;

then;

ComNav warrants to the Purchaser that the Equipment is free from defects in workmanship and materials under normal use and service and will perform substantially in accordance with the specifications set forth in the Manual for a period of three (3) years from the date of purchase of the Equipment, subject to the other provisions of this Agreement.

### NO OTHER WARRANTIES

TO THE MAXIMUM EXTENT PERMITTED BY APPLICABLE LAW, COMNAV DISCLAIMS ALL OTHER WARRANTIES AND CONDITIONS, EITHER EXPRESSED OR IMPLIED, STATUTORY OR OTHERWISE WITH RESPECT TO THE EQUIPMENT, INCLUDING BUT NOT LIMITED TO IMPLIED WARRANTIES OR CONDITIONS OF MERCHANTABILITY AND FITNESS FOR THE ORDINARY PURPOSES FOR WHICH THE EQUIPMENT IS USED OR FITNESS FOR A PARTICULAR PURPOSE AND ANY OTHER OBLIGATIONS ON THE PART OF COMNAV, ITS EMPLOYEES, SUPPLIERS, AGENTS, OR REPRESENTATIVES.

**NO LIABILITY FOR CONSEQUENTIAL DAMAGES**

TO THE MAXIMUM EXTENT PERMITTED BY APPLICABLE LAW, IN NO EVENT SHALL COMNAV, ITS EMPLOYEES, SUPPLIERS, OR REPRESENTATIVES BE LIABLE FOR ANY DAMAGES WHATSOEVER, INCLUDING WITHOUT LIMITATION DAMAGE FROM COLLISION WITH OTHER VESSELS OR OBJECTS, INJURY TO ANY PERSON OR PERSONS, DAMAGE TO PROPERTY, LOSS OF INCOME OR PROFIT, BUSINESS INTERRUPTION, OR ANY OTHER CONSEQUENTIAL, INCIDENTAL, RESULTING PUNITIVE, OR SPECIAL DAMAGES ARISING OUT OF THE USE OF OR INABILITY TO USE THE EQUIPMENT, INCLUDING THE POSSIBLE FAILURE OR MALFUNCTION OF, OR DEFECTS IN THE EQUIPMENT, OR ANY PART THEREOF, EVEN IF COMNAV HAS BEEN ADVISED OF THE POSSIBILITY OF SUCH DAMAGES. SOME STATE/JURISDICTIONS DO NOT ALLOW THE EXCLUSION OR LIMITATION OF CONSEQUENTIAL OR INCIDENTAL DAMAGES, SO THE ABOVE LIMITATION MAY NOT APPLY TO THE PURCHASER.

**REMEDIES NOT TRANSFERABLE**

The Purchaser’s remedies under this Agreement only apply to the original enduser of the ComNav Equipment, being the Purchaser, and only apply to the original installation of the Equipment. The Purchaser’s remedies under this Agreement are not transferable or assignable by the Purchaser to others in whole or in part.

**NOTICE OF DEFECT**

The Limited Warranty and the Extended Warranty will not apply with respect to any defective Equipment unless written notice of such defect is given to ComNav, by mail to the address for ComNav set forth above, or by facsimile to ComNav at 604-207-8008, and is received by ComNav within 10 days of the date upon which the defect first became known to the Purchaser. Notices sent by mail will be deemed to be received by ComNav on the seventh (7th) day first following the date of posting in North America and on the tenth (10th ) day next following the date of posting anywhere else in the world. Notices sent by facsimile will be deemed to be received by ComNav on the date of transmission with appropriate answerback confirmation.

**WARRANTY LIMITATIONS**

Reversing Pumps & Motors, Hydraulic Linear Actuators, Watch Alarms & Motor Control boxes which may comprise part of the Equipment are warranted by ComNav for a period of two (2) years under the Extended Limited Warranty described above. All Remote Controls, Remote Cables, Jog Switches, Analog meters (rudder angle indicators), Rudder Angle Indicator Systems & Accessories, Magnetic Compasses & Accessories, Constant Running Pumps, Engine Driven Pumps, Hydraulic Manifolds & Hydraulic Steering are warranted by ComNav for a period of one (1) year under the Limited Warranty described above.

**IMPLIED WARRANTIES**

Any implied warranties with respect to the Equipment are limited to one (1) year. Some states/jurisdictions do not allow limitations on how long an implied warranty lasts, so the above limitation may not apply to the Purchaser.

**CUSTOMER REMEDIES**

ComNav's entire liability and the Purchaser's exclusive remedy against ComNav for the defective Equipment shall be, at ComNav's option, either: (a) repair or replacement of the defective Equipment under the warranties set forth in this Agreement, or, (b) refund of the purchase price of the defective Equipment, all pursuant to and in accordance with the conditions set forth below:

1. If the Equipment, or any part thereof, proves to be defective within the relevant warranty period, the Purchaser shall do the following:
    a. contact ComNav by phoning 604-207-1600 to discuss the nature of the problem and obtain shipping instructions (many times a satisfactory solution can be reached without returning the item); and
    b. prepare a detailed written statement of the nature of the circumstances of the defect, to the best of the Purchaser's knowledge, including the date of purchase of the Equipment, the place of purchase, the name and address of the installer, and the Purchaser's name, address and telephone number to be sent, along with proof of purchase, to ComNav;
2. If upon examination by either ComNav or an authorized ComNav Dealer, the defect is determined to result from defective workmanship or material and if the defect has occurred within the relevant warranty period set forth above, the Equipment or the defective parts thereof shall be repaired or replaced, at ComNav's sole option, without charge, and shall be returned to the Purchaser at ComNav's expense. Return delivery will be by the most economical means. Should the Purchaser require that the Equipment be returned by a faster method, the costs incurred by the expedient delivery will be pre-paid by the Purchaser;
3. No refund of the purchase price for the Equipment will be made to the Purchaser unless ComNav is unable to remedy the defect after having a reasonable number of opportunities to do so. Prior to the refund of the purchase price, the Purchaser must submit a statement in writing from an Authorized ComNav Dealer that the installation instructions in the manual have been complied with in full and that the defect remains.
4. Warranty service shall be performed only by ComNav or an Authorized ComNav Dealer. Any attempts to remedy the defect by anyone else shall render the warranties set forth in this Agreement void;
5. Charges for overtime, standby, holiday and per diem will not be paid by ComNav and are specifically excluded from the warranties set forth in this Agreement. ComNav may, under special circumstances, and with ComNav's PRIOR approval, pay ONE TIME travel costs. Any cost of ferry, boat hire, or other special means of transportation must have prior approval from ComNav. ComNav reserves the right to refuse service charges in excess of one hour if the technician has not contacted ComNav's service department for assistance. Travel cost allowance to service certain Equipment with a suggested retail price of below $2,500.00 (Canadian funds or equivalent) is not authorized. If repairs are necessary, these products must be forwarded to ComNav or an authorized ComNav Dealer at Purchaser's expenses and will be returned as set out in **CUSTOMER REMEDIES**, Item 2;
6. There shall be no warranty for defects in, or damages to, the Equipment caused by:
    a. faulty installation or hook-up of the Equipment;
    b. abuse, misuse or use of the Equipment in violation of the instructions set forth in the Manual;
    c. shipping, alterations, incorrect and/or unauthorized service;
    d. accident, exposure of the Equipment to excessive heat, fire, lightning, salt or fresh water spray, or water immersion except for Equipment specifically designed as, and stated in the Manual to be, waterproof. Water damage to the Equipment due to failure to cover unused receptacles is specifically excluded from any warranty set forth in this Agreement; and
    e. improper or inadequate ancillary or connected equipment;
7. This warranty does not cover routine system checkouts, alignment, or calibration unless the service has been authorized in writing by ComNav PRIOR to its commencement; and
8. No Equipment shall be repaired or replaced under warranty if the serial number of that Equipment has been removed, altered or mutilated.

**CHOICE OF LAW AND JURISDICTION**

This Agreement is governed by the laws of the Province of British Columbia, Canada. If you acquired the Equipment outside of Canada, each of the parties hereto irrevocably attorn to the jurisdiction of the courts of the Province of British Columbia, Canada and further agree to settle any dispute, controversy or claim arising out of or relating to this Limited Warranty, or the breach, termination, or invalidity of it, by arbitration under the rules of the British Columbia International Commercial Arbitration Centre ("BCICAC"). The appointing authority shall be BCICAC [or, if the BCICAC shall cease to exist, the Chief Justice of the Supreme Court of British Columbia]. BCICAC shall administer the case in accordance with BCICAC Rules. There shall be one arbitrator and the place of arbitration shall be Vancouver, British Columbia.

The United Nations Convention on Contracts for the International Sale of Goods Act, S.B.C 1990, c. 20, and any other statutory enactments of the United Nations Convention on Contracts for the International Sale of Goods do not apply to this Agreement.

THIS LIMITED WARRANTY GIVES THE PURCHASER SPECIFIC LEGAL RIGHTS. THE PURCHASER MAY ALSO HAVE OTHERS WHICH VARY FROM STATE/JURISDICTION TO STATE/JURISDICTION.

This Agreement is a legal contract between you (the "Purchaser") and ComNav. By retaining the Equipment for more than thirty (30) days and/or installing and/or using the Equipment, the Purchaser agrees to be bound by the terms of this Agreement. If the Purchaser does not agree to be bound by the terms of this Agreement, the Purchaser may return the Equipment in the same condition in which it was received for a full refund (less shipping and handling costs) within thirty (30) days of purchase.

***WARNING***

*The Equipment is an aid to navigation only. It is not intended or designed to replace the person on watch. A qualified person should always be in a position to monitor the vessel's heading, watch for navigational hazards and should be prepared to revert to manual steering immediately if an undesired change of heading occurs, if the heading is not maintained within reasonable limits, or when navigating in a hazardous situation.*

***ALWAYS REMEMBER:***
***WHENEVER UNDER WAY, A QUALIFIED PERSON ON WATCH IS REQUIRED BY LAW.***

# CE COMPLIANCE

**This product is in compliance with the Electro-Magnetic Compatibility (EMC) standards of the European Community, and bears the CE mark. It was tested according to the applicable sections contained in:**

**CE Directives IEC 945:1994, BS EN 60945:1996**
**Marine Navigational Equipment, General Requirements**

**The applicable sections for methods of testing and required test results are:**

| | |
|---|---|
| **Section 4.5.4:** | **Radiated interference** |
| **Section 4.5.4:** | **Immunity to electro-Magnetic Environment** |
| **Annex A, Section A.3:** | **Immunity to conducted audio frequencies** |
| **Annex A, Section A.4:** | **Immunity to earth lead coupling** |
| **Annex A, Section A.5:** | **Immunity to conducted radio frequencies** |
| **Annex A, Section A.6:** | **Immunity to radiated interference** |

**The tests were done 05 & 06 July 2000. Results and a declaration of conformity are on file at:**

**ComNav Marine Ltd.**
**#15 13511 Crestwood Place**
**Richmond, BC V6V 2G1**
**Canada**

## USER NOTES

You can use this table to record the serial numbers of the components of your system, setup settings, any notes you made during installation, and any other information you might want to keep handy.

| |
|---|
| HEAD S/N: |
| PROCESSOR S/N: |
| COMPASS S/N: |
| RUDDER FEEDBACK S/N: |
| PUMP S/N: |
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