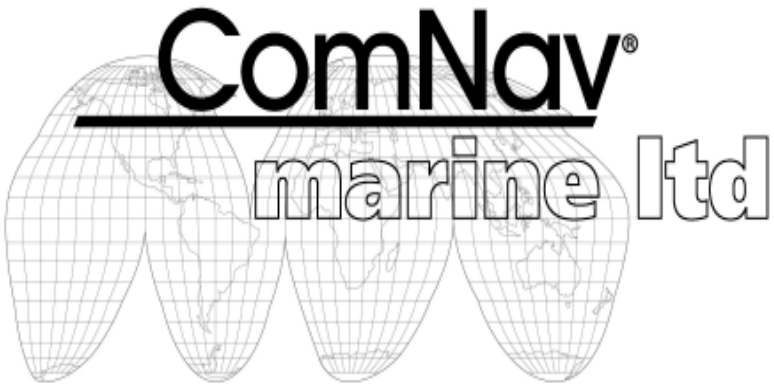


# 5001 Autopilot System
# Installation and Operation Manual

**Version 2.0**

| **Serial #** |
| --- |
| |

NOTE: In the case of differences of interpretation as regards the terms used in various translations of this manual, the English version shall be regarded as correct and shall supersede all other versions.


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CE

PN 29010020
January 2004

# Welcome

Congratulations on your purchase of ComNav Marine's 5001 Autopilot System! At ComNav, we are proud of our prominence as a leader in the design and manufacture of marine autopilot systems. Our dedication to performance and reliability will ensure your satisfaction with the ComNav 5001. Developed as a result of ComNav's many years of experience in autopilot design, the 5001 system provides better performance and more features than any other autopilot in its class.

Yours truly,

Richard Summers
Vice President Operations
ComNav Marine Ltd.

# 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 Section 9 of this manual.**

# Operator's Warning

**This Autopilot will automatically steer your vessel, 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. This 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.**

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# Table of Contents (continued)

# List of Figures and Tables

# 1. About This Manual

This manual provides essential information for the safe and reliable operation of the 5001 Autopilot System. You are urged to read this manual in its entirety before you use your Autopilot for the first time, and to keep it handy until you become thoroughly familiar with the operation of your Autopilot.

Throughout this manual, you will see a number of different typefaces used, as well as some distinct phrases, or "jargon". Please take a moment to become familiar with the following terms:

## Important Terms in this Manual

**Modes of Operation**
Specific "modes of operation" are placed in bold uppercase lettering.
Example: **POWER STEER** mode.

**Button**
5001Control Head buttons and controls are placed in uppercase lettering.
Example: the MENU button.

**System Component**
Specific system components are capitalized.
Example: the 5001Control Head, or a Handheld Remote Control.

**LCD Display**
Text that appears in the LCD display is in quotation marks.
Example: "E-Turn"

**"press"**
A button "press" refers to a single momentary activation of a particular button.

**"press and hold"**
Press and hold the indicated button for a minimum of one-half of a second.

This time delay is purposely programmed for the operation of some buttons to prevent casual or accidental activation of the button function.

**"maintain"**
Hold the indicated button for as long as required to achieve a given result.

For example, to dodge, press either the PORT DODGE or STARBOARD DODGE button, and maintain it in that position until the vessel has dodged clear of any obstructions in its path.

# 2. How Autopilots Work

The purpose of this section is to briefly describe in general terms what an Autopilot does and some of the things you should expect when using an Autopilot with your boat. As well as this section, you must carefully read all the operating instructions in other parts of this manual before operating your autopilot.

## Basic Autopilot System

Figure 1 is a block diagram of the major components of an Autopilot system.

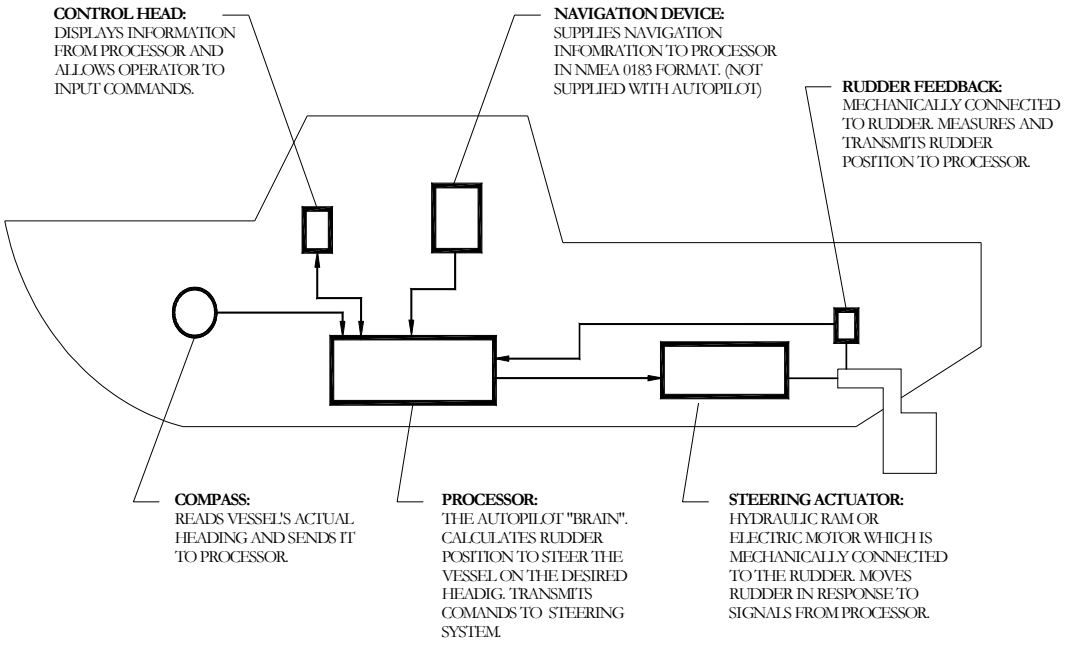



**Figure 1—Basic Autopilot System**

The Compass indicates the direction in which the boat is pointed, called the actual heading. Depending on the type of boat, you may be using a magnetic compass, an electronic fluxgate compass or a gyroscopic compass. A reliable Compass is absolutely vital to the autopilot because without a compass the pilot has no way of knowing which way the boat is headed.

The actual heading is fed electronically from the Compass to the Processor, which is the heart of the Autopilot. The Processor contains the microprocessors, electronic hardware and sophisticated control software necessary to steer the boat.

The Control Head, normally located in the wheelhouse, is the interface between the user (that's you) and the Autopilot. The Control Head displays information about what the Autopilot is doing. It has various controls (buttons or knobs) which allow the user to give commands to the Autopilot.

The final part of the picture is the steering system. In order for the Autopilot to steer the boat, there must be some sort of steering actuator capable of moving the rudder independently of the ship's wheel. This might be a hydraulic steering ram which acts on the tiller or an electric motor connected to the steering cables. Electronic signals from the Processor signal the Steering Actuator to move the rudder. Your Autopilot also will have a Rudder Feedback, a device which tells the Processor what position the rudder is in at any given time.

## Basic Operation

Say, for example, the Autopilot was steering your boat northwest and you wished to change direction to northeast. To initiate the turn you would turn the knob on the Control Head to set the desired heading to $45^0$ (i.e. northeast). The Processor would compare this to the boat's actual heading of $315^0$ (northwest), as indicated by the Compass, and calculate a difference of $90^0$. This in turn would cause the Processor to send a signal to the steering system to move the Rudder to starboard so that the boat turns to the right. The Processor verifies that the Rudder has moved by reading its position from the Rudder Feedback.

As the boat turns, the difference between the desired heading and the actual heading gets smaller and the Processor starts to 'back off" the rudder so that the boat does not overshoot the desired heading. Eventually, the actual heading will match the desired heading. The Processor will keep steering the boat on a heading of $45^0$, plus or minus $1/2^0$, until new instructions are received from the Control Head.

Figure 2 shows a vessel turning in **AUTOPILOT** mode.

Your ComNav Autopilot maintains a desired heading when it is in **AUTOPILOT** mode. When the user first selects **AUTOPILOT** mode, the Autopilot will use the current actual heading as the desired heading. This important feature prevents the Autopilot from executing an unexpected turn when you first select **AUTOPILOT** mode.

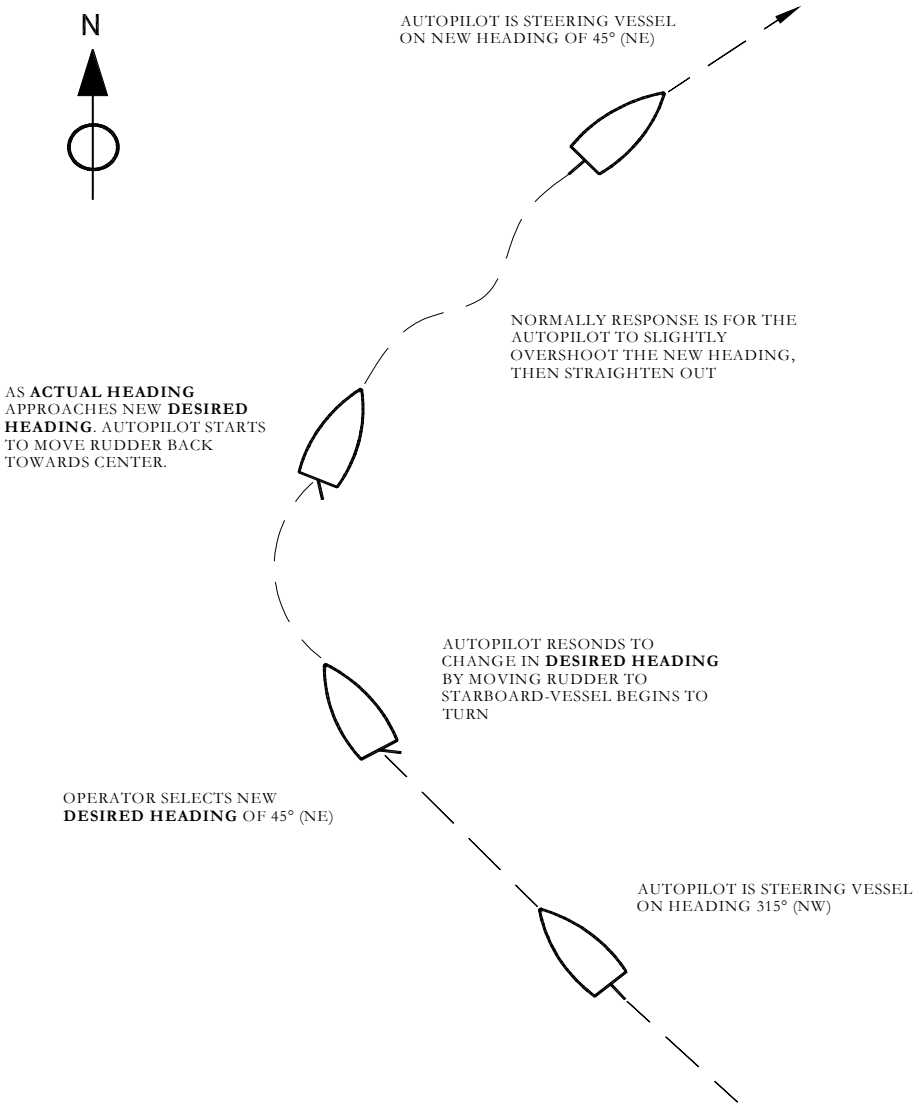



**Figure 2—Heading change in PILOT mode**

## Tide, Wind and Current

If your boat encounters a tide, crosswind or current, the boat will be pushed away from the desired heading repeatedly, each time in the same direction. After the Autopilot has made several corrections, the Processor will simply maintain the rudder a few degrees to port or starboard of the center position to counter the effect of wind, tide or current. This feature, known as “trim”, will keep your vessel pointed in the right direction.

## Following a Track With an Autopilot

So far, we have seen how an Autopilot operates in **AUTOPILOT** mode. In this mode, a new desired heading must be selected on the Control Head each time you wish to change direction. This is handy for short trips, when a boat is working or when you can see your objective. For longer trips, which might involve a number of legs, it would be useful to be able to pre-program your Autopilot to follow a given track. All ComNav Autopilots will allow you to do just that.

Before using this feature, the Autopilot must be connected to an external source of navigation data such as a LORAN C receiver, a chart plotter or a GPS receiver. Fortunately, most of the hundreds of commercially available navigation devices transmit data in the NMEA 0183 format, so interfacing a navigation device to the ComNav Autopilot is relatively simple.

A long passage will consist of a series of waypoints which are discrete locations on the water's surface defined by their latitude and longitude. These waypoints are entered into the navigation device. The navigation device is able to determine the current location of the boat and calculate a course to steer to reach the next waypoint.

Now the Autopilot is switched into **NAV** mode. The Processor reads the information from the navigation device, which includes a course to steer to the next waypoint and the crosstrack error, which is the distance (in nautical miles), from the boat to the desired track. Using these two pieces of information, the Processor steers the shortest possible course to the next waypoint. Tides, crosswinds or currents are compensated for automatically each time the navigation device updates the crosstrack error.

As the boat nears a waypoint, the Autopilot will alert the user by activating an alarm. When a waypoint is reached, the Processor will turn the boat to head to the next waypoint. If the last waypoint is reached, the boat will circle the waypoint until the Autopilot either is switched out of **NAV** mode or given new instructions. Because the boat will turn automatically and without input from the user, when planning the trip it is crucial that the user verify that there will be sufficient room to execute the turn at each waypoint.

## Power Steer

Some Autopilots have a **POWER STEER** mode which allows Full Follow Up steering. Control is usually through two buttons on the Autopilot. One button will move the rudder to STARBOARD, the other button will move it to PORT. Using the buttons, the rudder can be placed in any desired position where it will remain. This feature is useful when docking or maneuvering because the person steering the vessel can take their hands off the controls between rudder movements.

# 3. System Overview

The following section gives a brief description of the major components that comprise the 5001 Autopilot System, their function, and relationship to each other.

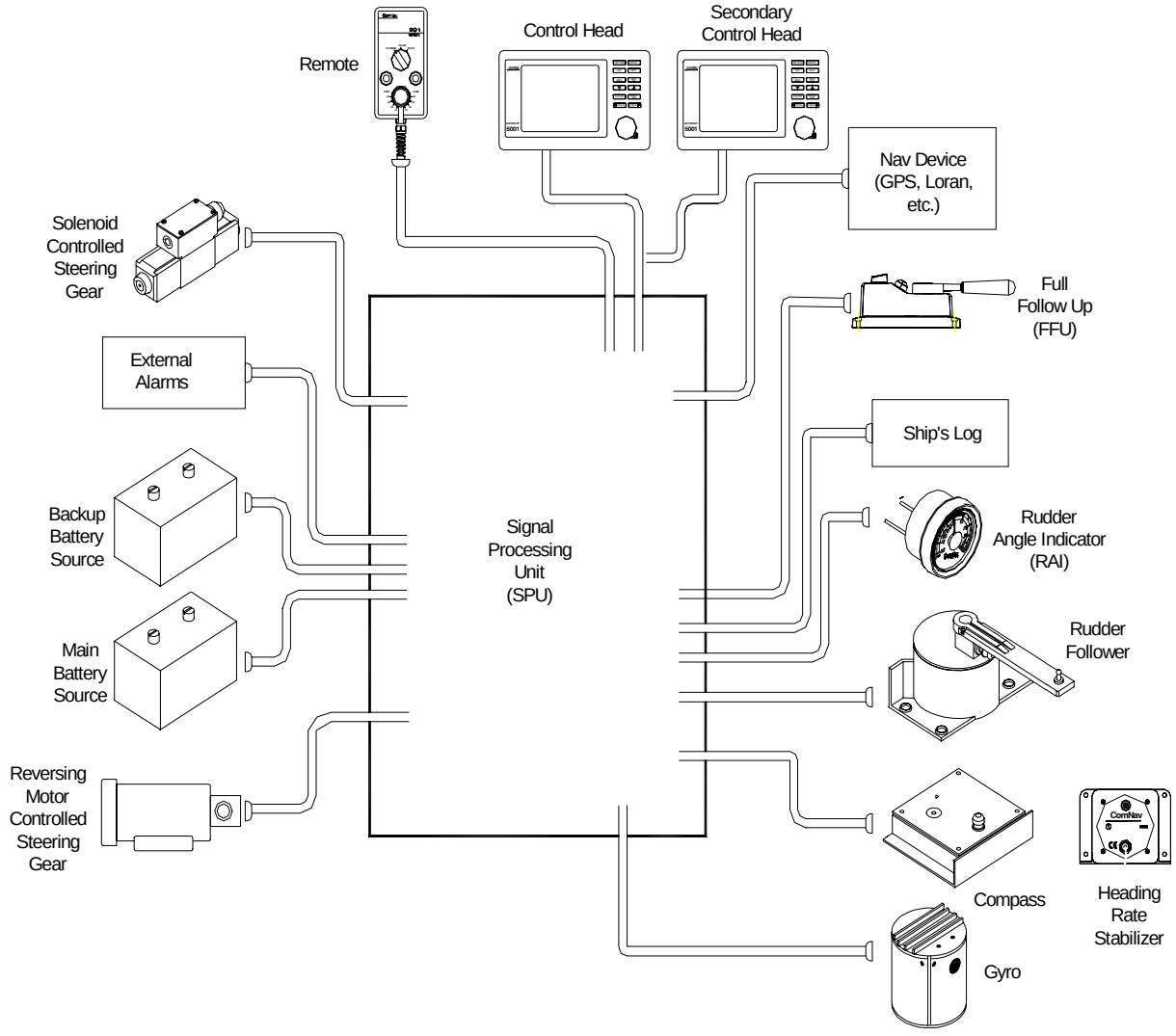
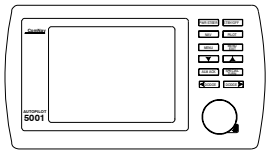



**Figure 3—Typical Autopilot System**
**(showing possible interconnections between the Autopilot System, accessories and external equipment)**

# Control Head



**5001 Control Head**
Part # 20020001

The 5001 Control Head provides a means for the user to control the Autopilot and monitor the system while it is in use.

The Control Head connects directly to the Signal Processing Unit (SPU), via a six conductor cable on the rear of the unit. This cable comes complete with a special connector on the end to allow it to quickly and easily plug into the Control Head receptacle on the SPU.

The 5001 Control Head may be surface or flush mounted directly to a console panel or secured using the stainless steel Angle Mounting Bracket included with the Autopilot System.

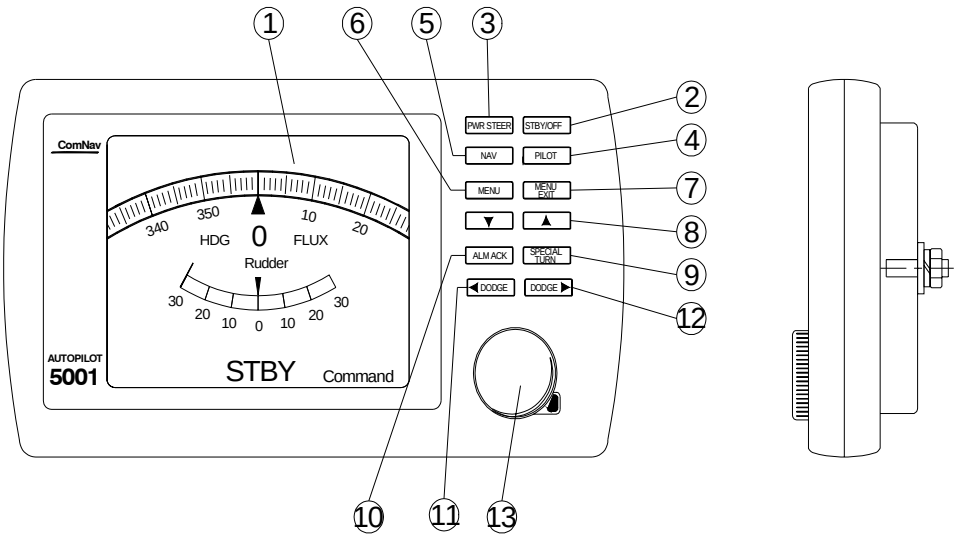



**Figure 4—5001 Control Head**

1) LCD SCREEN
2) STBY/OFF (Standby/Off) button
3) PWR STEER (Power Steer) button
4) PILOT (Autopilot) button
5) NAV (Navigate) button
6) MENU button
7) MENU EXIT button
8) ▲ and ▼ button
9) SPECIAL TURN button
10) ALM ACK (Alarm Acknowledge) button
11) Port DODGE button
12) Starboard DODGE button
13) ADJUSTMENT KNOB

**1) LCD SCREEN**
When the Autopilot power is on, the screen displays the compass heading and rudder angle. It also displays additional information such as mode of operation and various menus. These items are displayed in response to the various command buttons listed below. Pressing both the ▲ and ▼ buttons displays BRIGHTNESS on the left side of screen. Pressing both buttons again displays CONTRAST. Make your selection and adjust accordingly using the ▲ or ▼. Adjustments can not be made once a MENU is displayed.

**2) STBY/OFF button**
When power is initially turned on, "STBY"(STANDBY) appears at the bottom of the display screen. While in this mode, the Autopilot will not exert any control over your vessel. **STANDBY** mode is used when you want manual control of the vessel, or when you want to change the Autopilot parameters via the various menus available.

When pressed and held for approximately 2 seconds, this button turns off the Autopilot. See "Getting Started" for more detail.

**3) PWR STEER** (POWER STEER) **button**
When pressed, this button places the Autopilot into **POWER STEER** mode. This mode allows you to steer the vessel through the Autopilot by using the ADJUSTMENT KNOB or by pressing and holding the DODGE PORT and DODGE STARBOARD buttons.

**4) PILOT** (AUTOPILOT) **button**
Pressing this button places your vessel in the hands of the 5001 Autopilot. You can control the vessel's heading by using the ADJUSTMENT KNOB. Obstacles can be avoided by using the DODGE PORT or DODGE STARBOARD buttons.

**5) NAV** (NAVIGATION) **button**
If your vessel is equipped with a GPS, Loran C, or another Navigation Device, this button enables the Autopilot to steer from NMEA 0183 data provided by those devices.

**6) MENU button**
Pressing this key takes you to the MAIN MENU. Pressing a second time takes you to the sub-menu that is highlighted on the screen.

**7) MENU EXIT button**
Pressing this button while in a sub-menu or MAIN MENU clears the MENU system from the display.

**8)** ▲ and ▼ buttons
Pressing up arrow moves you to the previous selection while, pressing down arrow moves you to the next selection. They also adjust BRIGHTNESS and CONTRAST and KEYPAD backlighting.

**9) SPECIAL TURN button**
Pressing this button while in **AUTOPILOT** mode initiates one of three turn sequences: a U-turn, Emergency Turn, or a Continuous Circle Turn. The turn is not executed until either the DODGE PORT or the DODGE STARBOARD button is pressed to indicate in which direction the turn is to be made. The type of turn to be executed must be pre-selected from the USER CONFIG menu.

**10) ALM ACK (Alarm Acknowledge) button**
Pressing this button turns off the audible alarm and lets the Autopilot know that you have acknowledged an alarm.The ALARM remains displayed on the LCD until it is cleared.

**12) DODGE PORT button**
Pressing and holding this button in **PWR STEER** mode moves the rudder to port for as long as the button is held. Pressing this button while in **AUTOPILOT** or **NAV** modes allows you to avoid obstacles in the vessel's path by turning to port. Releasing the button automatically recovers your original heading or track afterwards.

In **POWER STEER**, **AUTOPILOT**, or **NAV** mode, pressing both **DODGE** buttons simultaneously centers the rudder.

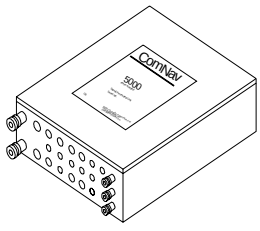
**13) DODGE STARBOARD button**
Pressing and holding this button in **PWR STEER** mode moves the rudder to starboard. Pressing this button while in **AUTOPILOT** or **NAV** modes allows you to avoid obstacles in the vessel's path by turning to starboard. Releasing the button automatically recovers your original heading or track afterwards.

In **POWER STEER**, **AUTOPILOT**, or **NAV** mode, pressing both **DODGE** buttons simultaneously centers the rudder.

**14) ADJUSTMENT KNOB**
In **PWR STEER** mode, one turn 'click' of the **KNOB** changes the rudder angle by 1 degree. A quick turn 'spin' of the **KNOB** moves the rudder approximately 10 degrees in **PWR STEER** mode.

In **AUTOPILOT** mode, one turn 'click' of the **KNOB** changes the commanded course by 1 degree. A quick turn 'spin' of the **KNOB** moves the commanded course approximately 10 degrees when in **AUTOPILOT** mode.

# Signal Processing Unit (SPU)




**5001 Signal Processing Unit**
Part # 20020003

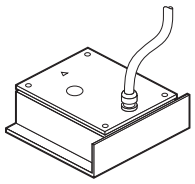
The SPU, as its name suggests, accepts a number of signals from the other components of the Autopilot System and processes them as necessary to control the movement of the vessel's rudder so as to maintain a given heading. As well as steering the vessel, the sophisticated software within the SPU continually checks all aspects of the Autopilot's performance, and will advise the user via the Control Head if any problems are detected.

The SPU comes complete with knockout plugs and weatherproof glands to support additional cables.

# Compasses

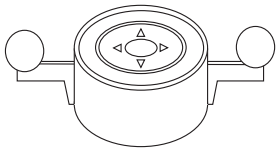
The 5001Autopilot will function with heading input from either a ComNav Fluxgate Compass or Magnetic Compass with a 12 KHZ Compass Sensor.

## Fluxgate Compass



**Fluxgate Compass**
Part # 20320004

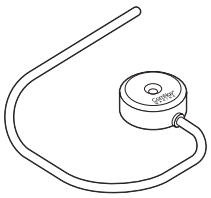
Specifically designed for ComNav autopilots, the ComNav Fluxgate Compass directly senses the earth's magnetic field. The unit incorporates a heeling coil for better performance when the vessel is either rolling or heeled. The Fluxgate Compass is a sealed, waterproof unit, 142 mm (5.6") square which may be mounted on a deck, shelf or bulkhead. A single connection with a 12 m (40') cable plugs into a special interface cable (Part # 31110024) which is wired into the 5001SPU.



**Binnacle Mount Compass**
(6" binnacle compass shown)

## Magnetic Compass

ComNav can supply high quality, externally gimbaled Magnetic Compasses of either 5" or 6" diameter. These compasses may be purchased as either bracket mount or binnacle mount. Compensating spheres and arms are available for binnacle compasses. Consult your ComNav dealer or the factory for part numbers.



**Bottom Mount**
**12KHZ Compass Sensor**
Part # 30320002

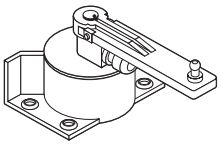
## Magnetic Compass Sensor

The 12 KHZ Magnetic Compass Sensor senses the position of the compass card of an externally gimbaled magnetic compass. The sealed unit attaches to the bottom of a ComNav supplied magnetic compass. A single connection with a 3 m (10') cable plugs into a special interface cable (Part # 31110024) which is wired into the 5001SPU.

## Other Compasses

ComNav recommends the use of ComNav supplied compasses for best 5001 performance but you may choose to use either a fluxgate compass or a magnetic compass from another manufacturer. See your dealer or contact the factory for information on interfacing these compasses with the 5001Autopilot.

# Rudder Follower



**Medium Duty Rudder Follower**
Part # 20330008

The 5001Autopilot is normally supplied with a ComNav Medium Duty Rudder Follower.

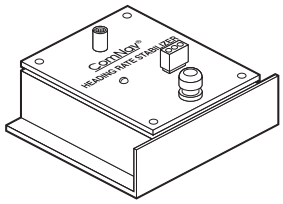
The Rudder Follower is used to transmit the position of the vessel's rudder to the SPU. It should be connected to whichever part of the steering system the Autopilot controls. Normally, this is the vessel's rudder, however, if the vessel has 2-stage steering where the Autopilot drives a control or servo ram, the Rudder Follower should be mounted to the servo ram rather than the rudder.

Some 5001 Installations may use a ComNav Linear Feedback (Part # 20330002) or a Heavy Duty Rudder Follower (Part # 20330012). Separate installation instructions are included with these Rudder Followers.

# Optional Equipment

This subsection describes optional equipment that may be configured into the Autopilot System. These are Auxiliary Station Control Heads, Remote Controls, Jog Switches, Remote Control Expanders, Heading Rate Stabilizers and Rudder Angle Indicators (RAI).

## Heading Rate Stabilizer



**Heading Rate Stabilizer**
Part # 20320005

Perhaps the single greatest factor affecting Autopilot performance is the quality of the compass heading information it receives. Compass error due to pitch and roll, high turn rates and high speed turns are common to both fluxgate and magnetic compasses.

Northerly turning error is another phenomenon that affects both types of compasses, particularly at higher latitudes, due to an increase in the earth's vertical magnetic field component.

The sideways acceleration of a vessel in a high speed turn will also affect the accuracy of compasses.

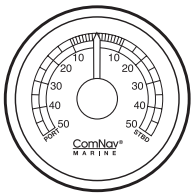
ComNav's Heading Rate Stabilizer minimizes the effect of these factors.

The Heading Rate Stabilizer measures the horizontal component of the rate of change in the vessel's heading and adjusts the compass reading to minimize the effects of pitch and roll, fast turn rates and northerly turning error.

The heading output provided to the Autopilot is dramatically improved in terms of dynamic responsiveness and stability, enabling the Autopilot to perform more accurately and efficiently.

The ComNav Heading Rate Stabilizer is designed to work with ComNav's Fluxgate Compass (Part # 20320004).

## Rudder Angle Indicator (RAI) 3”




**Rudder Angle Indicator**
Part # 20360014

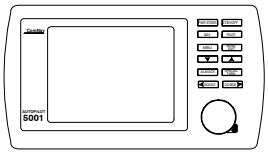
The ComNav RAI is a backlit 3 inch (76mm) gauge that displays the actual position of the vessel’s rudder. The RAI is flush mounted, encased in high impact resistant polycarbonate plastic with a water resistant front face, and requires a lighting voltage supply of 12, 24 or 32VDC.

An optional Bezel Kit (Part # 30360004), Wheelhouse Case (Part # 20360017) and Watertight Case (Part # 20360016) are available.

## Secondary Control Heads

Means are provided for the 5001 Autopilot to accept an Auxiliary Station. This may be either a second 5001 Control Head functioning as a remote unit, or a ComNav Handheld Remote. Up to 3 Auxiliary Stations can be added. If the optional Remote Expander is added, the Autopilot can also support up to 4 Handheld Remotes.

## Auxiliary Station

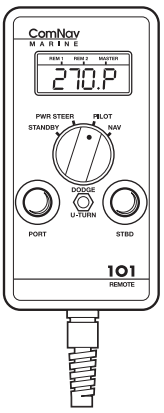



**5001 Auxiliary Station Control Head**
Part # 20020002

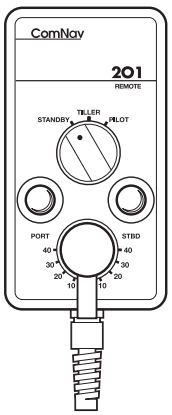
The 5001 Auxiliary Station is identical to the 5001 Control Head. It has all the functions of the main Control Head and comes complete with a connection cable and mounting bracket.

## Remote Controls

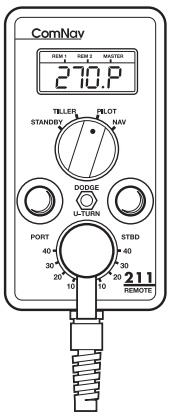
Figure 5 shows some of the Remote Control devices that are compatible with the 5001Autopilot. In addition to remote control of the Autopilot, some of these devices provide the capability of remotely operating compatible engine control systems. There is also an Interface Cable, Remote to 5001 (Part # 31110025). It interfaces ComNav's 101, 201, 211, and TS-202 remotes to the 5000 Series Compass Interface Card. Each of these devices comes with its own operating and installation instructions. See your ComNav dealer or contact the factory for more information on selecting, purchasing and installing Remote Controls.



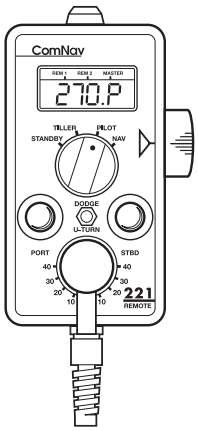

**101 Remote with Power Steer**
Part # 20310007



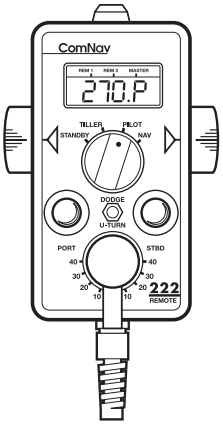

**201 Remote with Tiller**
Part # 20310013



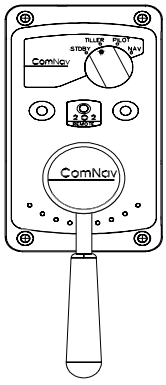

**211 Remote with Tiller**
Part # 20310015



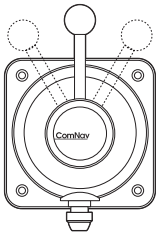

**221 Single Engine Remote**
Part # 20420002



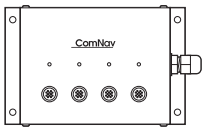

**222 Dual Engine Remote**
Part # 20420005




**TS-202 FFU (Full Follow Up)**
Part # 20310020




**Jog Switch NFU (Non Follow Up)**
Part # 20310002




**Remote Control Expander**
Part # 20310017

**Figure 5 —ComNav Remote Controls for use with 5001Autopilot**

# 4. Installation

## Technical Requirements

This subsection describes the technical requirements that should be met before installation of the ComNav 5001 Autopilot System.
These include Steering System and Power Supply.
**THE WARRANTY ON THIS PRODUCT MAY BE EXTENDED IF INSTALLATION IS PERFORMED BY A COMNAV DEALER. REFER TO THE WARRANTY SECTION OF THIS MANUAL BEFORE PROCEEDING WITH INSTALLATION.**

**HAZARD WARNING !!!**

- **CAUTION:** Extreme caution is advised when using tools powered by alternating current (AC) from household type mains. Water is an excellent conductor and can complete a path to ground through a person's body, **causing injury or death**, if a tool malfunctions or short circuits. Battery powered tools are recommended. If AC tools are used they must be plugged into a circuit which is adequately protected in accordance with local electrical codes.

**Steering System**

- To obtain the best performance from your Autopilot, your vessel's steering system must be in good working order. The hydraulic system should be bled, and should be operating with minimal play.

**Power Supply**

- For reliable and optimal operation of your Autopilot, your vessel's power supply system must have an adequately breakered DC (direct current) power supply at a nominal voltage of either 12, 24, or 32 volts. If the circuits are fused, a switch should also be provided. Ensure that adequate wire sizes are used to handle expected maximum currents.

**Special Tools**

- A 2.5mm [0.1"] slotted screwdriver is required for tightening the small terminals.

- Other general purpose items such as portable drill, pliers, wire cutters, screwdrivers, wire, mounting bolts and wrenches will also be required.

# Control Head

The 5001 Control Head is normally mounted in the vessel's wheelhouse. It can also be mounted in more exposed locations, such as on a flying bridge. Although the Control Head is waterproof, it should not be submerged, nor should it be exposed to prolonged direct sunlight. The Control Head comes with a 12.5m [41'] cable with connector.

## Surface Mounting

1. Ensure that the location you choose for the 5001 Control Head has a behind-the-panel clearance of at least 51mm [2"] to allow for the cable and connector. (See Figure 6b).

2. Use the Angle Mounting Bracket as a template to mark the center location of the two holes on to the panel surface where the Control Head will be mounted. Measure and mark the distance on the panel for the Control Head cable connector. (See Figure 6a).

3. Drill two holes at 6.5mm [1/4"] diameter into the panel. Drill a 25 mm [1"] diameter hole to accommodate the 5001 Control Head cable plug.

4. Feed the connector end of the Control Head cable through the large hole in the panel. Connect and tighten to the back of the Control Head.

5. Ensure that the mounting screws supplied with the Control Head are threaded all the way into the brass inserts on the rear of the Control Head. Line up the mounting screws with the corresponding holes drilled into the panel, and lie the Control Head flat on the surface of the panel.

6. Secure the Control Head with the flatwashers, lockwashers, and hexnuts provided to the mounting screw.

7. Route the Control Head cable to the SPU.

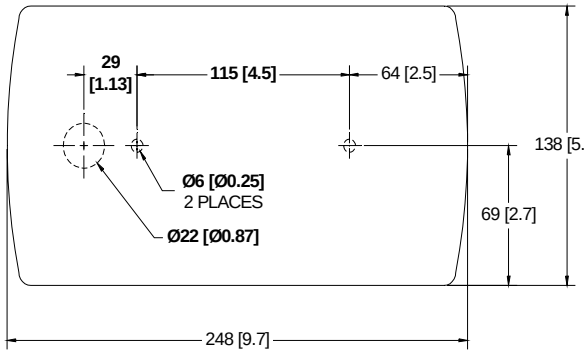



**Figure6a—5001 Control Head Mounting Hole Locations**

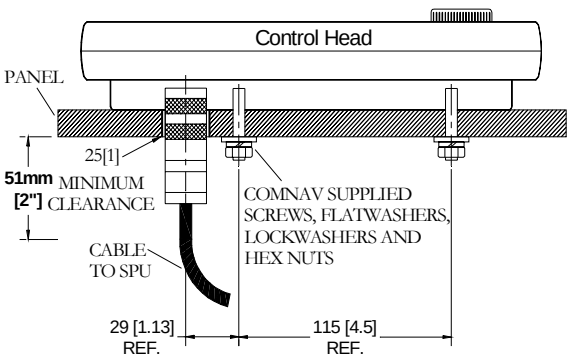



**Figure 6b—5001 Control Head Surface Mounted**

## Flush Mounting

1. Ensure that the location you choose for the 5001 Control Head has a behind-the-panel clearance of at least 51mm [2”] to allow for the cable and connector. Ensure that the mounting screws supplied with the Control Head are threaded all the way into the brass inserts on the rear of the Control Head.

2. Cut out panel for Control Head to sit in. Lay the Control Head flat on the surface of the panel. (See Figure 7a).

3. Feed the connector end of the Control Head cable to the back of Control Head. Connect and tighten.

4. Line up inside hole of the supplied brackets and insert over mounting screws. (See Figures 7a & 7b). Secure the Control Head with the supplied brackets, flatwashers, lockwashers, and hexnuts provided to the mounting screw. Note: There are 4 mounting holes drilled in the supplied brackets. These can be used to further secure the unit if desired.

5. Route the Control Head cable to the SPU.

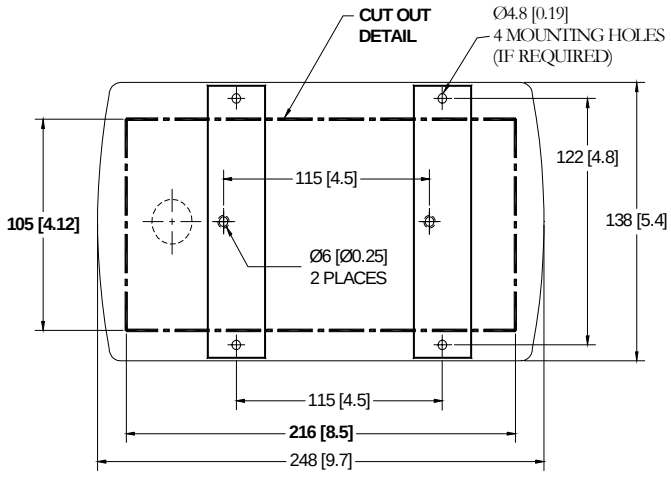



**Figure 7a—5001 Control Head Rear View**

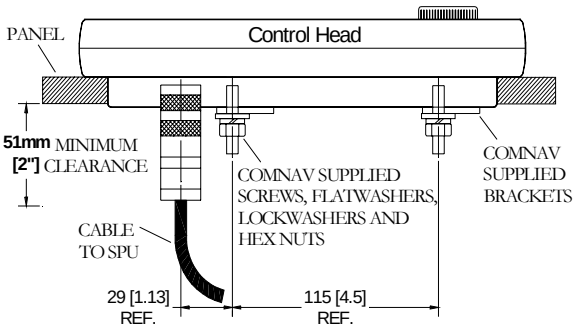



**Figure 7b—5001 Control Head Flush Mounted**

## Angle Bracket Mounting

1 . Ensure that the location you choose for the 5001 Control Head and bracket has sufficient clearance to allow for the cabling behind the unit.

2. Using the Angle Mounting Bracket as a template, mark the location of the two mounting holes on the panel surface to which the bracket will be attached. Mark the location on the panel surface for the cable to SPU. (See Figure 8a).

3. Drill two 6mm [1/4”] diameters in surface panel for mounting the Angle Mounting Bracket. Drill out 25mm [1”] diameter in surface panel for cable. Position the Angle Mounting Bracket over the mounting holes and secure it with customer supplied fasteners.

5. Ensure that the mounting screws supplied with the Control Head are threaded completely into the brass inserts on the rear of the Control Head. Line up the mounting screws with the corresponding holes on the Angle Mounting Bracket. Lay flat the Control Head on the Angle Mounting Bracket.

6. Secure the Control Head mounting screws with the flatwashers, lockwashers, and hexnuts provided.

7. Route the Control Head cable to the SPU.

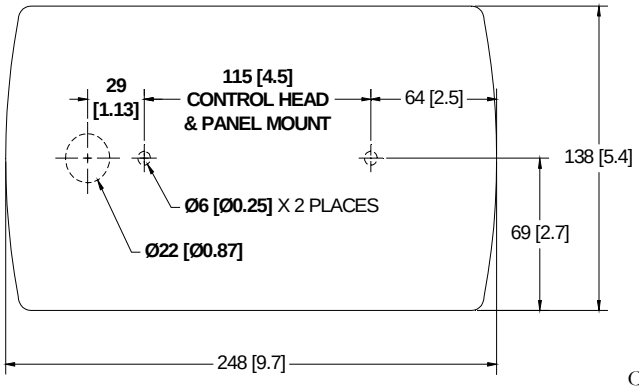



**Figure 8a—5001 Control Head Back View**

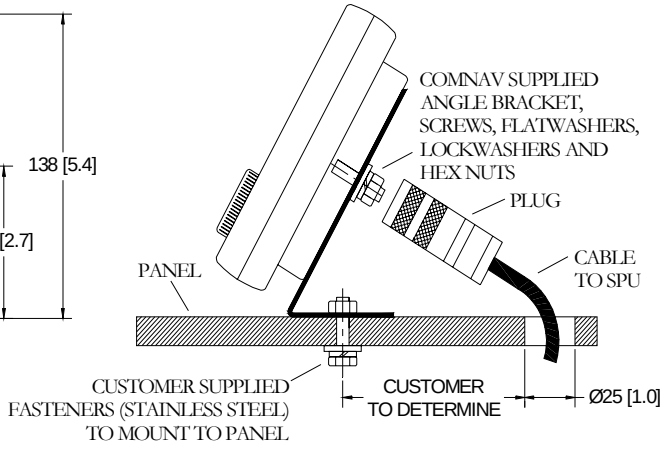



**Figure 8b—Angle Bracket Mounting**

# Signal Processing Unit

The SPU should be mounted in a clean and dry area, away from heat, moisture and salt water. The SPU should be centrally located and mounted at least 1m [3’] from the compass due to possible electrical interference. It can be mounted in a vertical or horizontal position, whichever is best for routing cable.

1. Determine a suitable location for the SPU. Ensure there will be adequate clearance for the cables.

2. Remove the 4 screws holding the SPU lid to the box.

3. Locate the 4 mounting holes in each corner. Mark the center location of the 4 mounting holes of the SPU on to the mounting surface. (See Figures 9a & 9b). Drill accordingly.

4. Mount SPU to the panel surface using customer supplied 6mm (1/4”) stainless steel fasteners.

Note: The SPU is supplied with plastic knockout caps installed. Do not remove any caps unless there is a cable gland to replace it. Damage to internal components caused by exposure will not be repaired or covered under warranty.

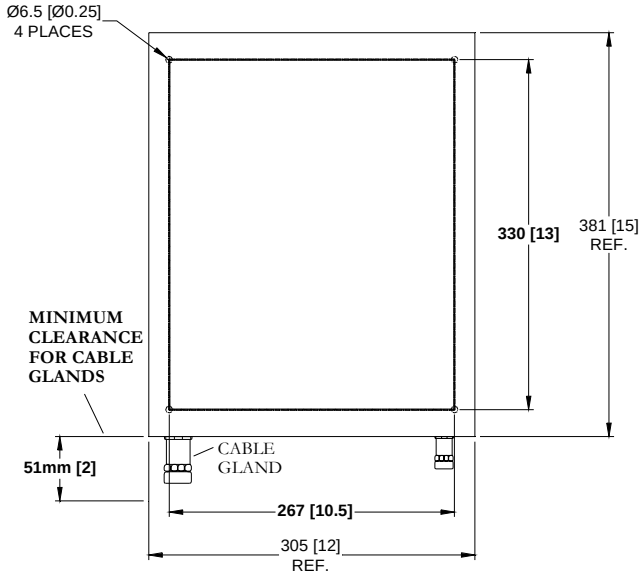



**Figure 9a—SPU Mounting Dimensions**

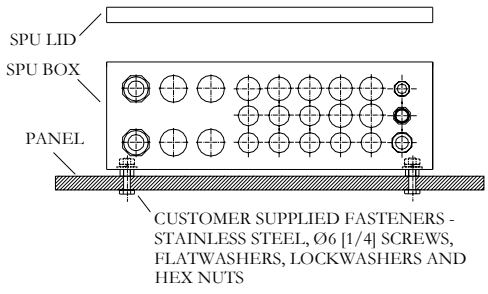



**Figure 9b—SPU Mounting Detail**

# Compass Installation

The 5001Autopilot is normally supplied with either a ComNav Fluxgate Compass or a magnetic compass with a ComNav Magnetic Compass Sensor. The choice of compass depends on the type and intended use of the vessel. Refer to the appropriate section below for installation instructions for your compass.

When first installed, most compasses will have a deviation which is the error between the compass reading and the vessel's actual heading. Deviation is a result of magnetic fields induced in the vessel's hull (for steel vessels) and fields from objects such as engines, davits, galley equipment, etc. If you have a ComNav Fluxgate Compass, the 5001Autopilot can compensate for the deviation. This is done during the Sea Trials. If you have a magnetic compass, it will have to be manually compensated. This job is often done by a professional compass adjuster.

If you intend to use a fluxgate compass other than a ComNav Fluxgate Compass, or if you are using a magnetic compass not supplied by ComNav, you should contact your dealer or the factory for instructions on how to install and setup your compass.

**NOTE: DO NOT PERMANENTLY INSTALL THE COMPASS UNTIL SEA TRIALS ARE COMPLETE. DEPENDING ON THE OUTCOME OF THE SEA TRIALS, IT MAY BE NECESSARY TO RELOCATE THE COMPASS.**

## ComNav Fluxgate Compass

Choose a location for the Fluxgate Compass.

For best performance, the Fluxgate Compass must be mounted as close as possible to the vessel's center of pitch and roll. This is typically low in the vessel, at or about the waterline, and slightly aft of the center of the vessel.

You must keep the compass at least 1m (about 3') away from engines, electric motors, and other magnetic objects.

Holes are provided to attach the Fluxgate Compass to either a bulkhead or to a horizontal shelf or deck. The compass must be mounted parallel to, and as close as possible to the centerline with the arrow labeled "BOW" pointing forward. The cable should be coming out of the top of the unit.

Wiring the Fluxgate Compass to the SPU is accomplished most easily by first wiring the “Fluxgate/HRS to 5001 Interface Cable” (Part #31110024) to the SPU as per the instructions included with the interface cable. Then, simply plug the Fluxgate Compass cable onto the interface cable until it snaps into place. If the 12m (40') cable is too short, plug-in Compass Extension Cables are available in various lengths from your ComNav dealer. Cutting and splicing the Fluxgate Compass cable is NOT recommended.

## Magnetic Compass Sensor

The advantage of using a Magnetic Compass with a Magnetic Compass Sensor attached to it is that the Autopilot is sensing the position of the magnets on the compass card rather than sensing the earth’s magnetic field directly.

Since the card of the compass has physical inertia, it does not react immediately to the changes in the magnetic field it is immersed in, but only to those changes which persist long enough to overcome the resistance of the compass card to movement. This means that the compass is a more stable heading reference than a Fluxgate Compass. The Magnetic Compass will largely ignore changes in the magnetic field in the plane of the compass card caused by vessel motion to which the Fluxgate Compass may react.

This is particularly important in high latitudes, (such as Alaska, Labrador or the North Sea), where the horizontal component of the earth’s magnetic field (which is the portion that the compass is trying to detect) is very small relative to the magnetic field of the vessel.

The disadvantage of the Magnetic Compass is that in very rough weather with the vessel going to windward, it is possible for the vessel motion to upset or “tumble” the compass card, disabling the Autopilot.

Because of the relative insensitivity of the Magnetic Compass to both the earth’s and the vessel’s vertical magnetic fields (due to its inertia), it is recommended for use at latitudes higher than 50 degrees (north or south), and for use on steel vessels when optional quadrantal spheres are included.

Locate and mount the compass in a position which minimizes magnetic interference. The compass should be at least 1m [about 3’] away from such equipment as radios, radars, depth sounders, and engine instruments.

The compass can be used as a steering compass if desired. If the amount of cable supplied is too short to reach the SPU, obtain an extra plug-in length of cable from your ComNav dealer. Cutting and splicing the compass cable is NOT recommended.

To reduce the possibility of the card 'tumbling' in rough weather, mount the compass as close as practical to the center of pitch and roll. Mounting the compass far forward under a bunk or similar location is a poor choice for rough weather performance.

## IMPORTANT!

**It is important to remember that the compass is a vital part of the 5001 Autopilot System. Locating it properly, particularly on steel-hulled vessels, is essential to ensure proper operation of the Autopilot. We recommend that the services of a qualified compass adjuster be used to select the best installation location and to compensate the compass properly for deviation, including that caused by heeling error.**

**Care must be taken not to place compensating magnets too close to the compass, as this will cause the Compass Sensor, mounted underneath the compass, to read incorrectly. To correct compass deviation on steel vessels, or on other vessels with magnetic compensating problems due to interference from adjacent iron masses such as an engine block or winches, the use of a pair of compensating quadrantal spheres is recommended.**

## Mounting ComNav Compass Sensor

A ComNav Sensor can be mounted to a wide variety of 'externally gimballed' compasses. The sensor SHOULD NOT be attached to 'internally gimballed' compasses (where the compass card is gimballed and the bowl of the compass is not), because the compass card does not remain parallel to the sensor when the vessel rolls or pitches, resulting in large errors between the compass and the Autopilot.

Mounting the Sensor above the compass reduces the possibility of interference from the compensating magnets, but also reduces the visibility of the compass.

The Sensor can be mounted to the bottom of the compass using the brass screw supplied, or it may be bonded directly to the compass bowl using a suitable adhesive. The Nylon Washer should be placed between the Compass Sensor and the bottom of the compass bowl.

Ensure that there is sufficient slack in the cable to allow the compass bowl to tilt and rotate freely in all directions. If the 3m (10') cable is too short, plug-in Compass Extension Cables are available in various lengths from your ComNav dealer. Cutting and splicing the Magnetic Compass Sensor cable is NOT recommended.

Because the Sensor mounts to the bottom of the bowl, the magnetic compass may be used as a steering compass if desired.

Optimum positioning of the sensor can only be accomplished once the Autopilot system has been installed and powered up. See the SETUP section of the manual to perform this procedure.

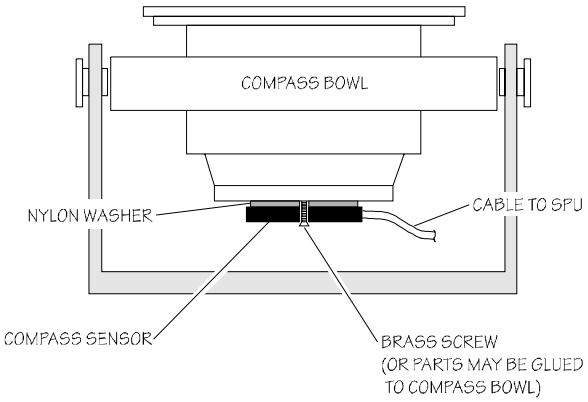



**Figure 10—Magnetic Compass Sensor Installation**

## ComNav Heading Rate Stabilizer

Steel-hulled vessels and vessels constructed of ferro-cement need special consideration for the type and location of the Autopilot compass. Some advantage may be realized by augmenting a fluxgate compass with a ComNav Heading Rate Stabilizer on these types of boats.

When using a ComNav Fluxgate Compass and a Heading Rate Stabilizer on steel-hulled or ferro-cement vessels, the Fluxgate Compass needs to be installed at least 2m (6') above the metal decking or other metal structures. It should be mounted on an aluminum or other non-ferrous pedestal. You may mount it on an existing mast bracket as long as it is well away from radar or other high-powered antennas.

The Heading Rate Stabilizer may be mounted anywhere, but for best results it should be mounted at a distance of 40cm (16") to 100cm (39") from the Fluxgate Compass. This ensures that it will be subjected to the same accelerations as the Fluxgate Compass.

Complete Installation details are covered in the Heading Rate Stabilizer manual.

# Rudder Follower

The Rudder Follower is used to transmit the position of the rudder back to the Autopilot. It should be connected to whatever parts of the steering system the Autopilot controls. Normally, this will be the vessel's rudder. However, if the vessel has 2 stage steering, where the Autopilot drives a control or servo ram, the Rudder Follower should be mounted to the servo ram rather than to the rudder.

Normally the Rudder Follower is mounted in the stern of the vessel, close to the rudder post. A mounting base may have to be fabricated to position the Rudder Follower properly. Mount the Rudder Follower in a location where the possibility of damage from any equipment stowed in the area is minimized.

Mount the Rudder Post Arm on the rudder post using a stainless steel band clamp (not supplied). Bolt the ball joint to the hole in the Rudder Post Arm corresponding to the diameter of the Rudder Post in inches, making sure the ball is facing upwards. Mount the Rudder Follower so that the Rudder Follower Arm is the same height as the Rudder Post Arm. ***The Rudder Follower is centered when the arm is directly above the cable gland (see Figure 11).***

The distance between the centerline of the Rudder Post and the Rudder Follower must not exceed 24 inches. Make sure that the ball joints on the Rudder Arm and Rudder Follower arm are facing upwards as shown in Figure 11. Snap the rod assembly onto the ball joints. Be sure to close the release clamps on each socket. Refer to Figure 11, and adjust the length of the rod to get the correct geometry with the rudder dead-ahead.

If the locking screw in the Rudder Follower arm has been loosened, or the arm removed from the Rudder Follower, re-attach the arm and check the potentiometer center position. When the rudder is dead-ahead, the electrical resistance between the black and green wires and the white and green wires should be equal (approx. 600 ohms each).

Be careful to check the installation for any mechanical obstructions or binding of the linkage, and correct it now, before it becomes a problem.

The Rudder Follower is supplied with approximately 15.5m (50') of cable. Run the cable from the Rudder Follower towards the SPU, ensuring that a hose or conduit protects it wherever it passes through fish or cargo holds, or any other area where it could be damaged.

If the length of cable supplied is too short to reach all the way to the SPU, obtain a terminal strip and sufficient additional cable from your dealer. Mount the terminal strip in a convenient DRY location.

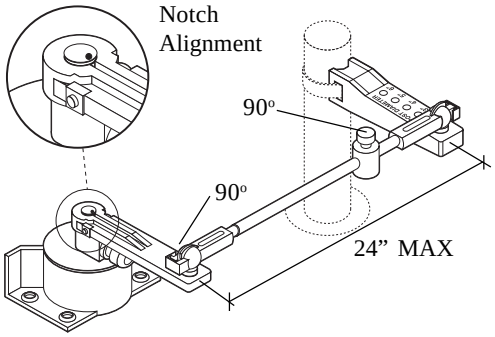



**Figure 11—Rudder Follower Linkage Detail**

## Other Rudder Followers

The ComNav Heavy Duty Rudder Follower and the ComNav Linear Feedback are also compatible with the 5001Autopilot. If you have purchased one of these devices, follow the installation instructions supplied with the unit.

# NMEA 0183 Output

The 5001 Autopilot system provides data output in NMEA-0183 format. This output can be used to send information from the 5001 Autopilot to other devices capable of listening to NMEA-0183 sentences. Two sentences are sent: $HDG, which contains information about the vessel's actual heading, and a proprietary sentence called $PCMNS.

$HDG is transmitted at a rate of 10 times per second, suitable for displaying heading on ARPA radar screens. HDG normally contains information about magnetic sensor heading, deviation, and variation. However, since the autopilot cannot know the deviation or variation for a given vessel and position, this information is transmitted as "null" (empty) fields, as per the NMEA specifications.

$PCMNS is transmitted at a rate of once per second. This sentence contains information about the status of the autopilot system. It is generally only used for factory diagnostics.

Details of the sentence structure for each of these sentences is given in section 11 of this manual.

The two data sentences are automatically output on the "TX" line of the port labeled "RS-232" located on the Processor card. If the "COMM" port is also configured as an output, these sentences will be sent out of the "COMM" port too. The "COMM" port can be changed to an output port by means of the COMM PORT TYPE variable in the SETUP, CONFIG MENU.

**Connecting NMEA OUTPUT through the COMM port:**
1. From the COMM port, use a shielded cable having two conductors to connect the terminals labeled "NMEA 'A'" and "NMEA 'B'" to the terminals labeled 'A' and 'B' on the listening device. Sometimes the listening device terminals are labeled '+' and '-', which correspond to 'A' and 'B' respectively, or 'SIG' and 'RTN' which also correspond to 'A' and 'B' respectively.
2. The shield should be connected to the terminal "SHIELD" on the 5001 only. Do not connect the shield to the receiving device, ship's ground, battery negative, or any other device.

**Connecting NMEA OUTPUT through the RS-232 port:**
1. Connect the "TX" terminal on the RS-232 terminal block to the RX line of the listening device.
2. Connect the "SIG GND" (signal ground) terminal to the Signal Ground line of the listening device.
3. Connect the cable shield to the "SHIELD" terminal on the RS-232 terminal block. Do not connect the shield to receiving device, ship's ground, battery negative, or any other device.

# Signal Processing Unit - Component & System Option(s) Interconnections

Figure 12 is a typical example of the SPU showing possible interconnections between the Autopilot System, accessories and external equipment. Note: All cable connections are made from one side of the SPU Box.

Once you have mounted the SPU, Control Head, Compass and Rudder Follower, you are ready to begin the wiring procedure.

**Warning:** Do NOT apply power until the final check procedure has been completed.

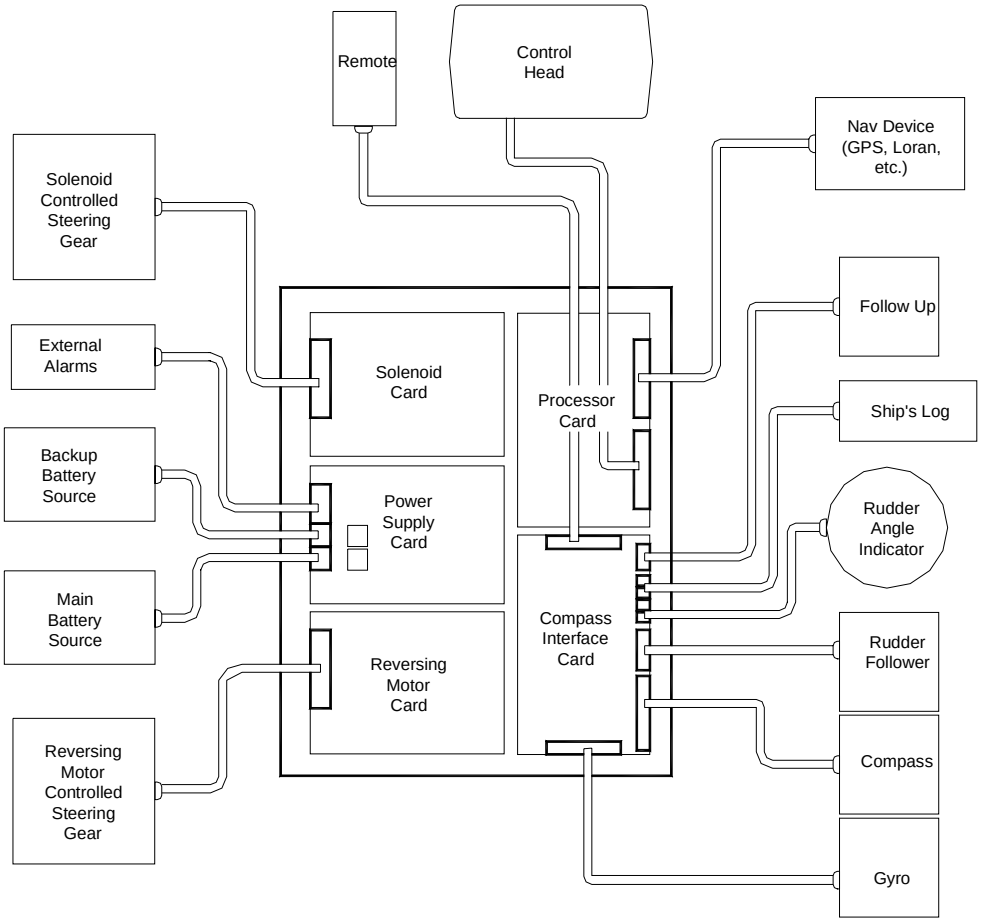



**Figure 12—SPU System Options Interconnections to PCB Cards Typical Example**

Please note the minimum recommeneded wire gauges provided for each component as shown in Table 1.

1. Route all cables through the glands supplied into the SPU. If more glands are required, obtain a 5001 Accessory Kit, ComNav Part # 20020004.

2. Remove 6.5mm [1/4”] of insulation from the flying leads and insert wires into the appropriate connector plug, as shown in the following pages.

3. Tighten the connectors with a screwdriver. Small connectors require a 2.5mm [0.1”] screwdriver

Note: ComNav provides wiring for all main components. THESE SHOULD NOT BE SPLICED. Obtain additional wiring as necessary from ComNav. Should you utilize other wiring, it is important to follow the guidelines as per Table 1.

| FUNCTION / USE | TYPE / GAUGE |
|---|---|
| SPU POWER SUPPLY | 2 X 16 AWG |
| STEERING DRIVE; 12/24/32 VDC SOLENOID VALVE | 3 X 18 AWG |
| STEERING DRIVE; REV. MOTOR | 2 X 16 AWG REFER TO INSTRUCTIONS SUPPLIED WITH DRIVE MOTOR |
| RUDDER FOLLOWER | 3 X 18 AWG SHIELDED CABLE |
| NAVIGATION COMPUTER INTERFACE | 2 X 24 AWG SHIELDED CABLE |
| RUDDER ANGLE INDICATOR | 2 X 24 AWG |

**Table 1 —MINIMUM Recommended Wire Gauges**

# Power Supply Card

This CARD provides the connections for BATTERY POWER INPUTS, OUTPUTS to DRIVE CARDS, and RELAY OUTPUTS for Alarms. It also provides power to the rest of the 5001 System.

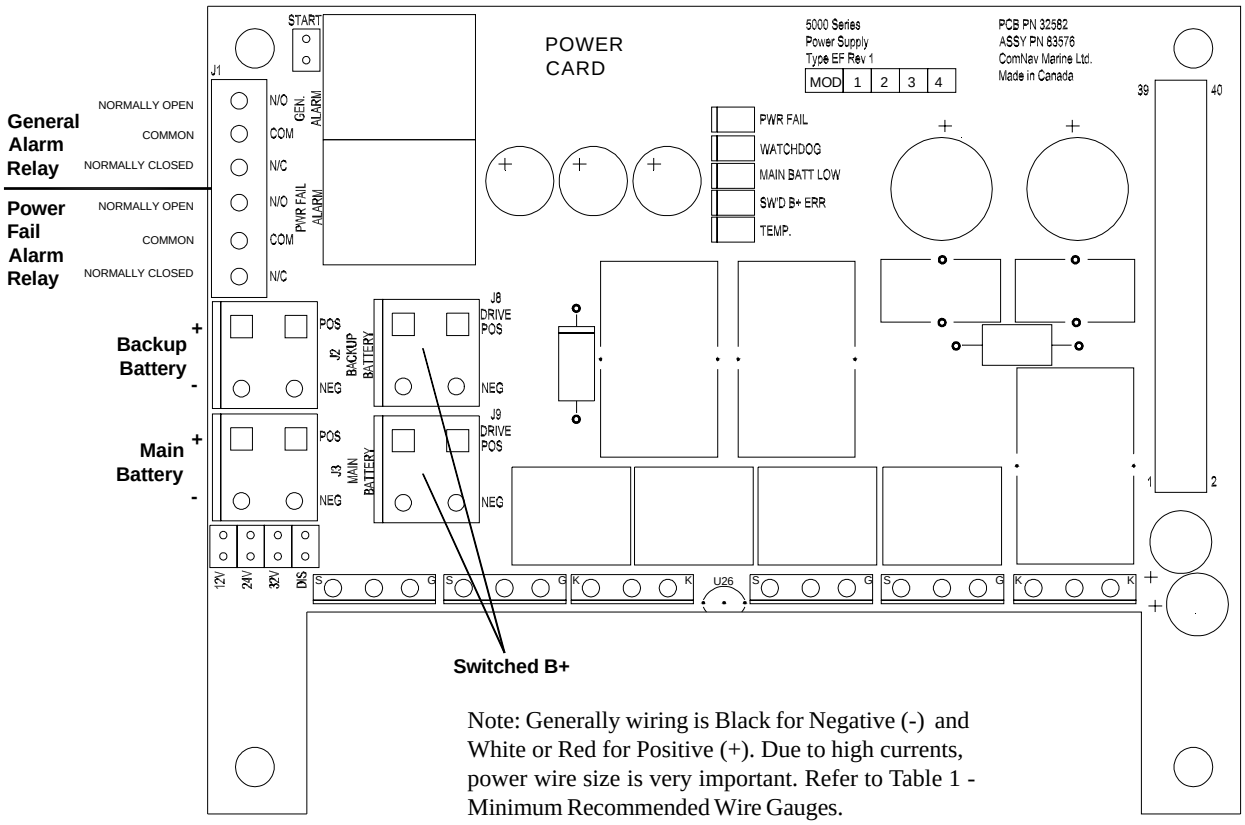
**Note: See Figure 13 for all wiring connections noted on this page.**

**BATTERY**

NOTE: DO NOT POWER UP THE SPU UNTIL COMPLETION OF SYSTEM INSTALLATION AND POST-INSTALLATION CHECK.

- Before inserting the power plug into the receptacle inside the SPU, check the power source from the battery for correct polarity, wire size, tightness of connections, fusing, and operation of the battery power switch.

- Pass cables through appropriate GLANDS. Connect the MAIN BATTERY and (optional) BACKUP BATTERY wires to the terminal plugs supplied, as indicated in the diagram.




Note: Generally wiring is Black for Negative (-) and White or Red for Positive (+). Due to high currents, power wire size is very important. Refer to Table 1 - Minimum Recommended Wire Gauges.

**Figure 13 —Power Supply Card Wiring Diagram**

**Note: See Figure 13 for all wiring connections noted on this page.**

**VOLTAGE SELECTION JUMPER**

On the POWER SUPPLY CARD, only one JUMPER is required. It is used to select the main battery switchover condition.

- If you have a 12 volt electrical system and a BACKUP battery supply going to the Autopilot, the JUMPER should be set to the 12V position on the Power Supply Card. This ensures that the POWER SUPPLY will automatically switch over to the backup battery supply if the main batteries drop below about 10 volts.

- Similarly, choose 24V or 32V for supplies which use one of those nominal battery supply voltages.

- For any of the voltages, if you do not have a backup battery for the Autopilot, the JUMPER should be set to the DIS (disable switchover) position.

**POWER TO DRIVE CARDS**

- The POWER SUPPLY CARD has a connection for a 'PIGTAIL' wire from the DRIVE CARD(S).

Ensure that the PIGTAIL wire from the DRIVE CARD is connected to the DRIVE (SWITCHED B+) connector on the POWER SUPPLY CARD.

**ALARM**

- The POWER SUPPLY CARD provides connections for an external GENERAL ALARM and an external POWER FAIL ALARM.

- Attach the three wires from the ALARM to the appropriate connector on the POWER SUPPLY CARD.

N/O = Normally Open
N/C = Normally Closed
COM = Common

# Compass Interface Card

This card provides connections for COMPASS, RUDDER FOLLOWER, RAI, FULL or NON FOLLOW UP, SHIP'S LOG, and REMOTE. JUMPERS are required to select various options, as described in the following instructions:

**Note: See Figure 14a for all wiring connections noted on this page.**

**FLUXGATE COMPASS**

- Attach the appropriate 7 wires from the FLUXGATE COMPASS to the CARD.

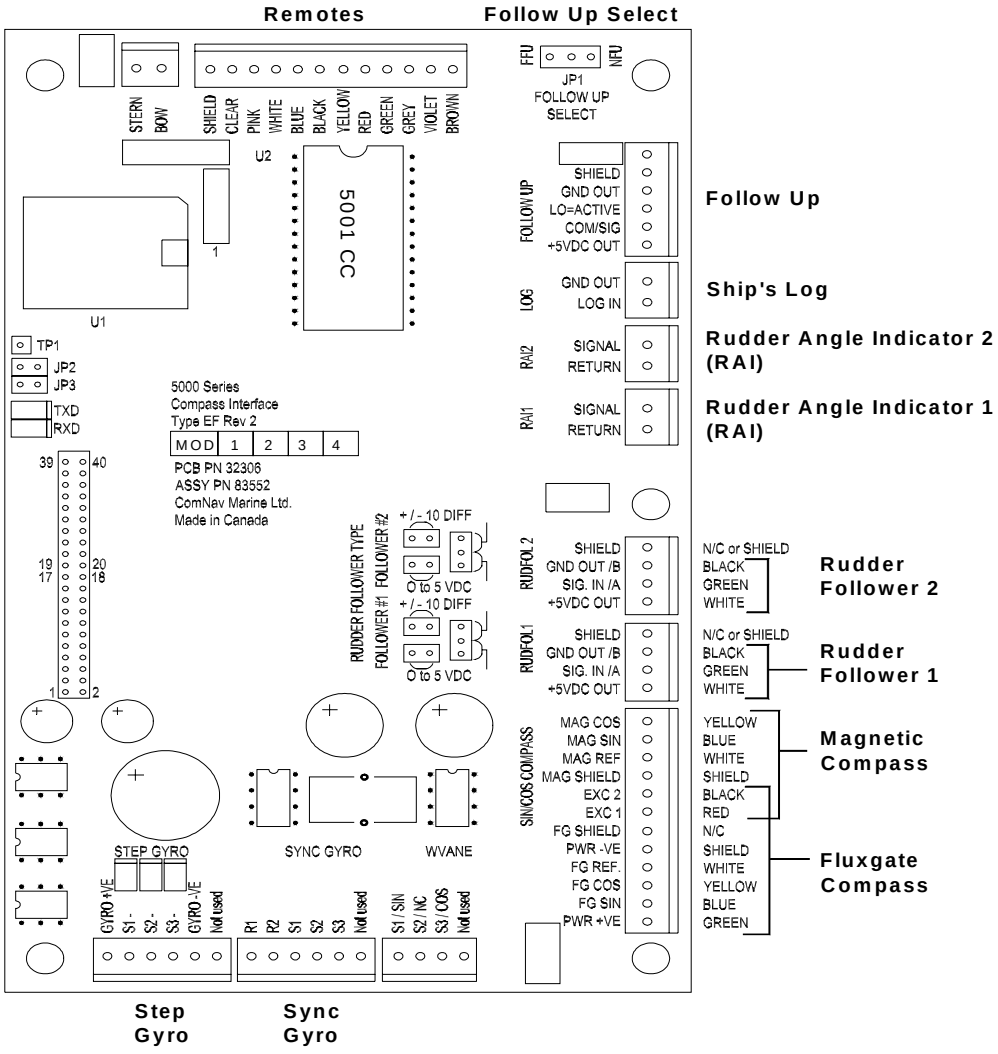



**Figure 14a —Compass Interface Card Wiring Diagram**

**Note: See Figure 14a for all wiring connections noted on this page.**

**MAGNETIC COMPASS (WITH MAGNETIC SENSOR)**

- Attach the appropriate 6 wires from the MAGNETIC COMPASS SENSOR to the Compass Interface Card.

- ONCE THE ENTIRE AUTOPILOT SYSTEM HAS BEEN INSTALLED, you can perform the procedure to determine the optimum location of the MAGNETIC SENSOR, as follows:

- Attach a voltmeter between terminal #10 (MAG REF) and terminal #1 (MAG SIN) on the COMPASS terminal block (see Figure 14a).

- Turn the Autopilot on and place it in STANDBY mode.

**Note: ComNav supplied compasses offer the option of mounting the sensor directly to the bottom of the compass. (See Figure 10)**

- Hold the MAGNETIC SENSOR either above or below the compass and rotate it until a maximum level is displayed on the voltmeter.

- Move the SENSOR towards and away from the compass until a new maximum reading is achieved. This is the optimum distance from the compass to mount the SENSOR. Any closer and the SENSOR may interfere with the operation of the compass. Any further and the SENSOR accuracy will begin to decrease.

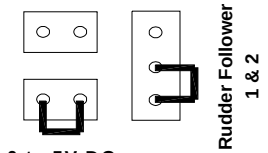
- Affix the sensor using brass screws or silicone adhesive. Use non-magnetic spacers as required.

- Perform a test by rotating the compass through 360 degrees, comparing readings every 20 degrees. The readings should agree within +/- 2 degrees if the compass is compatible with the SENSOR.

- Perform another test by tilting the bowl of the compass so the compass card tilts relative to the sensor. The heading on the CONTROL HEAD should not change more than 2 degrees while the compass is still indicating the same heading. If the change is more than 2 degrees, it is an indication that the magnets on the compass card are not compatible with the SENSOR.

**Note: If the accuracy of the compass and SENSOR combination cannot be made to be within a +/- 2 degree range, the compass is not compatible with the SENSOR. Your ComNav dealer can supply a compatible compass. The compass may be influenced by external magnetic materials. Relocation or compensation of compass may be required. Contact ComNav for advice.**

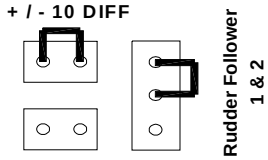
**Note: See Figure 14a for all wiring connections noted on this page.**




**0 to 5V DC**

**Position of Jumpers if using ComNav Rudder Followers**

**+ / - 10 DIFF**




**Position of Jumpers if using + / - 10 Differential Rudder Followers**

**Figure 14 b**

**STEP GYRO COMPASSES**

- Refer to the compass manufacturer's instructions. Attach the appropriate 5 wires from the GYROCOMPASS to the CARD.

**RUDDER FOLLOWER 1 AND 2**

- Attach the appropriate 3 wires and cable shield wire from the RUDDER FOLLOWER to the CARD.

**JUMPERS for RUDDER FOLLOWERS**

- On the CARD, four JUMPERS are required to be set to configure the RUDDER FOLLOWERS (See Figure 14b).

- The type of RUDDER FOLLOWER determines the setting of two jumpers for each of the RUDDER FOLLOWERS.

- The RUDFOL 1 receptacle should be used if you have only one RUDDER FOLLOWER.

- If you have a ComNav manufactured RUDDER FOLLOWER, both JUMPERS should be set to the 5 VOLT positions. Similarly for RUDFOL 2 if required.

- If you are using a RUDDER FOLLOWER that requires ±10 volts differential sensing, move the two JUMPERS to the DIFF positions. Similarly for RUDFOL 2 if required.

**RAI ( Rudder Angle Indicator) 1 AND 2**

- RAI 1 follows RUDFOL #1, and RAI 2 follows RUDFOL #2. Each RAI output can drive up to five ComNav RAI units (Part # 20360014 or #94244) wired in series.

- Attach the appropriate 2 wires from the RAI to the CARD.

**SHIP'S LOG**

- Attach the appropriate 2 wires from the SHIP'S LOG to the CARD.

**Note: See Figure 14c for FFU connections.**

**FULL FOLLOW UP CONTROL (When Jog Levers are not used)**

- On COMPASS INTERFACE CARD, set JP1 FOLLOW UP SELECT to FFU position.

- Attach the appropriate 4 wires from the FOLLOW UP to the CARD. (See Figure 14c).

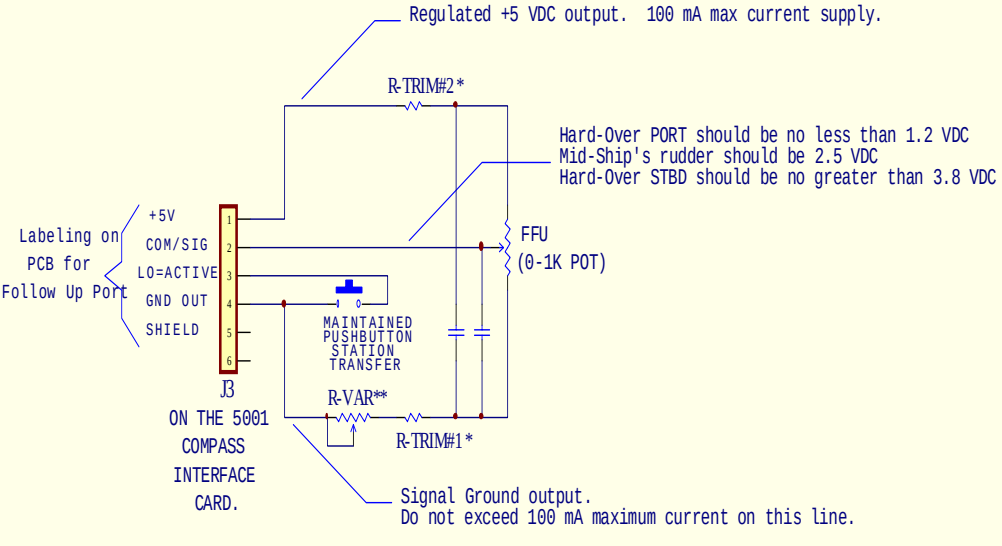



**Figure 14c—FFU Wiring Diagram**

* Choose value of R-TRIM so that specified voltages are not exceeded when FFU is Hard-Over. Value of R-TRIM#1 should equal value of R-TRIM#2.
** R-VAR is used to zero rudder position when FFU is at mid-ship's position. Typical value = 0-200 ohms.

**NON FOLLOW UP CONTROL (When Full Follow Up Not Used)**

- On COMPASS INTERFACE CARD, set JP1 FOLLOW UP SELECT to NFU position.
- Connect the common wire to COM/SIG terminal.
- Connect the PORT or STBD wire to the +5V OUT.
- Connect the remaining wire STBD or PORT to GND OUT.
- Connect a jumper wire from LO=ACTIVE to GND OUT. (See Figure 14d).

**Note(s):**
- Wire colors refer to ComNav standard Jog Lever (Part # 20310002) cabling.
- Common (Green) wire will measure 2.5VDC to ground when Jog not actuated.
- Additional Jog Levers are wired in parallel.

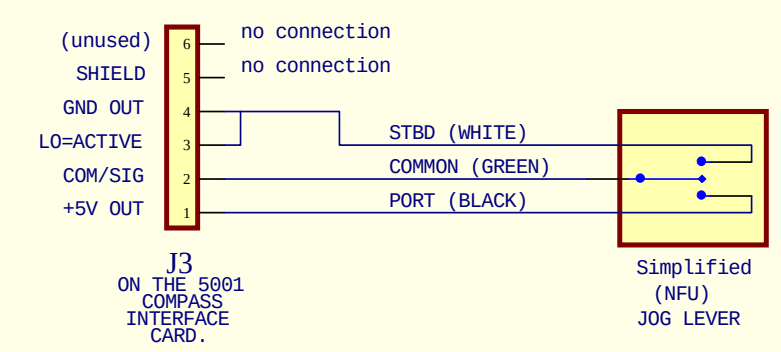



**Figure 14d — NFU Wiring Diagram**

**REMOTES**

ComNav remotes are supplied with a 12-position plug on the end of the cable. The 5001 SPU is designed to accept “flying leads”. This means that the plug connector will have to be cut off, and each wire conductor will have to be stripped and tinned with solder before the remote can be connected to the SPU. Alternatively, you can use an interface cable supplied by ComNav. This “Remote To 5001” interface cable, Part # 31110025, has a receptacle on one end (to accept the plug on the Remote’s cable) and is equipped with flying leads on the other end. This allows a Remote or Remote Expander to be quickly and easily unplugged should service ever be required.

The wiring for Remotes, Remote Expanders, or “Remote To 5001” interface cables is as follows:

Note that if you are wiring a Remote Expander, there will be an Orange wire left over. This wire may safely be cut off or taped back. It is not used on the 5001 system.

| SPU "Remote" Receptacle Position | Wire Color | Function |
|---|---|---|
| 1 | Brown | 5 VDC (Power to Remote) |
| 2 | Violet | Rotary Switch '0' |
| 3 | Grey | Rotary Switch '1' |
| 4 | Green | Starboard Pushbutton |
| 5 | Red | Port Pushbutton |
| 6 | Yellow | Dodge Switch |
| 7 | Black | U-Turn Switch |
| 8 | Blue | Tiller signal |
| 9 | White | Serial Data |
| 10 | Pink | Serial Clock |
| 11 | Clear (Shield Drain Wire) | Common Signal Ground |
| 12 | Isolated Shield | Not used for ComNav Remotes |

**Note: See Figure 14a for Remote wiring connections noted on this page.**

- Attach the appropriate 12 wires from the REMOTE or the REMOTE EXPANDER to the CARD.

**INTERFACE REMOTE CABLE**

- Interfaces with ComNav’s 101, 211 and TS-202 Remotes to 5000 Series Compass Interface CARD. Cable is approximately 45cm [18”] (Part # 31110025).

## Processor Card

This card provides connections for the HEADS, NAV EQUIPMENT INPUTS, OUTPUTS, and RS 232 Communications.

Note: JUMPERS do not need to be selected on the PROCESSOR CARD. They are configured at the factory.

**Note: See Figure 15 for all wiring connections noted on this page.**

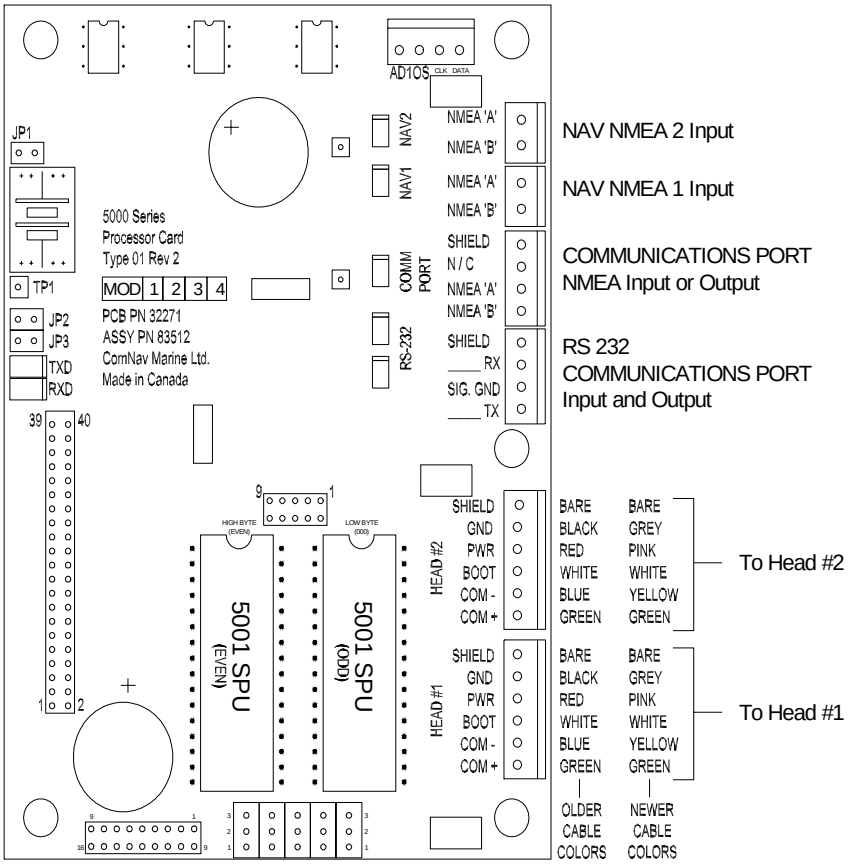
**HEAD #1 & HEAD #2**

- Attach the appropriate 6 wires from each HEAD cable to the CARD. Two HEADS can be paralleled on each connector.

**NAV 1 & 2 INPUTS**

- Attach the appropriate 2 wires from each NAV device to the NAV NMEA 1 or NAV NMEA 2 input connections on the CARD.

**Figure 15—SPU Processor Card Wiring Diagram**



**Note: See Figure 15 for all wiring connections noted on this page.**

**COMM PORT (NMEA IN or OUT)**

The COMM port can be set to operate as an NMEA 0183 receiver, or as a transmitter. As a receiver, it functions in exactly the same way as the NAV1 and NAV2 ports. As a transmitter, it ouputs the Autopilot heading at a rate of 10 times per second. This can be used to display heading on a radar screen, for example. In addition, the port transmits a proprietary sentence at a rate of once per second. The proprietary sentence contains information about the current status of the Autopilot such as mode, commanded course, rudder angle, etc. This can be used to log data onto a computer for analysis.

- Attach the appropriate 3 input/output wires from the NMEA COMMUNICATIONS DEVICE to the NMEA INPUT/OUTPUT connections on the CARD.

- This provides either an IN or OUT configuration. Go to the DEVICE MENU in the SETUP MENU, then highlight the SERIAL OUTPUT PORT sub-menu and select COMM PORT for output.

NOTE: If the COMM PORT is used as an output, it cannot be used or selected as any of the inputs (i.e SPEED PORT or NAV PORT).

**RS 232 COMM**

The RS-232 PORT handles both transmit and receive functions at the same time. This port can be connected to a computer to either log data from the Autopilot, or receive data from a computer that is running navigation software. The port is capable of receiving and sending the same messages as the COMM port.

NMEA 0183 uses voltage levels described by RS-422. Oftentimes, you can interface RS-422 to RS232 without any problems. However if the two devices you are connecting are far apart, reliable communication may be a problem. There are also many versions of RS-232 (i.e. there is RS-232-A, RS-232-B, etc.). The older formats do not always work reliabily with RS-422. By supplying an actual RS-232 port instead of RS-422, many interfacing problems have been eliminated.

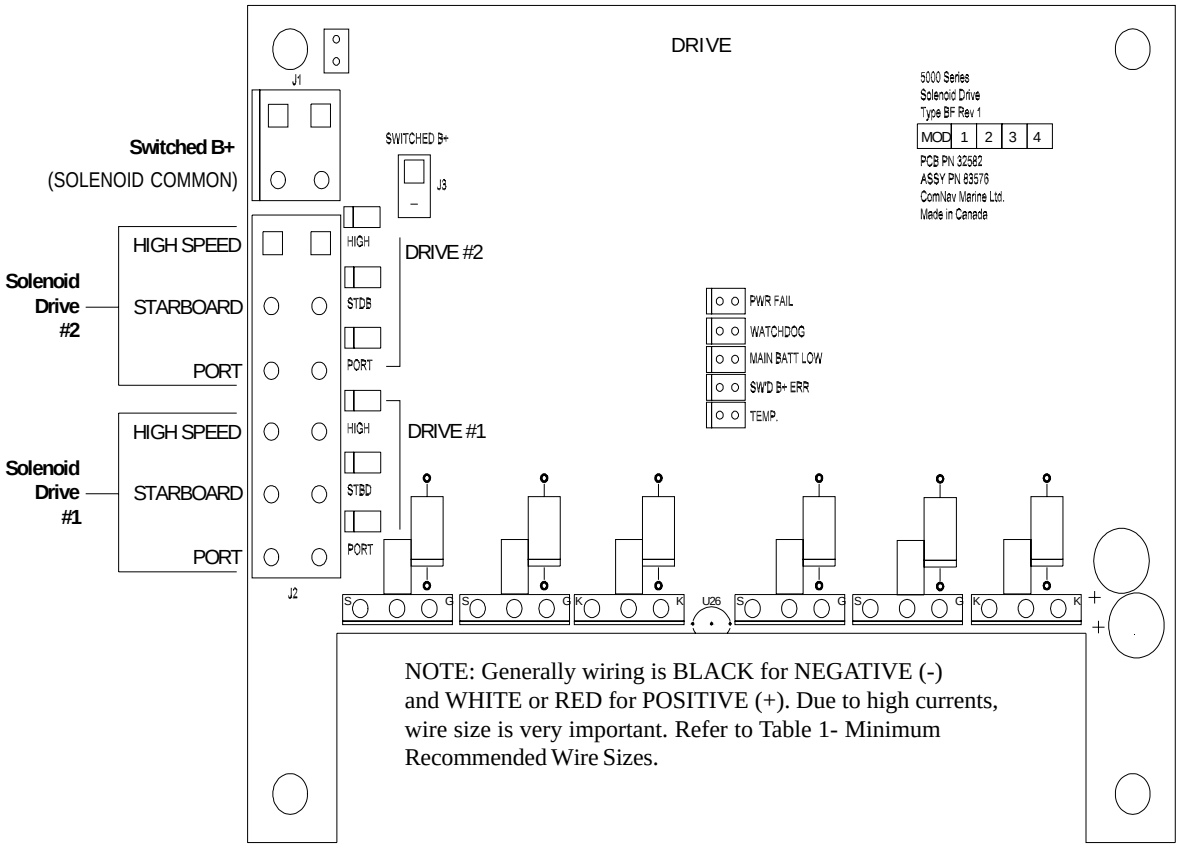
**Note: MENU selections for the configurations of these PORTS is covered in the SETUP Section.**

## 2 Speed Solenoid Driver Card

This card provides connections for the SOLENOID DRIVE.

The card contains two sets of ouputs. They are labeled **DRIVE1** and **DRIVE2**. Each DRIVE consists of three ouputs, **PORT**, **STARBOARD**, and **HIGH**. The DRIVE is therefore capable of operating either single speed or two speed manifolds without the need for ComNav's CT5 drive box (Part # 20350004).

For solenoid operated steering systems, **DRIVE1** is the primary rudder drive. The outputs switch to ground when they are activated, and go open-circuit when they are off. An LED lamp is attached to each output to indicate when it is active. The LED lamps on the 5000 Series Solenoid Drive card are connected directly to the terminal block outputs. This means that when the lamp is lit, you can be sure that the output is truly activated. In addition to this visual indication, the 5000 Series Processor Card continually scans the ouputs, and will raise an alarm if a) an output did not go on when it was commanded to, or b) if an output did not shut off when it was commanded to.




NOTE: Generally wiring is BLACK for NEGATIVE (-) and WHITE or RED for POSITIVE (+). Due to high currents, wire size is very important. Refer to Table 1- Minimum Recommended Wire Sizes.

**Figure 16a —2 Speed Solenoid Driver Card Wiring Diagram**

**Note: See Figure 16 for all wiring connections noted on this page.**

Each output is capable of supplying in excess of 20 amps. However, an error alarm will be raised if the current draw from the output rises above about 13.5 amps.

**DRIVE 2** can be configured to act in one of three ways. The configuration is set in the SETUP MENU. The choices are:

- **OFF** - In this case, **DRIVE2** outputs are never activated.
- **COPY DRIVE1** - The Drive outputs mimic their counterparts on **DRIVE1**. Thus if the **PORT** output on **DRIVE1** is activated, then so will the **PORT** output on **DRIVE2**. In the unlikely event that an output goes on **DRIVE1**, the user can simply swap the solenoid wires over to **DRIVE2** and carry on; it's like having a spare Drive card built-in.
- **BOW THRUSTER** - Bow thrusters can be used to augment the steering of the vessel at very slow speeds.

For bow thrusters, set **DRIVE2** to "**COPY DRIVE 1**", then route the outputs of **DRIVE2** through a selector switch to the controller for the thruster. When the selector switch is closed, the thruster will be activated in conjunction with the rudder.

**FOR STANDARD 4-WAY VALVE SOLENOID DRIVES**

- The 4-way valve common wire should be connected to the SWITCHED B+ terminal. The PORT valve is connected to the DRIVE # 1 PORT output terminal on the card and the STARBOARD valve is connected to the DRIVE # 1 STBD output terminal. If a HIGH SPEED solenoid is also used, it is connected to the DRIVE # 1 HIGH output terminal on the card.

- If a second set of drive valves are required, make the connections to DRIVE #2 in a similar manner.

**FOR 4-WAY VALVES WITH JOG LEVERS**

- If any JOG LEVERS are being used in the system, they should be connected to the three terminals shown in Figure 16. If the jog levers are to be active all the time, whether the Autopilot is turned on or off, connect the common from the solenoid operated 4-way valve to MAIN BATT + (on the POWER SUPPLY CARD) instead of SWITCHED B+.

**WARNING! If the SWITCHED B+ POWER is not used and there is a malfunction which causes the 4-way valves to stay on, the power breaker must be used to turn solenoids off.**

**FOR CONSTANT RUNNING PUMP WITH SINGLE SPEED SOLENOIDS (see Figure 16b).**

Below is a diagram showing typical connections for constant running electric pumps with single speed electric valves.

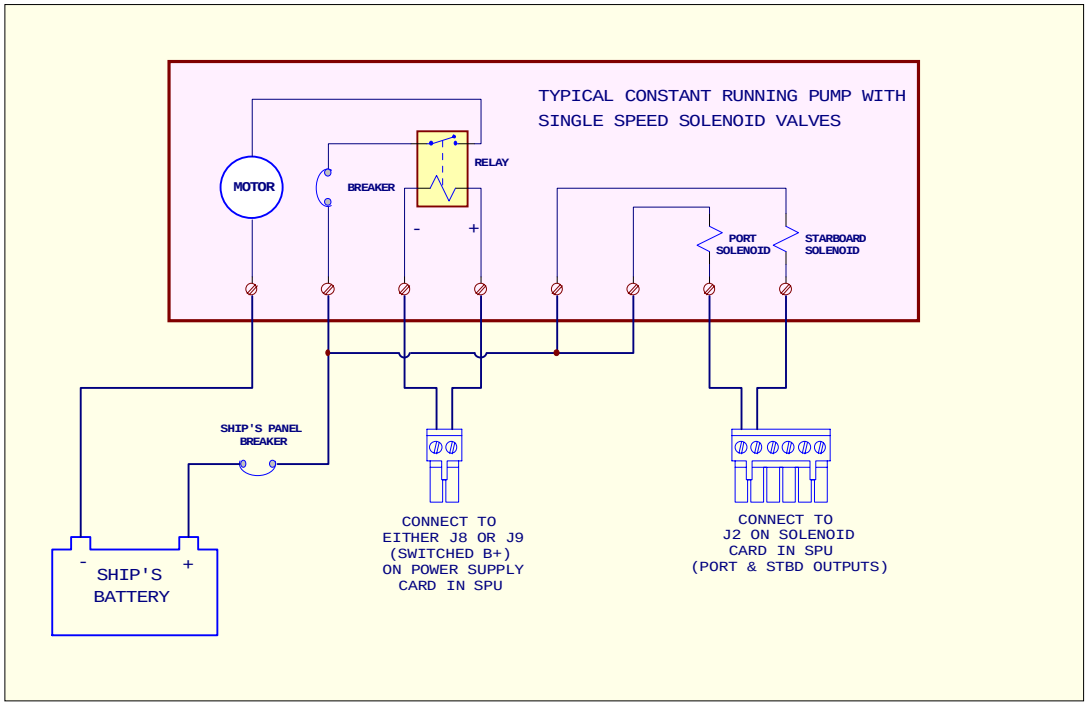



**Figure 16b - Single Speed Solenoid Valves - Typical**

# Reversing Motor Driver Card

This card provides connections for a REVERSING MOTOR. The Drive Card is compatiable with all reversing motor pumpsets sold by ComNav. It will operate on any battery voltage between 10 and 40 volts.

A unique feature of the Reversing Motor Driver is the ability to Pulse-Width Modulate the speed of the pumpset motor. This is useful when the hard-over to hard-over time for a given steering system is quite short. Ordinarily, the result would be that the Autopilot has less than optimal control on the rudder position. However, by turning down the speed of the motor, the hard-over to hard-over time can be increased to an acceptable level.

The Reversing Motor Driver has the capacity to directly operate motors up to about 20 amps. However, for really high-power motors (requiring more than about 20 amps), ComNav still recommends the use of a CT2-40A (Part # 20350001) coupled to a Solenoid Driver Card.

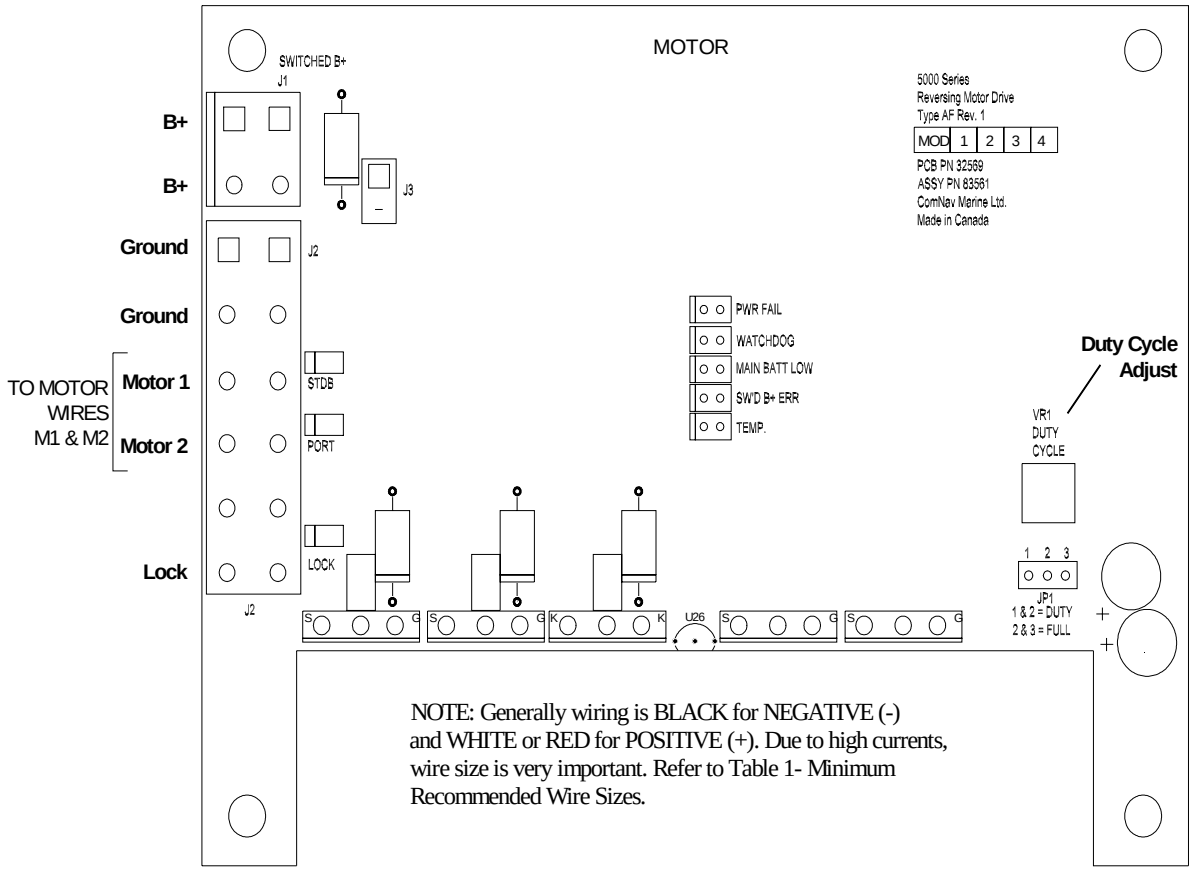



**Figure 17a —Reversing Motor Drive Card Wiring Diagram**

**Note: See Figure 17a for all wiring connections noted on this page.**

**DRIVE POWER**

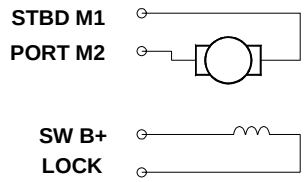
A separate pair of BATTERY+ and BATTERY- power wires is recommended for the DRIVE POWER.

- Connect BATTERY+ to the terminals marked B+ and connect BATTERY- to the terminals marked GROUND.

**DRIVE**

- For PERMANENT MAGNET reversing motors or COMPOUND MOTORS with single speed control, connect Starboard and Port wires to MOTOR WIRES STBD and PORT, or MOTOR 1 and MOTOR 2.

- For SHUNT FIELD reversing motors, connect M1 and M2 to motor wires STBD and PORT. Connect the SHUNT FIELD COIL POSITIVE (+) to SWITCHED B+ on the DRIVE CARD, and NEGATIVE (-) to LOCK on the DRIVE CARD (See Figure 17b).




**Drive Connections for Shunt Field Reversing Motors**

**Figure 17b**

- For LINEAR ACTUATOR or MECHANICAL ROTARY DRIVE, connect PORT and STBD wires to MOTOR 1 and MOTOR 2. Connect SWITCHED B+ and LOCK on the DRIVE CARD to the clutch assembly.

**JUMPERS**

- On the REVERSING MOTOR DRIVE CARD, one JUMPER at JP1 must be installed to either FULL duty cycle or to partial DUTY cycle. When set to partial DUTY cycle the speed of the motor is adjusted by the potentiometer.

- Although the 5001 Autopilot will automatically compensate for most of the variations in rudder movement speed, it may be necessary to slow down a very fast RUDDER.

- Begin by setting the JUMPER to FULL.

- Check the Rudder's hard-over to hard-over time by using the POWER STEER mode (after setting the rudder limits in SETUP).

- If the cycle is longer than about 8 seconds, leave the JUMPER at FULL.

- If the cycle is less than about 8 seconds the RUDDER is too fast. Move the JUMPER to the DUTY position and adjust the potentiometer so that the RUDDER cycle time is more than 8 seconds.

# Post Installation Electrical Check List

Once you have completed the installation and wiring of the Autopilot System, check to ensure installation is complete and has been installed in a safe and secure manner.

- Check the power source from the battery for correct polarity, wire size, tightness of connections, fusing, and operation of the battery power switch before connecting the power cables into the power terminals on the Signal Processing Unit.
- Check the connection from the compass to the SPU.
- Check the connections from the Rudder Follower.
- Check that when the rudder is moved from full starboard to full port, the Rudder Follower has full free movement and is not being restricted in any way.
- Check the connection from the Control Head to the SPU.
- Check the connections to the drive equipment from the SPU.
- Check that the cables are neatly placed and secured.
- Check manually that the steering system is operating correctly.
- Ensure that all extraneous materials (wire strands, etc) have been removed.

# Post Installation Hydraulic Checks

If you have installed a ComNav Marine Reversing Motor Pump, a Constant Running Pump or an Engine Driven Pump, there are several checks that must be done during the first weeks of usage in order to prevent poor or dangerous steering performance. During this period you must check for air or leaks in your hydraulic system.

**Residual air in your steering system**
Following the initial installation and bleeding of your ComNav pump, 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 the oil level may go down. Check several times and add more oil as required.

**Leaking fittings or equipment**
Following the initial installation and bleeding of your ComNav pump continuously monitor the oil level of the reservoir or the highest helm pump in your steering system and add oil as required. If this condition persists, it may be an indication of leakage in your steering system. Check all hydraulic steering fittings and equipment for leakage.

# 5. Getting Started

## Introduction

Your ComNav 5001Autopilot has four operating modes known as **STANDBY, POWER STEER, AUTOPILOT** and **NAV** plus a special mode called **DOCKSIDE SETUP.** While each of these modes has a distinct purpose, for safety and technical reasons you will make adjustments in one mode which affect the operation of your Autopilot in other modes.

In this "Getting Started" section, you will use **DOCKSIDE SETUP, STANDBY** and **POWER STEER** to setup your Autopilot to work with the compass, steering system and Rudder Angle Indicators (if installed) in your boat. Most of this setup can be done at dockside, however a fluxgate compass must be compensated while the vessel is underway.

Once you have completed the setup procedures in this section and understand operation of the pilot in **STANDBY** and **POWER STEER** modes, you will be ready to let your Autopilot "take the helm" in **AUTOPILOT** mode. The setup and operation of **AUTOPILOT** mode is described in the "Basic Operations" section.

The final step is to have your Autopilot follow a preset course in **NAV** mode, using information provided from a GPS, chart plotter or other navigation device in NMEA 0183 format. The setup and operation of **NAV** mode is described in the "Advanced Operations" section.

We recommend that you read all of the "Getting Started," "Basic Operations" and "Advanced Operations" sections before beginning to set up or use your Autopilot. We have provided a Setup and Sea Trials Checklist in this manual to assist you in getting the optimum performance from your Autopilot. Your ComNav 5001Autopilot is easy and intuitive to use once the setup has been done correctly. Many ComNav owners choose to have their dealer do the installation and setup of their Autopilot so that they have access to the Extended Warranty.

The current vessel heading and rudder angle will be displayed.

Pressing both the ▲ and ▼ buttons displays BRIGHTNESS on the left side of screen. Pressing both buttons again displays CONTRAST. Make your selection and adjust accordingly using the ▲ or ▼. Adjustments can not be made once a MENU is displayed.

The current vessel heading and rudder angle will be displayed.

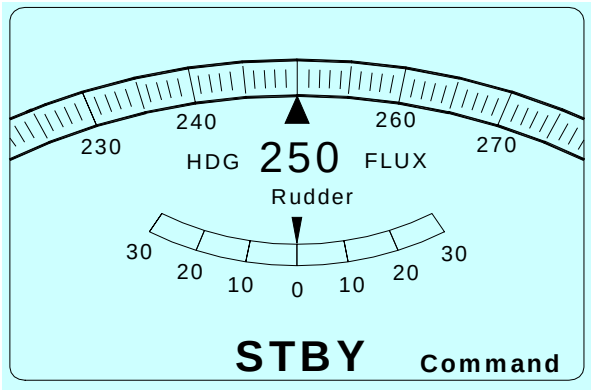
**To change the CONTROL HEAD to the COMMAND mode, you must "take control" by pressing both DODGE keys simultaneously for two seconds.**

# Power On / Off

## Power On

The Control Head system can be turned on in either of two modes:

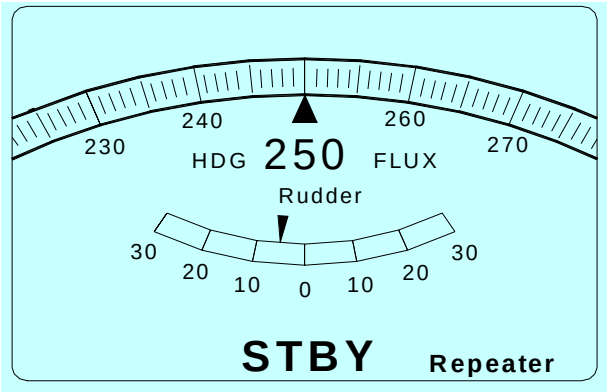
1) By pressing and holding the STBY/OFF key for two seconds, the system will power up (audible beep) with the CONTROL HEAD in the **COMMAND mode**, **allowing access to all functions**.
The LCD DISPLAY will appear showing the following:




The current vessel heading and rudder angle will be displayed.

"Command MODE"

2) By momentarily pressing the STBY/OFF key, the system will power up (audible beep) in STANDBY mode and the CONTROL HEAD will be in **REPEATER mode, with all system controls inactive**. The LCD DISPLAY will appear showing the following:




The current vessel heading and rudder angle will be displayed.

"Repeater MODE"

## Power Off

Power is turned off by pressing the STBY/OFF key for four seconds.

Adjustments to the brightness and contrast of the LCD screen can be made while in **STANDBY** mode.

## Brightness

Pressing the ▲ button increases the brightness of the display, while the ▼ button decreases it. While brightness adjustments are being made, the word "Bright" is shown on the display just to the left of the Rudder Angle Indicator.

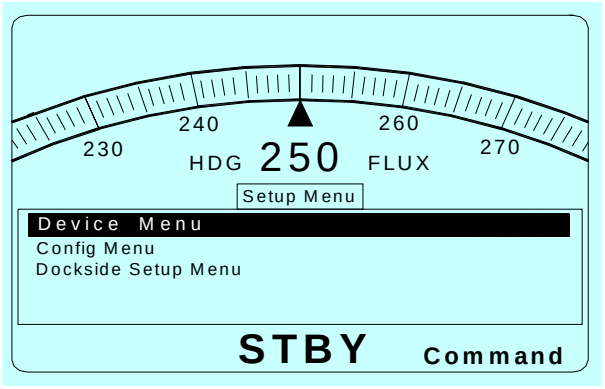
## Contrast

Pressing both the ▲ and ▼ buttons at the same time shows the word "Cont" (for "Contrast"), and thereafter the ▲ and ▼ buttons will adjust the contrast up or down.

Another push of both ▲ and ▼ buttons at the same time, and "Keypad" will be displayed. At this point, the ▲ and ▼ buttons can be used to adjust the backlighting level of the keypad buttons. Pressing both at the same time again will allow you to once again adjust the brightness of the display.

# Setup Menu

This is a special menu used for SETUP Only. Begin with the power off. The SETUP menu is entered by holding down the MENU key while turning on the power (STBY/OFF) key. Hold down both keys for two seconds to turn the power on. The SETUP menu screen will appear showing the following sub-menus:




## Device Menu

• This tells the Autopilot *which* devices are connected to the system.

## Config Menu

• This tells the Autopilot *what type of* devices are connected to the system.

## Dockside Setup Menu

• This familiarizes the Autopilot with your boat and its particular rudder and compass characteristics.

Use the ▲ and ▼ keys to scroll up and down through the menu list. This highlights the menu you want to enter. Press the MENU key to enter the desired menu. A sub-menu will appear. Turn the ADJUSTMENT KNOB left or right to select the desired setting on the right-hand side of the menu display. Press MENU EXIT to return to the MAIN MENU.

# Setup Procedure

To begin the SETUP procedure:

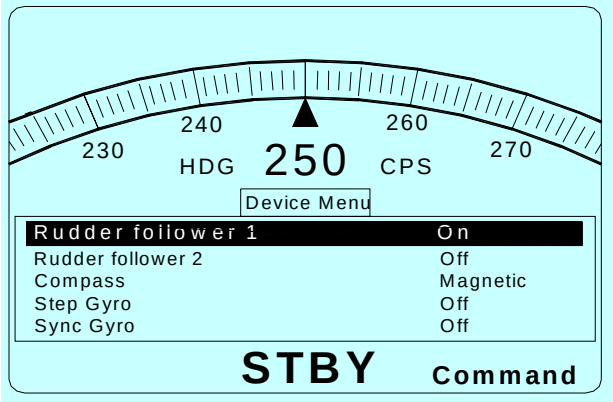
Enter the SETUP MENU by holding down the MENU key while turning on the power (STBY/OFF key).

The SETUP MENU will appear, displaying the DEVICE, CONFIG and DOCKSIDE SETUP sub-menus.

Using the ▼ key, highlight the DEVICE MENU. Press the MENU key. This screen will appear, displaying the DEVICE sub-menus:

Note: There are SIX submenus, only FIVE can be displayed at one time.To access “hidden” submenus, move the highlight to the bottom by pressing the ▼ button, then press it again to scroll the displayed menus.

Turn the ADJUSTMENT KNOB left or right to select the desired setting. This selection appears on the right-hand side of the menu display.




## Device Menu Setup

Highlight RUDDER FOLLOWER 1

- Select the ON or OFF setting.

Highlight RUDDER FOLLOWER 2

- If you have a second Rudder Follower, select ON.

Highlight COMPASS

- Select Magnetic or Fluxgate Compass.

Highlight STEP GYRO

- If you have a Step gyro, select ON.

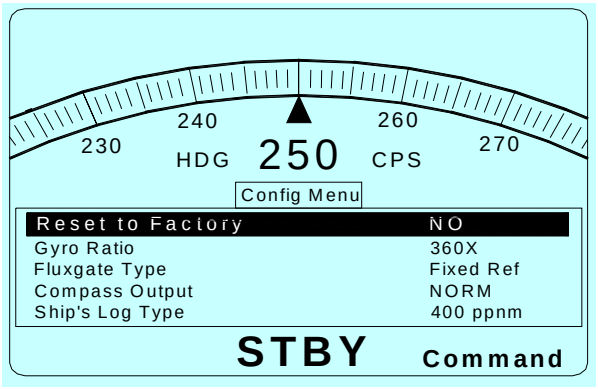
Highlight REMOTE

- If you have a Remote Control connected, select ON.

Once the DEVICE MENU settings are complete, press MENU EXIT. This takes you back to SETUP MENU

## Config Menu Setup

Scroll down to the CONFIG MENU. Press the MENU key. This screen will appear:




NOTE: Although FIVE sub-menus are displayed, there are actually 13 in total. To access them, scroll down to SHIP'S LOG TYPE, then continue scrolling. A new sub-menu will appear each time you press the ▼ key.

Highlight RESET TO FACTORY SETTINGS if you need to reset all settings to default values in all menus.

- Select YES to reset.

Then turn the POWER off and on again to enable the defaults.

Highlight GYRO RATIO.

- Select 36X, 90X, 180X or 360X (depending on your gyro).

Highlight FLUXGATE TYPE.

- Select FLOATING REF or FIXED REF. If you have a ComNav FLUXGATE, choose FIXED REF. (A 4 volt reference is generated from the fluxgate compass.)

Highlight COMPASS OUTPUT.

- Select NORM (normal) or REV (reverse). Choose REV if the compass displays on the 5001 Head decreases in the value when the vessel turns to Starboard.

Highlight SHIP'S LOG TYPE if you have a log type speed monitor to provide speed input.

- Select 200 PPNM or 400 PPNM (pulses per nautical mile) depending on the type of log input connected.

Highlight FOLLOW UP TYPE.

- Select NFU (Non Follow Up) if you are using Jog Levers, or FFU if you are using Full Follow Up Levers.

Highlight HIGH RATE CUTOUT (FOR 2 SPEED SOLENOIDS). This sets the rudder angle at which the high speed solenoid cuts in and out.

- Select from 0 to 30 degrees rudder angle. (Initial display is a factory default).

Highlight RUDDER DEADBAND. This defines the accuracy of rudder placement and should be as tight as possible without excessive “hunting”.

- Select from 0.1-2.5 degrees. (Initial display is a factory default).

Highlight TURN RATE DELAY. This sets a timer that defines how long the maximum turn rate can be exceeded before the TURN RATE ALARM is activated. If the timer is not set, the alarm will activate whenever the TURN RATE LIMIT is exceeded by 10%.

- Select from 0 to 8 seconds. (Factory default is 3 seconds).

Highlight DRIVE TYPE.

- Select SOLENOID, REVERSING or PROPORTIONAL.

Highlight SOLENOID 2 TYPE.

- If you have a second solenoid drive, select COPY DRIVE 1 to activate the second drive outputs on the card, or OFF.

Highlight BACKUP SUPPLY.

- If your vessel uses a second battery supply, select ON.

Highlight COMM PORT TYPE.

- Select INPUT or OUTPUT.

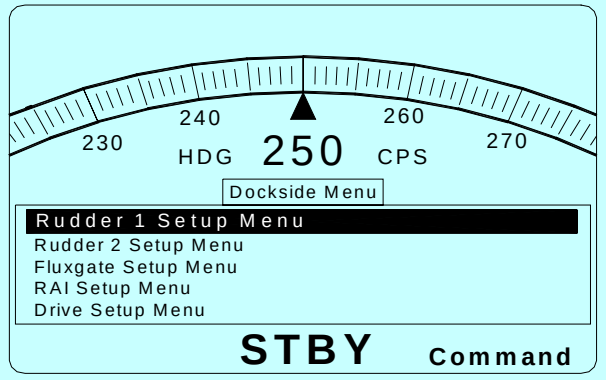
Once the CONFIG MENU settings are complete, press MENU EXIT. This takes you back to the SETUP MENU.

## Dockside Menu Setup

Scroll down to the DOCKSIDE MENU. Press the MENU key. This screen will appear:

**Note: Although it is called DOCKSIDE SETUP, part of this procedure actually takes place in open water. Before proceeding, please read these instructions to ensure that location, weather and time allow for this part of the set up procedure to be completed.**

**It may be appropriate to perform the DOCKSIDE SETUP in conjunction with the SEA TRIALS.**




### RUDDER 1 Setup Menu

Highlight RUDDER 1 SETUP MENU

- Press the MENU key.

Instructions will appear on the screen:
Using the vessel's steering wheel, move rudder to maximum STARBOARD. This will set the physical starboard rudder limit.

- Press the STBD DODGE key when done.

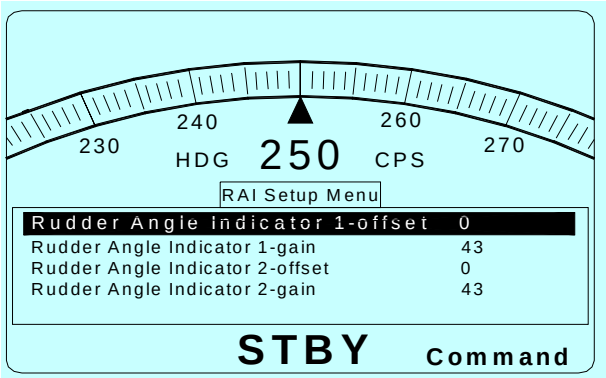
Instructions will appear on the screen:
Using the vessel's steering wheel, move rudder to maximum PORT.

- Press the PORT DODGE key when done.
- Press MENU EXIT.

The DOCKSIDE SETUP MENU will appear. If your vessel is equipped with a second rudder, follow the same procedure for RUDDER 2 SETUP as RUDDER 1 SETUP.

## RAI Setup Menu

Scroll down to the DOCKSIDE MENU. Press the MENU key. Select RAI Setup Menu. This screen will appear:




Highlight RUDDER ANGLE INDICATOR 1 - OFFSET.

- Select from 0 to +64 or -64.
- Set the RAI OFFSET so that the external RAI reads 0 when the rudder is centered.

Highlight RUDDER ANGLE INDICATOR 1 - GAIN.

- Select from 0 to 256.
- Set the gain so that the external RAI reading corresponds to the actual rudder angle.

Highlight RUDDER ANGLE INDICATOR 2 - OFFSET.

- Select from 0 to +64 or -64 as per instructions for RAI1.

Highlight RUDDER ANGLE INDICATOR 2 - GAIN.

- Select from 0 to 256 as per instructions for RAI1.

## Drive Setup Menu

NOTE: The RUDDER SETUP must be done before this.

Highlight DRIVE SETUP MENU

- Press the MENU key.

Instructions: “Center rudder then Press ‘ALM ACK’” will appear on the screen. When ALM ACK is pressed, the rudder will move and the screen will display “To stop drive test press SPECIAL TURN”.

- Press SPECIAL TURN to return to DOCKSIDE SETUP MENU, and press MENU EXIT to return to SETUP MENU.

## Fluxgate Menu Setup

NOTE: At this point you will have to leave the dock to compensate your compass (if your vessel is equipped with a fluxgate compass).

Read the following instructions before proceeding further. It is important to perform the procedure in an open area away from bridges, underwater cables or any other structures that may affect compass accuracy. You will also need enough room to execute slow (approx. 60 seconds) complete circles.

- Take your vessel into open water, as described above.
- Return to the DOCKSIDE SETUP MENU.
- Highlight FLUXGATE SETUP MENU and press the MENU key.
- Instructions will appear on the screen:
    - Press the 'ALM ACK' steer vessel in circle.
    - Execute two slow complete circles - approx. 60 seconds each.
    - Press the SPECIAL TURN key when done.
    - Menu exists back to SETUP MENU.

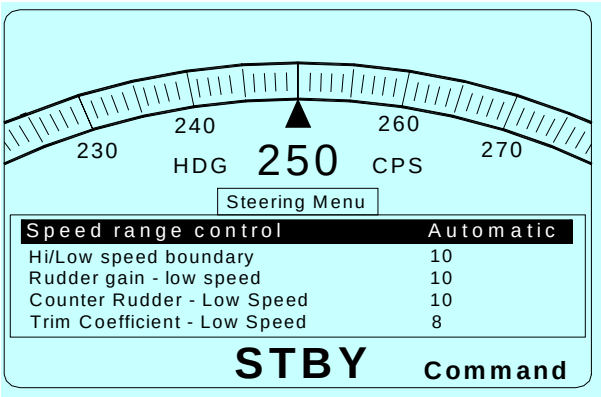
### How to Save the SetUp You Have Configured

Once you have gone through each section of the SETUP MENU and have made the appropriate selections in the SETUP configuration, your selections are automatically saved when you power off the Autopilot.

Turn power on. Now scroll through all the SETUP MENU selections again to ensure that you have completed every aspect of the setup, and to ensure that the computer has saved your selections in its memory.

## Main Menu

Turn the power on and press the MENU key.
The LCD DISPLAY will appear showing the following MAIN MENU:



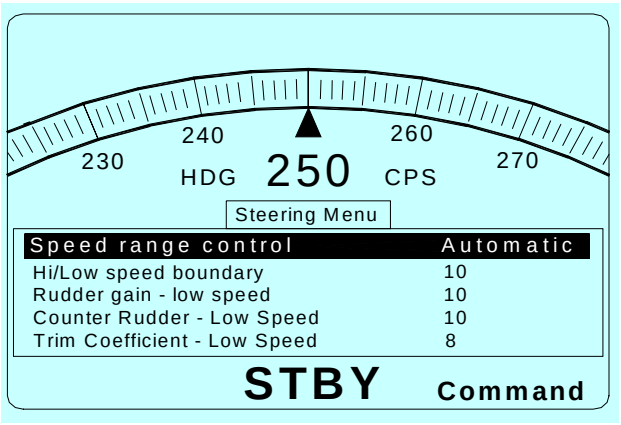

## Steering Menu

Press the MENU key. In the MAIN MENU, select STEERING MENU.

The following screen will appear:

Note: There are TEN submenus, FIVE are displayed. To access submenus, scroll down to desired selection by pressing the ▼ key.

Turn the ADJUSTMENT KNOB left or right to select the desired setting. This selection appears on the right-hand side of the menu display




Note: These settings are normally adjusted during SEA TRIALS.
Refer to the SEA TRIALS section of this manual for more information.

Highlight SPEED RANGE CONTROL. This determines which set of steering parameters (HI or LOW SPEED) is used by the Autopilot.

- Select AUTOMATIC, LOW SPEED or HI SPEED.

Highlight HI/LOW SPEED BOUNDARY. In AUTOMATIC mode, this boundary sets the speed range that is triggered by an external speed device.

- Select from 0 to 10 (Knots).

NOTE: The following items are the steering parameters, which will be optimized during SEA TRIALS.

Highlight RUDDER GAIN LOW SPEED.

- Select from 1 to 30.

Highlight COUNTER RUDDER LOW SPEED.

- Select from 0 to 30.

Highlight TRIM COEFFICIENT LOW SPEED.

- Select from 0 to 30.

Highlight RUDDER GAIN HI SPEED.

- Select from 1 to 30.

Highlight COUNTER RUDDER GAIN HI SPEED.

- Select from 0 to 30.

Highlight TRIM COEFFICIENT HI SPEED.

- Select from 0 to 30.

Highlight YAW.

- Select from 1 to 20 (degrees).

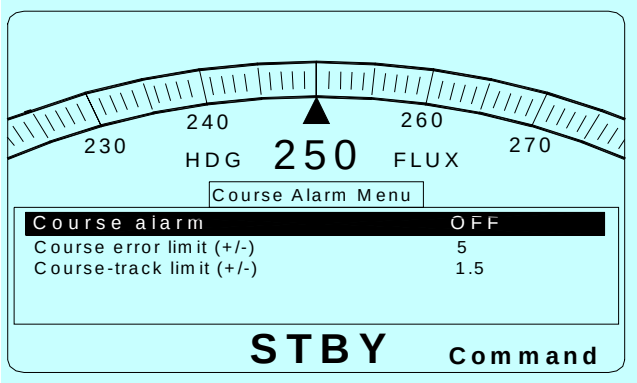
Highlight TURN RATE LIMIT. This should initially be set to the vessel's normal turn rate (See SEA TRIALS).

- Select from 1 to 20 (degrees per second).

Once the STEERING MENU settings are complete, press MENU EXIT. This removes the menu from the screen.

# Course Alarm Menu

Press MENU and scroll to COURSE ALARM MENU. Press the MENU key. This screen will appear, displaying the COURSE ALARM sub-menus:




Highlight COURSE ERROR LIMIT (+/-).

- Select from 3 to 20 degrees.

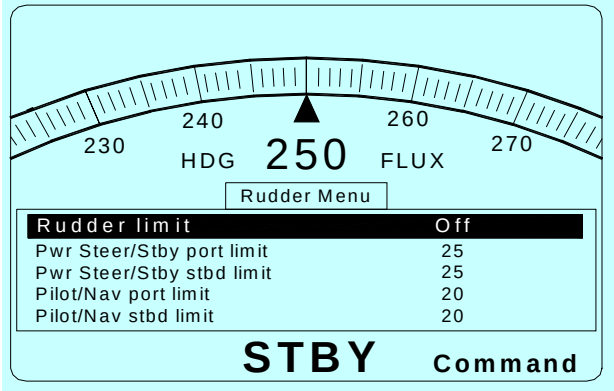
Highlight CROSS TRACK LIMIT (+/-).

- Select from 0.1 to 2.9 nautical miles or km depending on the GPS or external NAV device.

Once the COURSE MENU settings are complete, press MENU EXIT. This removes the menu from the screen.

# Rudder Menu

Press MENU and scroll to RUDDER MENU. Press the MENU key. This screen will appear, displaying the RUDDER sub-menus:




NOTE: The 'physical' rudder limits were set in SETUP, DOCKSIDE SETUP, and RUDDER 1 and RUDDER 2 setup menus. This is the absolute maximum limit that the Autopilot will move the rudder. In the RUDDER MENU, turning RUDDER LIMIT ON enables 'soft' rudder limits which allows the user to set additional tighter limits for use during PILOT/NAV modes or during PWR STEER/STBY modes. The default settings can be adjusted, as outlined below:

Highlight RUDDER LIMIT.

- Select On or OFF.

Highlight POWER STEER PORT LIMIT.

- Select from 5 to 90.

Highlight POWER STEER STBD LIMIT.

- Select from 5 to 90.

Highlight PILOT/NAV PORT LIMIT.

- Select from 5 to 90.

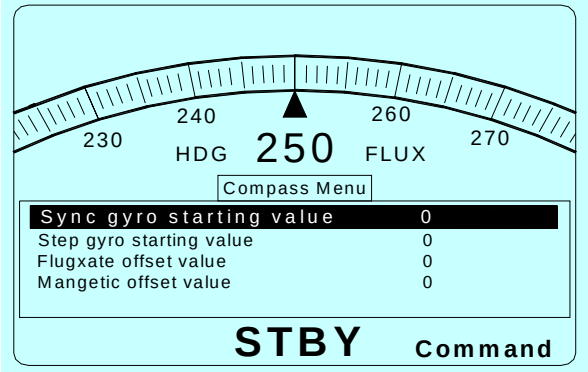
Highlight PILOT/NAV STBD LIMIT.

- Select from 5 to 90.

Once the RUDDER MENU settings are complete, press MENU EXIT. This takes you back to the current heading LCD DISPLAY.

## Compass Menu

Press MENU and scroll to COMPASS MENU. Press the MENU key. This screen will appear, displaying the COMPASS sub-menus:




Note: These adjustments are used to offset the reading on the heading display so that it agrees with the vessel's primary compass reading.

Highlight SYNC STARTING VALUE.

- Select from 0 to 359 degrees.

Highlight GYRO STARTING VALUE.

- Select from 0 to 359 degrees.

Highlight FLUXGATE OFFSET VALUE.

- Select from 0 to 359 degrees.

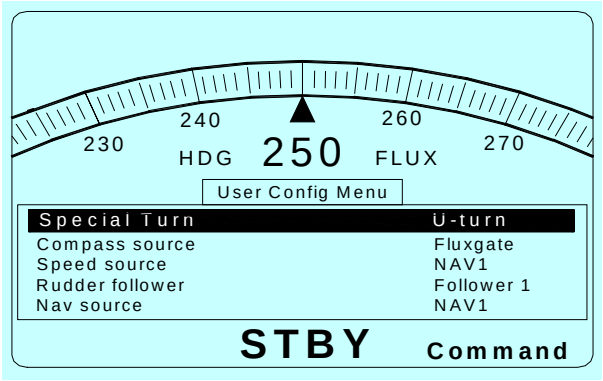
Highlight MAGNETIC OFFSET VALUE.

- Select from 0 to 359 degrees.

Once the COMPASS MENU settings are complete, press MENU EXIT. This takes you back to the STANDBY mode.

## User Config Menu

Press MENU and scroll to USER CONFIG MENU. Press the MENU key. This screen will appear, displaying the USER CONFIG sub-menus:




Highlight SPECIAL TURN.

- Select U-TURN, CIRCLE, or W.RECOVERY.

Highlight COMPASS SOURCE. This selects the type of compass the Autopilot will use to steer the vessel.

- Select COMPASS, STEPGYRO, SYNCGYRO, NAV1, NAV2 or RS-232.

Highlight SPEED SOURCE. This selects the type of external speed source the Autopilot uses to determine SPEED RANGE.

- Select SHIP'S LOG, NAV1, NAV2, COMM PORT or RS-232.

Highlight RUDDER FOLLOWER. This enables you to switch to a backup rudder follower (if your vessel is so equipped) due to failure of the primary unit.

- Select FOLLOWER 1 or FOLLOWER 2.

Highlight NAV SOURCE. In NAV mode, the autopilot uses the NAV device to provide steering information.

- Select NAV 1, NAV2, COMM PORT or RS232.

Highlight XTE sense.

- Select NORM or REV depending on which sense the GPS receiver or other device sends the cross-track error. See page 7-4 for further details.

**THE MAIN SETUP IS NOW COMPLETE.**

Highlight ENABLE XTE.

- Select YES or NO.

Highlight ARRIVAL ALARM.

- Select ON or OFF.

Highlight MAX XTE CORRECTION.

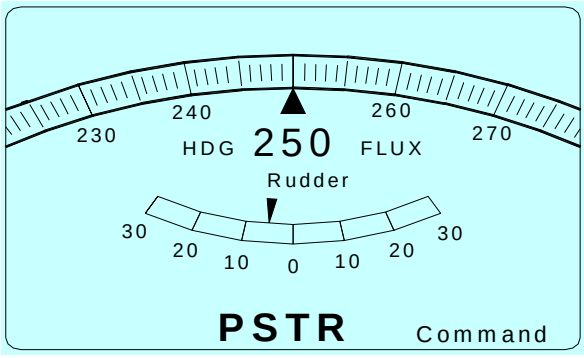
- Select 0 - 120 degree(s).

Once the USER CONFIG MENU settings are complete, press MENU EXIT. This puts you in STANDBY mode.

**THE MAIN SETUP IS NOW COMPLETE.**

# 6. Basic Operations

In POWER STEER mode, you can manually control the position of the vessel's rudder through the Autopilot interface. **To Select PWR STEER (Power Steer) mode:** Press the PWR STEER button. The LCD DISPLAY will appear showing the following:

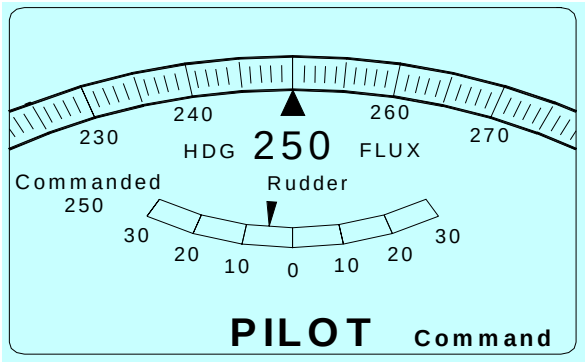



Turn (spin) the ADJUSTMENT KNOB left or right turning your vessel Port or Starboard. This will turn the rudder accordingly. Note that one "click" of the ADJUSTMENT KNOB will move the rudder just over 1/2 a degree, while a "spin" will move it approximately 4 to 6 degrees.

Alternatively, press or hold the PORT or STARBOARD DODGE keys. This will turn the rudder accordingly.

**To Select PILOT (Autopilot) mode:** Press the PILOT button. The LCD DISPLAY will appear showing the following:

**Actual Heading becomes Commanded Heading when entering PILOT mode.**

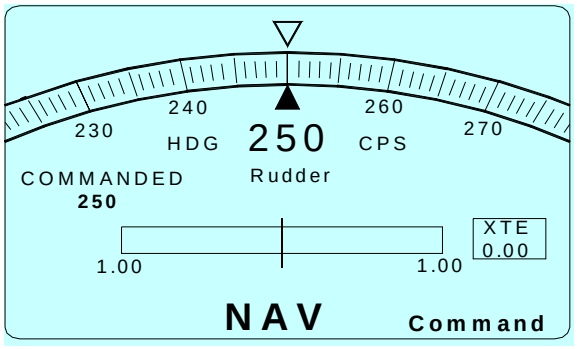



**YOU ARE NOW IN AUTOPILOT. The Autopilot will continue to steer the vessel on your selected course until you select a new course or overide the system, as follows:**

To CHANGE COURSE turn the ADJUSTMENT KNOB until your desired heading under the word "Commanded" is displayed on the LCD DISPLAY SCREEN. A quick turn the KNOB will change course by 10 degrees.

**To Select NAV (Navigation) mode:**

Using your GPS, Loran C or another NAV device, select your waypoint, then press the NAV button on the Autopilot. The LCD DISPLAY will appear showing the following:




**YOU ARE NOW IN NAV MODE. Using the NMEA 0183 data from your NAV device, the Autopilot will continue to steer the vessel to your selected waypoint until you select a new waypoint or overide the system, as follows:**

To CHANGE COURSE, make the appropriate waypoint selection on your NAV device. The Autopilot will automatically steer the vessel to the new waypoint.

To take MANUAL control of the vessel, press the STANDBY button. NOTE: The ADJUSTMENT KNOB has no effect in NAV mode.

See “Advanced Operations” for more NAV information.

## DODGE Function

When in **PILOT** or **NAV** modes, you can use the DODGE buttons to avoid an obstacle in the water. Pressing either the PORT DODGE button or STARBOARD DODGE button will cause the Autopilot to turn the vessel in that direction. However, it is important to realize that while the DODGE buttons are activated the Autopilot will not limit the rate of turn of the vessel. To maintain a heading part way through a dodge, hold both PORT DODGE and STARBOARD DODGE buttons simultaneously.

Once the DODGE buttons are released, the Autopilot will turn the vessel back to the commanded course, but this time the turn will occur at the turn rate that is set in the Steering Parameters.

Note: In PILOT mode only, if you dodge the vessel in one direction, once you release the DODGE button the vessel will return to the same heading but NOT the same track. The new track will be offset from the original track by the distance traveled during the dodge maneuver.

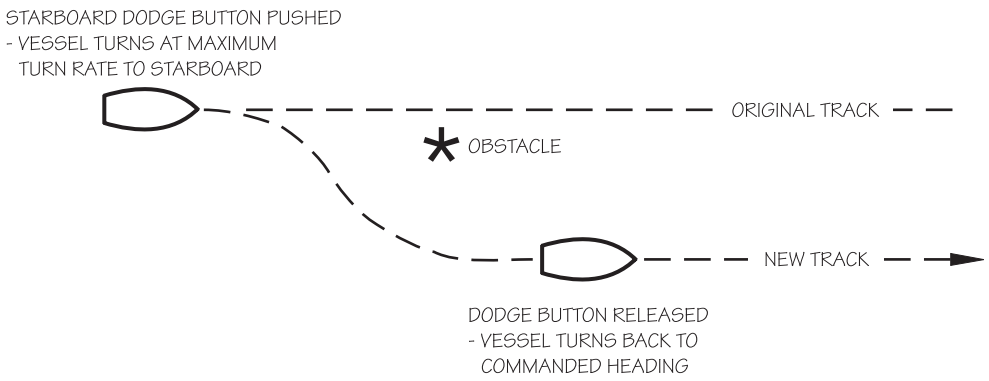


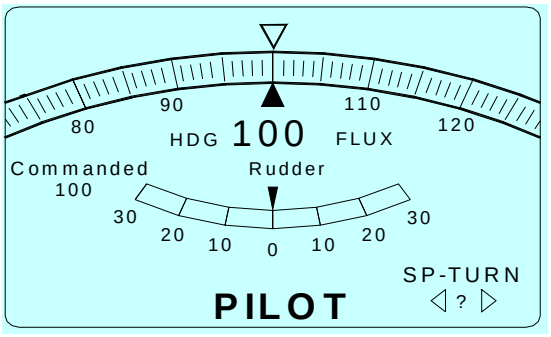

**Figure 18—DODGE Maneuver**

# Special Turns

A SPECIAL TURN is a series of preset turn commands the Autopilot uses to follow a specific course (see Figures 19a, b and c).

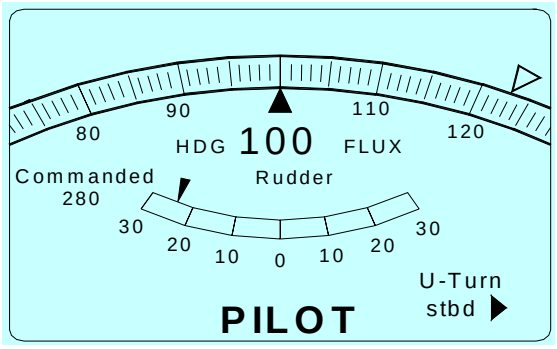
To initiate a SPECIAL TURN you must be in **AUTOPILOT** mode. You can only pre-select one type of turn. This is accomplished by going to the MAIN MENU, select USER CONFIG menu, and then choosing the SPECIAL TURN desired. Use ADJUSTMENT KNOB to make a selection. (For this example, U-Turn is selected). Now MENU EXIT.

Press the SPECIAL TURN button. Note that "SP-TURN" begins to flash in the lower right portion of the LCD SCREEN:




You must press either PORT or STARBOARD DODGE button to instruct the Autopilot as to which direction to turn. (For this example STARBOARD DODGE was selected).

The selected turn and direction will appear on the bottom right corner of LCD DISPLAY SCREEN:




Once a turn has been started you can cancel the Special Turn by changing the mode or turning the ADJUSTMENT KNOB. The turn may also be cancelled by pressing the SPECIAL TURN key a second time. The Autopilot will then PILOT on the heading selected at the moment the turn was cancelled.

The DODGE function can still be utilized during a SPECIAL TURN.

## U Turn

The U-TURN is just what it sounds like. The vessel makes a 180 degree turn in the direction that you ask it to.

To set up a U-TURN, press the MENU button, then select USER CONFIG MENU, then SPECIAL TURN. Using the ADJUSTMENT KNOB select “U-TURN” and MENU EXIT.

To execute a U-Turn while in AUTOPILOT mode, press SP-TURN, then one of the two DODGE buttons. The U-TURN and direction will appear on the bottom right of the LCD DISPLAY SCREEN.

If the PORT DODGE button is pressed, the Autopilot will make a 180 degree turn to port, and if the STARBOARD DODGE button is pressed, the Autopilot will make the 180 degree turn in the starboard direction.

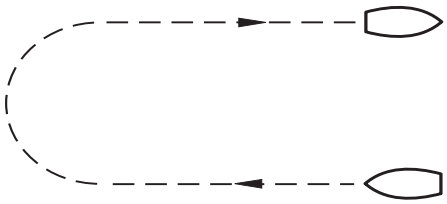


**Figure 19a—U Turn**

## Continuous Circle Turn

The Continuous Circle Turn, also known as C Turn, will turn the vessel in a circle until the turn is disabled by either turning the knob or by changing modes.

To set up a CIRCLE TURN, press the MENU button, then select USER CONFIG MENU, then SPECIAL TURN. Using the ADJUSTMENT KNOB select “Circle” and MENU EXIT.

To execute a CIRCLE TURN while in AUTOPILOT mode, press SP-TURN, then one of the two DODGE buttons. The “Circle” and direction will appear on the bottom right of the LCD DISPLAY SCREEN.

If the PORT DODGE button is pressed, the turn will be in the port direction, and if the STARBOARD DODGE button is pressed, the turn will be in the starboard direction.

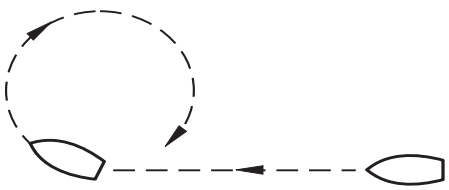


**Figure 19b—Continuous Circle Turn**

## Emergency Turn

The Emergency Turn, also known as the “Man Overboard” turn or Williamson Recovery, will turn the vessel around and follow the same path back, as long as the vessels turn rate and speed have not been changed.

To setup a EMERGENCY TURN press the MENU button, then select USER CONFIG MENU, then SPECIAL TURN. Using the ADJUSTMENT KNOB select “W. Recovery” and MENU EXIT.

To execute a EMERGENCY TURN, while in AUTOPILOT mode, press one of the two DODGE buttons. The “W. Recovery” and the direction will appear on the bottom right of the LCD DISPLAY SCREEN.

If the PORT DODGE button is pressed, the Autopilot will make a 90 degree turn to port, followed by a 270 degree turn to starboard, and retrace its track in the water. If the STARBOARD DODGE button is pressed, then the 90 degree turn will be to starboard, and the following 270 degree turn will be to port.

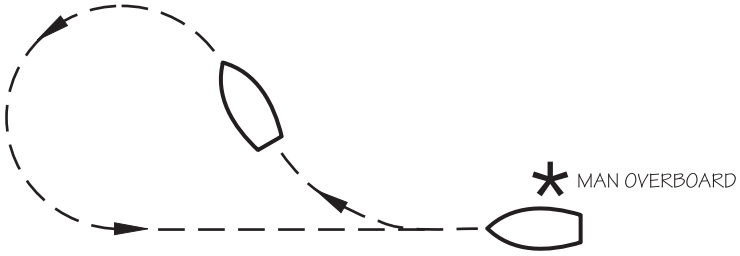



**Figure 19c—Emergency Turn**

# Sea Trials Procedure

The purpose of this section is to tune the Autopilot to your particular vessel in order to achieve smooth operation, accurate course-keeping and timely course changing without excessive steering motion of the rudder.

## Background Information

- Each type of vessel has unique design dynamics, and these change depending on speed, loading, and sea conditions.

- The Autopilot steering control software has a number of settings that can be tailored to suit many different vessels.

- These settings are repeated in two distinct “groups”, one group for “SLOW” vessel speeds and one group for “FAST” vessel speeds. These group labels are chosen because speed is often the single biggest factor in vessel dynamics.

SLOW and FAST settings each have the following adjustable parameters:

- RUDDER GAIN
- COUNTER RUDDER GAIN
- TRIM COEFFICIENT

There are adjustable parameters that affect both SLOW and FAST groups at the same time:

- TURN RATE DELAY*
- RUDDER HIGH RATE CUTOUT*
- RUDDER DEADBAND*
- TURN RATE LIMIT
- YAW

* See GETTING STARTED Section 5 - CONFIG MENU SETUP
The Autopilot is delivered to you with DEFAULT settings for all of the parameters that you may want to adjust during SEA TRIALS.

Reference the following two pages for explaination of the functions of each steering parameter.

# Steering Response

When you receive your ComNav Autopilot, it will have been pre-programmed with factory settings. These settings will provide average steering performance for a wide range of vessels when the Autopilot is in either **AUTOPILOT** or **NAV** mode. You can optimize your Autopilot's performance by adjusting four steering parameters—rudder, counter rudder, turn rate and yaw—to match the steering characteristics of your vessel. These parameters are easy to change and may also be changed while underway to adjust Autopilot performance to changing weather conditions.

**NOTE: This section explains the function of each steering parameter. The Sea Trials procedures later in this section provides detailed information on how to adjust the steering parameters to your vessel.**

## Rudder

Varying the rudder parameter controls the amount of rudder applied for a given amount of course error. At the maximum setting of 30, 2 degrees of rudder will be applied for each degree of course error.

## Counter Rudder

Varying the counter rudder parameter controls the amount of rudder applied for a given rate of change of course error. If the course error is increasing, the counter rudder adds to the rudder correction applied, and if the course error is decreasing the counter rudder subtracts from the rudder correction applied. At the maximum setting of 30, 0.3 degrees of rudder will be applied for a 1 degree per second rate of change of the course error.

## Turn Rate

Varying the turn rate parameter controls the maximum rate at which the vessel may make a course change in **AUTOPILOT** or **NAV** mode, return to its original heading after a Dodge maneuver, or execute a special turn. Factors such as speed, load, hull characteristics and weather conditions may limit the maximum achievable turn rate. The turn rate is shown in degrees per second.

## Yaw

The yaw parameter tells the Autopilot how far off course the vessel may "wander" before the Autopilot corrects the error. This value should be adjusted according to sea conditions. As conditions worse, the yaw setting can be increased. This will result in slighly poorer steering, but will reduce the amount of rudder movement and strain on the steering system.

The yaw parameter is expressed in degrees, centered on the commanded course. So a setting of 1degree will allow the vessel to wander 0.5 degree to Port or Starboard before taking corrective action.

## Fast/Slow Speed

The FAST/SLOW option on the 5001Autopilot gives you the ability to store two different sets of Steering Parameters. This allows for best performance under varying vessel speeds and/or loading conditions.

The 5001 Autopilot can be manually set to use the slow settings or the fast settings. This is done by changing the "Speed Range Control" in the Steering Menu from Fast to Slow or vice versa. There is also a selection for "Automatic". If "Automatic" is chosen, the autopilot will (automatically) switch from fast to slow or vice versa depending on the vessel's speed. For "Automatic" to work, the Autopilot must be connected to a Navigation device that outputs speed information in NMEA 0183 format, or a ship's log that outputs either 200 or 400 pulses per nautical mile (PPNM).

**POWER ON/OFF**
The system can be switched on in either of two modes:

1) By pressing and holding the STBY/OFF key for two seconds, the system will power up with the CONTROL HEAD in the COMMAND mode, allowing access to all functions.

2) If the STBY/OFF key is bumped or pressed momentarily, the system will power up in STANDBY mode and the CONTROL HEAD will be in REPEATER mode, with all the system controls inactive. The current vessel heading and rudder angle will be displayed.

3) To change the CONTROL HEAD to the COMMAND mode, you must "take control" by pressing both DODGE keys simultaneously for two seconds.

4) Power is turned off by pressing the STBY/OFF key for four seconds.

## Begin the SEA TRIALS procedure by checking that the following SETUP items are preset:

Enter SETUP by pressing and holding the MENU key and STBY/OFF key to turn on the Autopilot system.

Go to SETUP and CONFIG MENU and highlight HIGH-RATE CUTOUT. It should be set for your vessel's steering characteristics.

Highlight RUDDER DEADBAND.

- Set it for rudder placement without excessive 'hunting'.

Highlight TURN RATE DELAY.

- Set it to the default setting of 15.

Turn off the Autopilot system to exit SETUP.

This subsection describes the Sea Trial Procedure, which comprises the following:

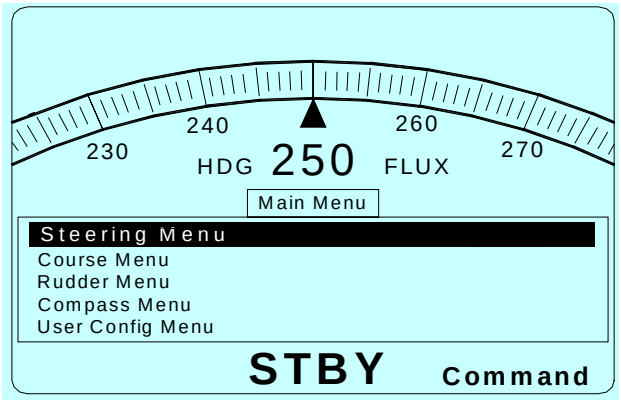
1) Set up COURSE-CHANGING parameters for SLOW
2) Set up COURSE-KEEPING parameters for SLOW
3) Set up COURSE-CHANGING parameters for FAST
4) Set up COURSE-KEEPING parameters for FAST
5) Set TURN RATE AND YAW

NOTE: SELECT REASONABLY CALM SEA CONDITIONS FOR THE SEA TRIALS.

**IMPORTANT NOTE:**
**RECORD ALL SEA TRIAL SELECTIONS IN THE SPACE PROVIDED IN THIS MANUAL (See SECTION 13) . THIS RECORD WILL BE AN INVALUABLE REFERENCE SHOULD YOU NEED TO RESET YOUR AUTOPILOT SYSTEM DUE TO CHANGES TO YOUR VESSEL'S AUTOPILOT OR STEERING SYSTEMS.**

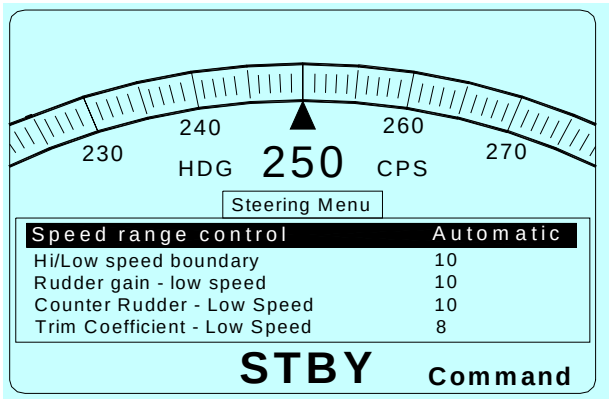
## Course Changing - Slow

Turn the Autopilot power on and press the MENU key. You will see a display like this:




Highlight the STEERING MENU (by using the ▼, ▲ buttons).

- Press the MENU key. This screen will appear, displaying the STEERING MENU sub-menus:




Note: There are TEN submenus, FIVE are displayed. To access submenus, scroll down to desired selection by pressing the ▼ key.

Turn the ADJUSTMENT KNOB left or right to select the desired setting. This selection appears on the right-hand side of the menu display

Adjust vessel speed appropriately for LOW SPEED running.

In the STEERING MENU, highlight SPEED RANGE CONTROL

- Select SLOW.

Highlight YAW (near the bottom of the menu)

- Select 1 (this setting is +/- 0.5 degrees).

Highlight TURN RATE LIMIT

- Select a setting that is aproximately 3/4 of your vessel's 'comfortable capability'. NOTE: You may have to time a complete circle while the vessel is turning at a comfortable rate. This turn should occur at the vessel speed most appropriate for SLOW. Then calculate 'comfortable capability' as 360 degrees divided by number of seconds it took to complete the turn.

Highlight TRIM COEFFICIENT LOW SPEED

- Select 0 (no trim). The default setting is 8.

Highlight RUDDER GAIN LOW SPEED

- Select 10.

Highlight COUNTER RUDDER LOW SPEED

- Select 10.

Exit the MENUS.

## Rudder Setting

Switch to PILOT mode (Autopilot uses current heading as selected heading).

Run for about 5 minutes. If the vessel holds course with minimal rudder activity, make a 40 degree course change (either direction).

If your vessel overshoots the new course more than 3 times (i.e., "essing") select RUDDER GAIN LOW SPEED from the MENU and decrease the setting by 3 increments, then REPEAT TEST.

If your vessel does not overshoot the new course at all, or if it does not come onto the new course, increase RUDDER GAIN LOW SPEED setting by 3 increments, then REPEAT TEST.

If your vessel still overshoots 1-3 times, REPEAT the test on different headings.

If all results are in the range of 1-3 overshoots, then proceed to COUNTER RUDDER HI SPEED adjustment. Otherwise increase or decrease the RUDDER GAIN HI SPEED setting as needed, then REPEAT TESTS.

### Counter Rudder Setting

Switch to PILOT mode (Autopilot uses current heading as commanded heading).

Make a 40 degree course change (either direction).

If your vessel overshoots the new course select COUNTER RUDDER HI SPEED from the MENU and increase the setting by 3 increments, then REPEAT TEST.

Continue to increase COUNTER RUDDER HI SPEED increments until your vessel comes smoothly onto the new course without overshooting.

If your vessel appears to approach the new heading and then veer back, then approach, veer, approach, etc, until the new course is finally reached, decrease the COUNTER RUDDER HI SPEED setting, then REPEAT TEST.

Once satisfactory results are obtained, REPEAT TEST on various headings to achieve consistent performance.

## Course Keeping - Slow

Set a course in AUTOPILOT and follow it for several minutes. If your vessel ‘hangs off’ of your selected course, but otherwise maintains a straight line, select TRIM COEFFICIENT SLOW SPEED from the MENU. Begin at the default setting of 8 and wait a few minutes to see the results. Adjust the setting incrementally until, in a smooth and timely manner, the actual course comes onto the course you have selected.

# Course Changing - Fast

Adjust vessel speed appropriately for FAST running. This is generally considered to be your vessel's "cruising" speed.

In the STEERING MENU, highlight SPEED RANGE SELECTION

- Select FAST.

Highlight YAW

- Select 1.

Highlight TURN RATE LIMIT

- Select a setting that is approximately 3/4 of your vessel's 'comfortable capability'. NOTE: You may have to time a complete circle while the vessel is turning at a comfortable rate. This turn should occur at the vessel speed most appropriate for FAST. Then calculate 'comfortable capability' as 360 degrees divided by number of seconds it took to complete the turn.

Highlight TRIM COEFFICIENT HI SPEED

- Select 0 (no trim).

Highlight RUDDER GAIN HI SPEED and select approximately 3 increments below the optimum SLOW operation setting you determined in the previous SEA TRIAL procedure.

Highlight COUNTER RUDDER HI SPEED

- Select approximately 2 increments below the optimum SLOW operation setting you determined in the previous SEA TRIAL procedure.

Repeat the same tests as implemented for: COURSE-CHANGING SLOW, but use the settings for FAST, as follows:

## Rudder Setting

Switch to PILOT mode (Autopilot uses current heading as commanded heading).

Make a 40 degree course change (either direction).

If your vessel overshoots the new course more than 3 times (i.e., "essing") select RUDDER GAIN HI SPEED from the MENU and decrease the setting by 3 increments, then REPEAT TEST.

If your vessel does not overshoot the new course at all, or if it does not come onto the new course, increase RUDDER GAIN LOW SPEED setting by 3 increments, then REPEAT TEST.

If your vessel still overshoots 1-3 times, REPEAT the test on different headings.

If all results are in the range of 1-3 overshoots, then proceed to COUNTER RUDDER HI SPEED adjustment. Otherwise increase or decrease the RUDDER GAIN HI SPEED setting as needed, then REPEAT TESTS.

### Counter Rudder Setting

Switch to PILOT mode (Autopilot uses current heading as commanded heading).

Make a 40 degree course change (either direction).

If your vessel overshoots the new course select COUNTER RUDDER HI SPEED from the MENU and increase the setting by 3 increments, then REPEAT TEST.

Continue to increase COUNTER RUDDER HI SPEED increments until your vessel comes smoothly onto the new course without overshooting.

If your vessel appears to approach the new heading and then veer back, then approach, veer, approach, etc, until the new course is finally reached, decrease the COUNTER RUDDER HI SPEED setting, then REPEAT TEST.

Once satisfactory results are obtained, REPEAT TEST on various headings to achieve consistent performance.

## Course Keeping - Fast

Set a course in AUTOPILOT and follow it for several minutes. If your vessel ‘hangs off’ of your selected course, but otherwise maintains a straight line, select TRIM COEFFICIENT FAST SPEED from the MENU. Begin at the default seting of 5 and wait a few minutes to see the results. Adjust the setting incrementally until, in a smooth and timely manner, the actual course comes onto the course you have selected.

## Turn Rate Setting

Make several course changes at different TURN RATE settings to ensure correct response of your vessel. If satisfied with your vessel's turning performance, leave the TURN RATE setting at the selected rate of turn for FAST.

If the Autopilot cannot turn your vessel at the desired rate of turn (assuming that the vessel is capable of being turned at that rate), adjust the RUDDER and COUNTER RUDDER settings with a little higher RUDDER GAIN HI SPEED. If this fails, the PILOT mode rudder limits (See DOCKSIDE SETUP section of manual) may need to be increased.

## Yaw Adjustment

NOTE: Yaw is normally adjusted under extreme weather conditions where the Autopilot may overwork the steering by trying to keep the vessel on too tight a course. A low setting selected during SEA TRIALS will provide the best performance under normal conditions.

Highlight YAW from the MENU

- Select desired setting.

# Sea Trial Completion

Your Sea Trials are now complete. However, you may wish to monitor and evaluate the performance of the Autopilot and make incremental changes to accommodate varying sea conditions. For example, in heavy following seas you may want to turn up RUDDER GAIN, while in a heavy cross current you may require a TRIM RATE adjustment.

The SPU has a battery that enables it to back up computer memory during power failure. However, memory retention cannot be guaranteeed during SPU servicing, or if the SPU battery fails.

**IMPORTANT NOTE:**
RECORD ALL SEA TRIAL SELECTIONS IN THE SPACE PROVIDED IN SECTION 12 OF THIS MANUAL. THIS RECORD WILL BE AN INVALUABLE REFERENCE SHOULD YOU NEED TO RESET YOUR AUTOPILOT SYSTEM DUE TO CHANGES TO YOUR VESSEL'S AUTOPILOT OR STEERING SYSTEMS.

# 7. Advanced Operations

## Introduction

Once your Autopilot is functioning properly in **AUTOPILOT** mode, and you have completed all of the Setup and Sea Trials in the "Getting Started" and "Basic Operations" sections, you are ready to use **NAV** mode.

The 5001 Autopilot has the capability to use steering information from an external NMEA device such as a GPS, DGPS, Loran, Chartplotter, or suitably equipped computer. This allows the vessel to steer to a waypoint destination or along a route of waypoints.

In **NAV** mode the Autopilot uses its own compass as its primary source of heading for course keeping while the data received from the external device is used to calculate the commanded heading to direct the vessel to the destination waypoint.

## Navigation Interface

The 5001 Autopilot may be interfaced to navigation devices capable of transmitting autopilot sentences in NMEA 0183 format. Five types of information from the NMEA data provided by the navigation device are used by the autopilot:

•**Vessel Heading** from NMEA sentences **HDG** (recommended), **HDT**, **HDM**.

•**Vessel Speed** is used if the autopilot is set to automatically switch between FAST and SLOW steering parameters. See Section 6—Basic Operations for more information on this feature. Vessel speed can be taken from NMEA 0183 sentence types **VTG** (recommended), **VHW**, or **VBW**.

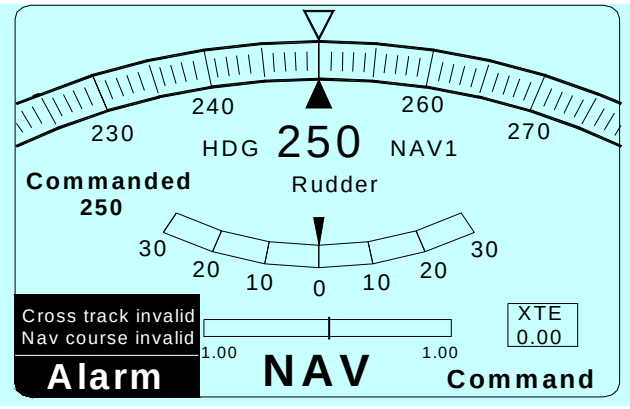
• **Bearing to Destination.** The best performance will be obtained if Bearing to Waypoint is used, but Bearing (from) Origin to Destination (BOD) will be selected if bearing to waypoint is not available. The commanded bearing can be taken from NMEA sentences **APB** (recommended), **APA**, **RMA** together with **RMB**, **RMC** together with **RMB** or **BOD**.

• **Cross Track Error** (XTE) is the perpendicular distance from the track and the direction to steer to get back on track. Cross track error can be taken from **APB** (recommended), **APA**, **RMA** together with **RMB**, **RMC** together with **RMB**, or **XTE**.

• **Waypoint Arrival Status.** This will cause the audible alarm to sound and the message "Waypoint Arrival" to be displayed on the autopilot when the vessel enters the arrival circle around the waypoint. The same alarm will occur if the vessel crosses a line perpendicular to the track at the waypoint. Waypoint arrival status can be taken from **APB** (recommended), **APA**, **RMA** together with **RMB**, or **RMB** together with **RMC**. Note that not all navigation devices send waypoint arrival status. Furthermore, navigation devices that are capable of sending waypoint arrival status may not do so all the time, depending on how they are configured.

Some navigation devices allow you to choose exactly which sentences the device will transmit. Others allow you to select groups of sentences. For some devices, the number and type of sentences are not adjustable. Consult the navigation device's manual to determine what options are available for your particular navigation device. There is no harm in transmitting more sentences than those listed above; they will simply be ignored by the Autopilot. However, if too many sentences are transmitted at too fast of a rate, the navigation device may truncate the number of sentences, and the Autopilot may not get all the information it needs. In this case, it will sound an alarm and display one or more of the following error messages:

- "Cross track invalid"
- "Nav course invalid"
- "Speed invalid"



## Steering Along a Track

In this method of navigating, the Autopilot will bring the vessel onto a "track" that is a straight line between the origin waypoint and the destination waypoint. If the vessel is not already on this track, there will be "cross-track error". Cross track error is the perpendicular distance from the track to the vessel's position.

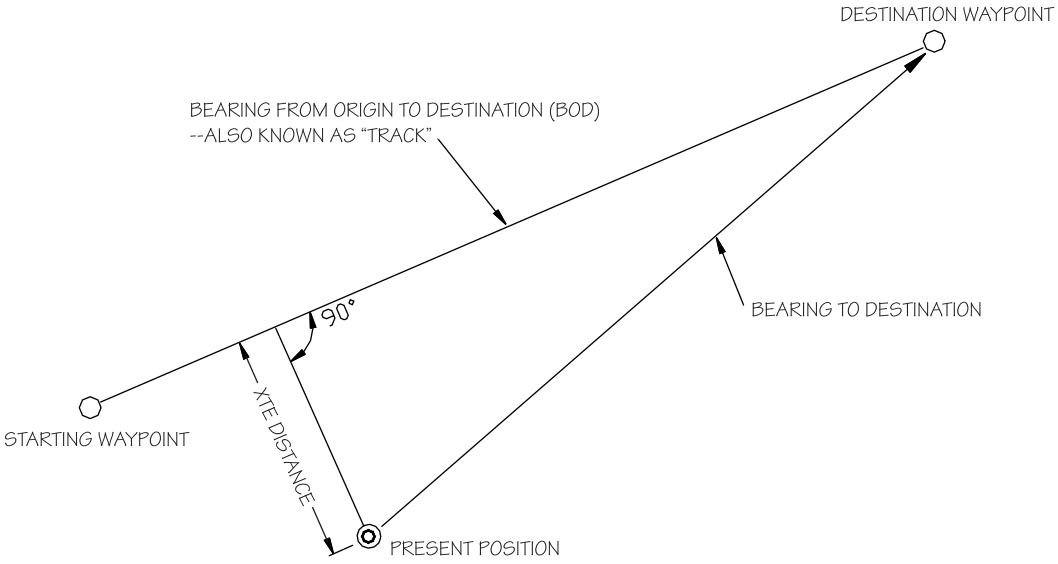



**Figure 16—Representation of Track and Bearing to Destination**

When steering along a track, the Autopilot tries to minimize cross-track error by steering to a heading that lies between the perpendicular to the track and the destination waypoint. The farther you are off track, the closer to the perpendicular the heading will be. As you come closer to the track, the heading of the vessel will change closer to the heading of the track. When you are on-track, the vessel's heading and the track heading will be identical.

You can limit the total number of degrees that the autopilot will correct the heading it receives from the navigation device as it tries to bring the vessel back on track. This adjustment is made in the "User Config" menu under "Max XTE Correction".

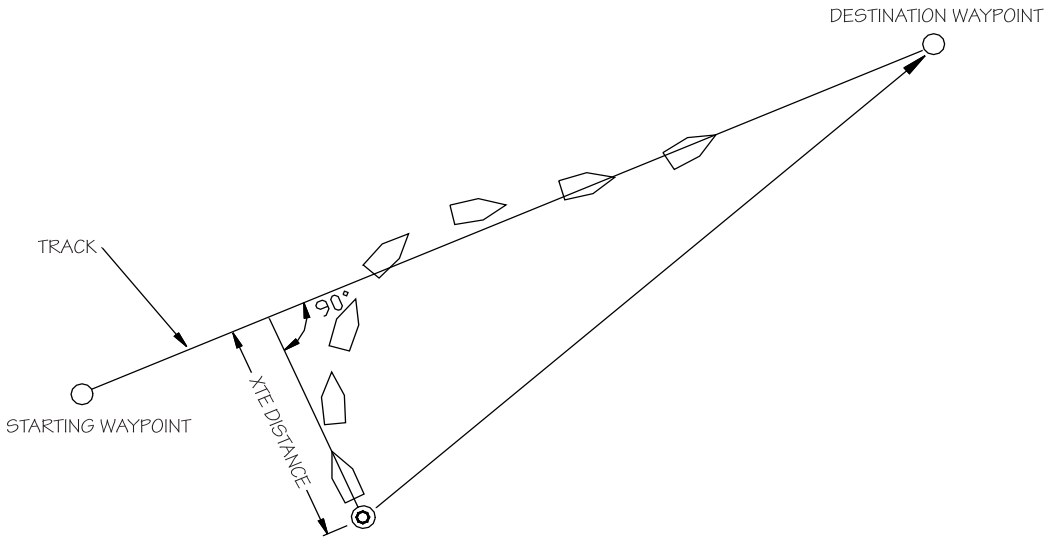



**Figure 17—Response of Vessel to Cross-Track Error**

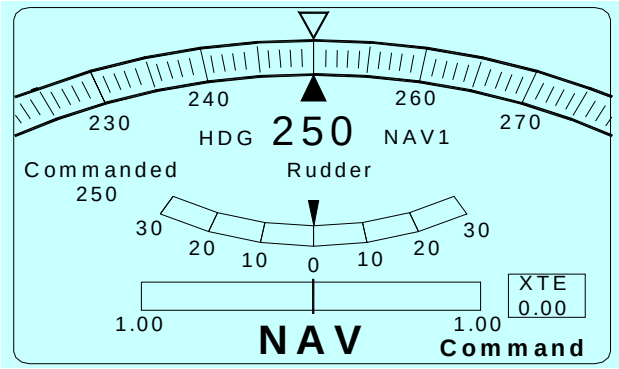
As seen in the above diagram, if there is a large cross-track error, the Autopilot may overshoot the intended track. This is a function of turn rate, vessel speed, and GPS positional updating. For best performance, it is always best to minimize any cross-track error before putting the Autopilot into **NAV** mode.

Test out how the Autopilot steers along a track by following these steps:

1. Make sure the navigation device is turned on and that a waypoint is programmed in.

2. Manually steer the vessel close to the waypoint track.

3. Put the Autopilot in **NAV** mode by pressing and holding the NAV button until the unit beeps and the word “NAV” appears in the bottom portion of the display.



4. Observe the vessel's response for several minutes. If the vessel seems to be continually falling off course away from the track, you need to reverse the sense of the XTE from "NORM" (normal) to "REV" (reverse). To do this, press MENU, then press USER CONFIG MENU and select XTE Sense. Use the ADJUSTMENT KNOB to select REV. Verify correct operation by manually steering back to the waypoint track (switch to **STANDBY** mode first), and then placing the Autopilot back into **NAV** mode. Observe the vessel's response as before.

   If the vessel is wandering back and forth but there are no alarms on the Autopilot or navigation device, the most common cause is poor signal quality. This may be due to:

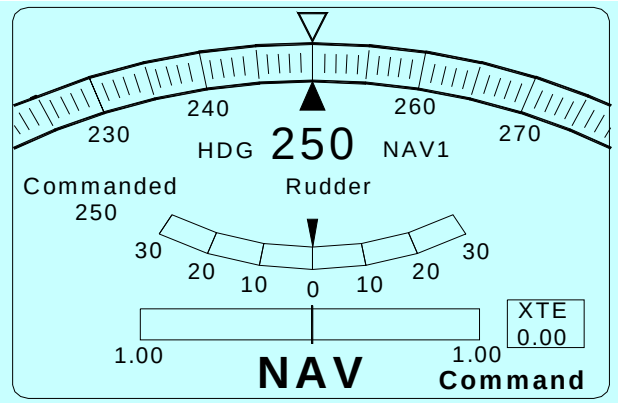
   • Improper grounding.

   • Electrical noise generated within the vessel (such as alternators, power packs, etc.).

   • Antenna location.

   Refer to the navigation device manual for signal quality displays and ideas on making improvements.

   You may still use the DODGE buttons to avoid obstacles in the water. The only difference between NAV and AUTOPILOT modes are that after you release the DODGE buttons, the vessel will steer back to its original track, rather than resuming its original course.



## Steering a Direct Bearing

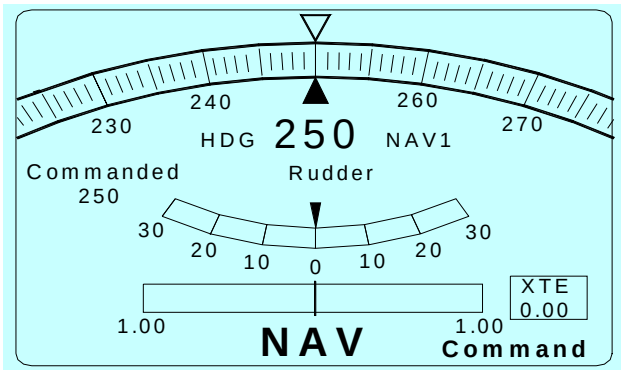
In this navigation method, XTE is not factored into the calculation that the Autopilot uses to determine the heading to steer. Test this out so as to be familiar with it by performing the following steps:

1. Press MENU, select USER CONFIG, select Enable XTE. Use the ADJUSTMENT KNOB to select Yes or No.

Make sure the navigation device is turned on and that a waypoint is programmed in.

2. Switch the Autopilot to STANDBY mode and manually steer the vessel away from the waypoint track by a few hundred meters.

3. Put the Autopilot back into **NAV** mode by pressing and holding the NAV button until the unit beeps and the word “NAV” appears in the bottom portion of the display:




4. Observe the Autopilot heading display. It should match the bearing reported by the navigation device.

## Problems in NAV mode

If while testing **NAV** mode the Autopilot displays one of “Cross Track Invalid”, “Nav Course Invalid” or “Speed Invalid”, then the Autopilot is not receiving the NMEA data from the navigation device properly.

Refer to Section 8 —Problem Solving for assistance.

# 8. SETUP & SEA TRIALS CHECKLIST

## Getting Started

### At the dock:

Enter **STANDBY** mode to:

1) Adjust LCD Screen Brightness & Contrast ☐

2) Read Battery Voltage ☐

Perform normal “Reset” or “Full Reset” to enter **DOCKSIDE SETUP** mode then:

3) Do Rudder Drive Test ☐

4) Select Compass Type ☐

Enter **POWER STEER** mode and:

5) Check Rudder Hard-over to Hard-over (HOH) time. ☐

6) Set Rudder Travel Angle for Digital RAI. ☐

Return to **STANDBY** mode:

7) Center and check external RAls (if fitted). ☐

### With the vessel underway and clear of traffic and obstacles:

Perform normal “Reset” to enter **DOCKSIDE SETUP** mode then:

8) Perform FIuxgate Compass compensation (if fitted). ☐

Return to **STANDBY** mode and:

9) Set Compass Offset to match vessel’s steering compass (if fitted). ☐

Enter **POWER STEER** mode:

I0) Check Autopilot operation in **POWER STEER.** ☐

# Getting Started

At the Dock:

SETUP MENU

1) Power on in SETUP MENU. Hold down the MENU key while turning on the power STDY/OFF key. Hold down both keys for two seconds to turn the power on. Autopilot will beep.
2) Highlight CONFIG MENU and select RESET TO FACTORY DEFAULTS. Use ADJUSTMENT KNOB and select Yes. Press MENU EXIT.
3) Turn off Autopilot by holding STDY/OFF key for four seconds.

DOCKSIDE SETUP MENU

4) Power on again in SETUP MENU. Hold down the MENU key while turning on the power STDY/OFF key. Hold down both keys for two seconds to turn the power on.
5) Highlight DOCKSIDE SETUP MENU and select RUDDER FOLLOWER 1 SETUP MENU. Press the MENU key. Follow the instructions displayed on the LCD SCREEN. Once completed, press MENU EXIT.
6) Select DRIVE SETUP MENU. Press the MENU key. Follow the instructions displayed on the LCD SCREEN. When completed, press MENU EXIT.
7) Turn off Autopilot by holding STDY/OFF key for four seconds.

OPTION(S)

8) Power on by pressing STDY/OFF key.
9) Press MENU and highlight COMPASS MENU. Use ADJUSTMENT KNOB and select type of compass used on your vessel. Press MENU EXIT.
10) Press DOCKSIDE SETUP MENU and select RAI SETUP MENU.
5) Highlight DOCKSIDE SETUP MENU and select RUDDER FOLLOWER 2 SETUP MENU. Press the MENU key. Follow the instructions displayed on the LCD SCREEN. Once completed, press MENU EXIT.

DEVICE MENU

11) Power on again in SETUP MENU. Hold down the MENU key while turning on the power STDY/OFF key. Hold down both keys for two seconds to turn the power on.
12) Highlight DEVICE MENU, select REMOTE and on. Press MENU EXIT.
13) Highlight RUDDER FOLLOWER 1, select on. Press MENU EXIT. (Repeat step if RUDDER FOLLOWER 2, is applicable).

DOCKSIDE MENU

14) RAI

# Basic Operations

## With the vessel underway and clear of traffic and obstacles:

Enter **STANDBY** mode to:

11) Set Speed Trip Point. ☐

Enter **AUTOPILOT** mode and:

12) Adjust turn rate, rudder and counter rudder at slow speed. ☐

13) Adjust yaw setting at slow speed. ☐

14) Adjust turn rate, rudder and counter rudder at fast speed. ☐

15) Adjust yaw setting at fast speed. ☐

16) Test dodge function. ☐

Enter **STANDBY** mode to:

17) Select type of Special Turn. ☐

Return to **AUTOPILOT** mode and:

18) Execute a Special Turn. ☐

# Advanced Operations

19) Setup Navigation Device and check that correct NMEA sentences are available. ☐

## With the vessel underway and clear of traffic and obstacles:

Enter **NAV** mode:

20) Check XTE sense is “Normal.” ☐

21) Check Autopilot operation in **NAV** mode with “Normal” XTE Sense. ☐

22) If necessary, select “Rev” XTE Sense. ☐

23) If necessary, check Autopilot operation in **NAV** mode with “Rev” XTE Sense. ☐

24) Turn XTE Sense “Off.” ☐

25) Check Autopilot operation in **NAV** mode with XTE Sense “Off.” ☐

26) Set XTE Sense value (Norm, Rev or Off) to desired value. ☐

# 8. Problem Solving

Several different problems and possible solutions are outlined below. If the suggested solution does not solve the problem, return the Autopilot to an authorized service center. NOTE: Some of the tests require a DC voltmeter.

**Autopilot does not turn on. Display Screen remains blank and does not light up.**
1. Check for power at the Autopilot and the connection to the Power Supply card.
2. Check the main fuses or circuit breaker panel.
3. Check the polarity of the power connection.
4. Check that the Head is properly connected to the SPU.
5. If power (+13VDC) is going to the Head, the Head may be faulty.

**The Display Screen comes on, the keys beep, but do not respond (Cannot change modes).**
1. There may be a loss of communications from the Head to the SPU.

**A display can be seen but it is dark.**
1. The backlight is turned off. Adjust brightness with UP arrow.
2. The backlight is burned out. Control Head problem.

**A display can be seen but it is very faded or very blue. The backlight is on.**
1. The contrast control is miss-adjusted. Adjust with the ▲ button.

**Display Screen comes on but is not normal (scrambled or brokenup display).**
1. Problem with Control Head or its communication to SPU.

**Cannot turn system off.**
1. Problem with SPU, CPU card or Power Supply card.
2. Could be a problem in Control Head.

**The Autopilot does not change modes or respond to key presses.**
1. The Head is in “Repeater” status. Press both DODGE keys to take command.
2. Loss of communications from Head to SPU.

**RUDDER SETUP MENU, the rudder limits are not retained or cannot setup rudder.**
1. During setup, when told to press the PORT or STBD DODGE key, it needs to be held longer.
2. Rudder Follower not working correctly. Check voltages on Rudder Follower connector.

**During DRIVE SETUP MENU, the Rudder doesn't move when it should.**
1. RUDDER SETUP must be done successfully before doing the DRIVE SETUP.
2. May be a fault in the drive mechanism. Check connections. Check steering system.
3. Mistake in menu selection. In SETUP, CONFIG MENU, the DRIVE TYPE selection may be incorrect.

**RAI SETUP MENU cannot set zero or cannot set gain.**
1. Check that rudder is centered if setting RAI zero then adjust gain.
2. Check the connections.

**The Autopilot turns on but does not turn the rudder**
1. Check connections. There should be separate power from the battery circuit breakers to the Reversing Motor card. Check circuit breaker or fuses.
2. Check if DRIVE SETUP in SETUP MENU moves the rudder.
3. Check that the Drive LEDs operate on the Drive card in POWER STEER mode.

**The Autopilot turns on but the display is "frozen". The compass rose does not update (change). Cannot turn off the Autopilot.**
1. Loss of communication between the Head and the SPU.
2. Turn off the main circuit breaker to reset the Autopilot.
3. If problem recurs, either the Head or the SPU could be faulty.

**Cannot take command at one of the Heads.**
1. Loss of communication from the Head to SPU.

**The Display flickers or blinks.**
1. The battery voltage at Autopilot should be more than 10V.

**Autopilot steers normally on some courses but not on others, particularly North or South.**

1. Check for any compensating magnets, particularly heeling magnets which are too close to the Fluxgate Sensor.
2. Check for and magnetic material such as tools, cans, speakers, etc. near the compass or directly under it, perhaps in a drawer or cabinet.
3. Contact a compass adjuster to adjust for correction.

**5001 ALARM MESSAGES**

Your Autopilot continually monitors various parameters during its operation to check for faults. These can sound the alarm and display an ALARM MESSAGE. The following list gives descriptions and possible faults. Note that many of the alarms are ‘soft’ alarms and only indicate a potential problem and not a failure. An example is the COURSE alarm, which could occur if the alarm is set too tight and there is a heavy sea. By clearing the cause, the Autopilot will continue to operate normally. Other alarms could indicate a card or unit fault and should be referred to an authorized dealer, distributor or the factory.

# Problem Solving Table

| ALARM | ALARM DESCRIPTION | POSSIBLE FAULT |
|---|---|---|
| Batt1 high | Main power supply high (>40VDC) | Main battery charging system fault |
| Batt1 low | Main power supply low (<10VDC) | Main battery system fault |
| Batt2 high | Backup power supply high | Backup battery charging system fault |
| Batt2 low | Backup power supply low | Backup battery system fault |
| B++ high | B++ voltage fault | Power supply card |
| B++ low | B++ voltage fault | Power supply card |
| Compass card fail | Compass card fault. | Compass card |
| Compass card Invalid | Compass card fault. | Compass card |
| Course error-port | Exceeded course error limit to port | Check pilot operation or increase limit |
| Course error-tbd | Exceeded course error limit to stbd | Check pilot operation or increase limit |
| Cross-track error | Exceeded cross-track limit | Check pilot operation or increase limit |
| Cross-track invalid | Faulty Nav data | Check Nav data source |
| Drive lockup | Reversing motor lockup overcurrent | Check lockup circuits or card fault |
| Drive misconfigured | Drive response incorrect | Check drive type in Setup |
| Drive overcurrent-port | Reversing motor port overcurrent | Check motor circuits or card fault |
| Drive overcurrent-starboard | Reversing motor stbd overcurrent | Check motor circuits or card fault |
| Heading invalid | Compass heading data fault | Check compass conn. or compass card |
| Main battery | Main battery switched to backup | Check low voltage on main battery |
| Nav course invalid | Invalid Nav course signal | Check Nav data source |
| No link to SPU | Head comm. to SPU not established | Check Head conn. at SPU on CPU card |
| Power fail | +5V fault on power supply card | Power supply card |
| PS overtemp | High temperature - power Supply | Shut off - check for power supply output short |
| Rev-drive port | Port drive fault on reversing motor | Reversing motor card or motor circuit |
| Rev-drive stbd | Stbd drive fault on reversing motor | Reversing motor card or motor circuit |
| Rev-hiside | High-side fault on reversing motor | Reversing motor card or motor circuit |
| Rev-temperature | High temperature-reversing motor | Reversing motor card or motor circuit, Shut motor down |
| Rev-vcc | +5V fault on reversing motor card | Reversing motor card |
| Rev-watchdog | Watchdog fault on reversing motor | Reversing motor card, CPU card |
| Rev lockup | Lockup fault on reversing motor | Reversing motor card or output circuit |
| Rudder follower unconfigured | Rudder response incorrect. | Configure rudder follower or check compass card |
| Rudder invalid (see above) | Faulty rudder signal | Check follower connection, and check follower with voltmeter |
| Sol - Vcc | +5V fault on solenoid drive card | Solenoid card |
| Sol #1 High | High-side fault on solenoid #1 | Solenoid #1 circuitry or solenoid card |
| Sol #1 high current | High speed solenoid #1 overcurrent | High speed #1 solenoid circuitry |
| Sol #1 port current | Port overcurrent on solenoid #1 | Port #1 solenoid circuitry |
| Sol #1 starboard | Stbd drive #1 fault on solenoid card | Stbd #1 solenoid circuitry or solenoid card |

| ALARM | ALARM DESCRIPTION | POSSIBLE FAULT |
|---|---|---|
| Sol #1 stbd current | Stbd overcurrent on solenoid #1 | Stbd #1 solenoid circuitry |
| Sol #2 high | High speed solenoid #2 fault. | High speed #2 solenoid circuitry or solenoid card |
| Sol #2 high current | High speed solenoid #2 overcurrent | High speed #2 solenoid circuitry |
| Sol #2 port | Port drive #2 fault on solenoid card | Port #2 solenoid circuitry or solenoid card |
| Sol #2 port current | Port overcurrent on solenoid #2 | Port #2 solenoid circuitry |
| Sol #2 starboard | Stbd drive #2 fault on solenoid card | Stbd #2 solenoid circuitry or solenoid card |
| Sol #2 stbd current | Stbd overcurrent on solenoid #2 | Stbd #2 solenoid circuitry |
| Sol drive 1 port | Port drive #1 fault on solenoid card | Por t #1 solenoid circuitry or solenoid card |
| Sol temp for | High temperature-solenoid card | Shut off - check for output short or cause overheating |
| Sol watchdog | Watchdog fault on solenoid card | Solenoid card or CPU card |
| Speed invalid | Invalid speed signal | Check speed data source |
| SPU PROM error | Fault in SPU processor card | CPU card |
| SPU RAM error | Fault in SPU processor card | CPU card |
| Switched B+ | Switched B+ circuit breaker fault | Check Sw B+ load reset the system by cycling the power |
| SW B+ high | Switched B+ fault - power supply | Check power supply card switched B+ |
| SW B+ low | Switched B+ fault - power supply | Check power supply card switched B+ |
| Sys V+ high | Sys V+ fault - power supply | Power supply card |
| Sys V+ low | Sys V+ fault - power supply | Power supply card or one of the heads |
| Turn rate high | Turn rate exceeded turn rate limit | Turn rate limit or turn rate delay - check steering response |
| V SPU high | +6V power supply high | Power supply card |
| V SPU low | +6V power supply low | Power supply card or +6V load from one of the SPU cards. |
| Watchdog | Watchdog fault in power supply card | Power supply card or CPU card |

# 9. 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 2Gl ("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;

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 end-user 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 1-604-207-8008, 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 1-604-207-1600 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 Purchasees 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.**

# 10. Specifications

## General

The Specifications for the 5001Autopilot System define the basic capabilities and operational limits of the equipment. These are as follows:

Operating Voltage 10 - 40 VDC

| | |
|---|---|
| Typical Power draw from ship's battery for SPU | 36 Watts |
| Typical Power draw from ship's battery per Head | 11 Watts |
| Power Inputs | Main & Backup |
| Switched B+ Output Voltage | Battery Voltage minus 1 VDC |
| Switched B+ Output current protection trip point | 20 Amps |
| Maximum permissible Power Fail Relay (dry contact) load | @ 10-40 VDC, 5 amps<br>@ 110VAC, 5 amps |
| Maximum permissible General Alarm Relay (dry contact) load | @ 10-40 VDC, 5 amps<br>@ 110VAC, 5 amps |
| Maximum output current for Solenoid Drivers | 20 amps (alarmed at 13 amps) |
| Maximum output current for Reversing Motor Driver | 100 amps pulsed peak<br>20 amp-seconds sustained |
| Maximum number of Heads per SPU | 4 |
| Maximum cable length per Head | 30.5 meters (100 feet) |
| Minimum cable length per Head | 2 meters (6.5 feet) |
| SRAM Backup Battery life expectancy | 10 years |
| NMEA 0183 input port current draw | < 2 mA at 2 VDC |
| NMEA 0183 differential output voltage | Open Circuit: 5 VDC<br>@ 40 mA, 2 VDC |
| RS-232 input voltage range | -30 to + 30 VDC |
| RS-232 input voltage threshold | LOW: 1.2 VDC typical<br>HIGH: 1.7 VDC typical |
| RS-232 input resistance | 5K$\Omega$ typical |
| RS-232 output voltage | +/- 9 VDC typical into 3K$\Omega$ |
| RS-232 output resistance | 300 ohms typical |
| RS-232 output short circuit current | +/-18 mA |

| | |
|---|---|
| AD10S output specifications | AD10S not implemented |
| Step Gyro input voltage | 5 – 150 Volts |
| Sync Gyro input voltage | 125 Volts maximum |
| Compass Excitation | +/- 5 VOLTS @ 14.4 KHz |
| Compass Reference | 2.5 to 4 VDC |
| Compass swing | +/- 1 VDC minimum<br>+/- 4 VDC maximum |
| Magnetic Compass Sensor input compatibility | ComNav PN 30320002<br>PN 20320001<br>PN 20320002 |
| Rudder Follower Input (RUDFOL1, RUDFOL2) | 1.2 – 3.8 VDC centered @ 2.5 VDC |
| Rudder Angle Indicator output | supports both 500 µA & 1 mA |
| Number of meters supported | up to 4 per RAI output |
| Remote Compatibility | ComNav 101, 201, 211, and TS-202 remotes. |
| Jog Lever input *** | Yes |
| FFU/Electric wheel input *** | 1.2 – 3.8 VDC centered @ 2.5 VDC |

*** Note: Jog Levers and FFU/Electric Wheel are mutually exclusive. In some cases where a FFU/Electric Wheel is required as well as Jog Levers, the FFU/Electric Wheel may be wired to the "Remote" port. Contact ComNav for wiring details.

| | |
|---|---|
| Size of Control Head | |
| Width: | 248 mm (9.75 inches) |
| Height: | 137 mm (5.4 inches) |
| Depth: | 43 mm (1.7 inches)<br>{51 mm (2 inches) required behind unit for cabling} |
| Weight of Control Head: | 0.79 kg (1.75 lbs) |
| Size of Signal Processing Unit | |
| Width: | 305 mm (12 inches) |
| Height: | 381 mm (15 inches) |
| Depth: | 108 mm (4.25 inches) |
| Weight of Signal Processing Unit: | 3.25 Kg (7.15 lbs) |

## NMEA OUTPUTS:

The NMEA output data may be used by NMEA 0183 compliant “listeners” or may be used to diagnostically observe various Autopilot parameters while the system is running. The 5001 outputs two sentences.

1. APHDG = Heading, deviation and variation. Sent ten times per second.

HDG - Heading, Deviation & Variation (Note: Deviation & Variation is null).
IMO Resolution A.382 (X). Heading (magnetic sensor reading), which if corrected for deviation, will produce Magnetic heading, which if offset by variation will provide True heading.

$APHDG, x . x , x . x , a , x . x , a * hh<CR><LF>

- Magnetic variation, degrees, E/W[2,3]
- Magnetic deviation, degrees E/W[1,3]
- Magnetic sensor heading, degrees

2. Proprietary sentence number one:

```
      1   3    5          7        9         11   13    15
$PCMNS, 51, Md, 325, 321, 122, 135, F, 15, 11, 09, 17, 03
   2    4     6          8       10    12     14     16
```

1. $ = symbol starts all NMEA 0183 data sentences.
2. P = identifies a proprietary sentence.
3. CMN = the identifier assigned to ComNav Marine Ltd. by NMEA.
4. S = status type sentence.
5. 51 = for 5000 series equipment, proprietary sentence number 1.
6. Md: SB = Standby mode, PS = Power steer mode, AP = Autopilot mode, NA = Nav mode.
7. Commanded course (Degrees).
8. Actual course (Compass).
9. Commanded rudder angle position (0 = hardover PORT, 255 = hardover STBD).
10. Actual rudder angle (0 = hardover PORT, 255 = hardover STBD).
11. Steering set to F = Fast, S = Slow.
12. Rudder gain setting.
13. Counter-rudder gain setting.
14. Trim setting.
15. Turn rate.(Degrees per second).
16. Yaw setting (Degrees).

# CE Compliance

**This product has been tested and is in compliance with the Electro-Magnetic Compatibility (EMC) standards of the European Community and bears the CE label. It has been tested according to the applicable sections outlined under;**

**Technical standard #IEC945/EN60945**

**Marine Navigation Equipment**

**General Requirements**

**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.6:** | **Immunity to Radiated Interference** |

**Test results and a declaration of conformity are on file at the ComNav plant;**

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

# 11. Care & Maintenance

The ComNav 5001 Autopilot system has been designed to provide many years of reliable service. The following periodic CARE and MAINTENANCE tips will help to ensure the longevity of your Autopilot.

## Cleaning and Appearance

Both the CONTROL HEAD and SPU should be carefully cleaned with a damp cloth and mild soap. This is particularly important for the LCD screen. DO NOT USE ABRASIVE CLEANERS OR CHEMICALS.

The CONTROL HEAD is designed to be weatherproof and splash resistant, but it should not be immersed in water for a prolonged period of time.

Environments exceeding a maximum temperature of 140 degrees F (60 degrees C) or below a minimum temperature of 5 degrees F (-15 degrees C) MUST BE AVOIDED. Exposure to prolonged direct sunlight should be avoided in order to prevent damage to the electronics and housing.

## Protection of Wires and Cabling

After installation, ensure that the system ís components are securely mounted and will not shake loose due to the vibrations that can be expected in a marine vessel.

Ensure that the cabling and wiring to all system components, ESPECIALLY REMOTE CONTROLS, are well secured with clamps or alternative fasteners.

Many potential problems can be avoided by ensuring that cabling and wiring do not cause strain on the connectors.

## Periodic Checks

After the first six months of operation a thorough examination of the entire Autopilot system MUST BE UNDERTAKEN. All electrical connections, cables, clamps, mounting brackets, and mechanical connections (i.e. RUDDER FOLLOWER) must be secure. All hydraulic pumps and lines must be inspected for leakage and loose mounting.

- An ANNUAL inspection should be undertaken thereafter.

# 12. User's Notes & Settings

## MAIN MENU

Adjust with MENU, ▲, ▼, and MENU EXIT Adjust with KNOB

| Parameter | Range | Default Value | User Settings 1 | User Settings 2 | User Settings 3 |
|---|---|---|---|---|---|
| **STEERING MENU** | | | | | |
| Speed range control | Automatic, Low speed, High speed | Automatic | | | |
| Hi/Low Speed boundary | 0 to 10 | 10 | | | |
| Rudder Gain - low speed | 1 to 30 | 10 | | | |
| Counter Rudder - low speed | 0 to 30 degrees | 10 | | | |
| Trim Coefficient - low speed | 0 to 30 degrees | 8 | | | |
| Rudder Gain - fast speed | 1 to 30 degrees | 10 | | | |
| Counter rudder - fast speed | 0 to 30 degrees | 10 | | | |
| Trim Coefficient - fast speed | 0 to 30 degrees | 5 | | | |
| Yaw | 1 to 20 degrees | 1 degree | | | |
| Turn rate limit | 1 to 20 degree/sec | 5 degrees | | | |
| **COURSE ALARM MENU** | | | | | |
| Course Alarm | Off, On | On | | | |
| Course error limit (+/-) | 3 to 20 degrees | 20 degrees | | | |
| Cross-track limit (+/-) | 0.1nm to 2.9nm in 0.1nm steps | 1.0nm | | | |
| **RUDDER MENU** | | | | | |
| Rudder limit | Off, On | Off | | | |
| Pwr Steer/Stby port limit | 10 to 90 degrees | 25 degrees | | | |
| Pwr Steer/Stby stbd limit | 10 to 90 degrees | 25 degrees | | | |
| Pilot/Nav port limit | 10 to 90 degrees | 20 degrees | | | |
| Pilot/Nav stbd limit | 10 to 90 degrees | 20 degrees | | | |
| Rudder display offset | -10 to +10 degrees | 0 degree | | | |
| **COMPASS MENU** | | | | | |
| Sync gyro starting value | 0 to 359 degrees | 0 degree | | | |
| Step gyro starting value | 0 to 359 degrees | 0 degree | | | |
| Fluxgate offset value | 0 to 359 degrees | 0 degree | | | |
| Magnetic offset value | 0 to 359 degrees | 0 degree | | | |

## MAIN MENU

Adjust with MENU, ▲, ▼, and MENU EXIT Adjust with KNOB

| **Parameter** | **Range** | **Default Value** | **User Settings 1** | **User Settings 2** | **User Settings 3** |
|---|---|---|---|---|---|
| **USER CONFIG MENU** | | | | | |
| Special Turn | U-Turn, Circle, W. Recovery | U-Turn | | | |
| Compass Source | Compass, Stepgyro, Syncgyro, NAV1, NAV2, RS-232 | Compass | | | |
| Speed Source | Ship's log, NAV1, NAV2, COMM PORT, RS-232 | Ship's Log | | | |
| Rudder Follower | Follower 1, Follower 2 | Follower 1 | | | |
| Nav Source | NAV1, NAV2, COMM PORT, RS-232 | NAV1 | | | |
| XTE Sense | Norm, Rev | Norm | | | |
| XTE Enable | Yes, No | Yes | | | |
| Arrival Alarm | Off, On | On | | | |
| Max XTE Correction | 30 to 90 degrees | 90 degrees | | | |

## SETUP MENU

Adjust with MENU, ▲, ▼, and MENU EXIT Adjust with KNOB

| Parameter | Range | Default Value | User Settings 1 | User Settings 2 | Users Settings 3 |
|---|---|---|---|---|---|
| **DEVICE MENU** | | | | | |
| Rudder Follower 1 | Off, On | On | | | |
| Rudder Follower 2 | Off, On | Off | | | |
| Compass | Magnetic, Fluxgate | Magnetic | | | |
| Step Gyro | Off, On | Off | | | |
| Sync Gyro | Off, On | Off | | | |
| Remote | Off, On | Off | | | |
| **CONFIG MENU** | | | | | |
| Reset to Factory Settings | No, Yes | No | | | |
| Gyro Ratio | 90X, 180X, 360X, 36X | 360X | | | |
| Fluxgate Type | Floating Ref, Fixed Ref | Fixed Ref | | | |
| Compass Output | Norm, Rev | Norm | | | |
| Ship's Log Type | 200 ppnm, 400 ppnm | 400 ppnm | | | |
| Follow Up Type | NFU, FFU | NFU | | | |
| High Rate Cutout | 0 to 30 degrees | 5 degrees | | | |
| Rudder Deadband | 0.0 to 2.5 degrees in 0.1 degree/sec | 0.4 degrees | | | |
| Turn Rate Delay | 3 sec to 8 sec | 3 sec | | | |
| Drive Type | Solenoid, Reversing, Proportional | Solenoid | | | |
| Solenoid 2 Type | Off, Copy Drive 1 | Off | | | |
| Backup Supply | Off, On | Off | | | |
| Comm Port Type | Input, Output | Input | | | |

## SETUP MENU

Adjust with MENU, ▲, ▼, and MENU EXIT Adjust with KNOB

| Parameter | Range | Default Value | User Settings 1 | User Settings 2 | Users Settings 3 |
|---|---|---|---|---|---|
| **DOCKSIDE SETUP MENU** | | | | | |
| Rudder 1 Setup | Move rudder to max. stbd, Press Dodge > | 90 degrees | | | |
| | Move rudder to max. port, Press Dodge < | 90 degrees | | | |
| Rudder 2 Setup | Move rudder to max. stbd, Press Dodge > | 90 degrees | | | |
| | Move rudder to max. port, Press Dodge < | 90 degrees | | | |
| Fluxgate Setup Menu | Press ALM ACK, Steer vessel in circle. Do two circles, Press SPECIAL TURN. | --- | | | |
| RAI Setup Menu | Rudder Angle Indicator 1 - offset | 0 degree | | | |
| | Rudder Angle Indicator 1 - gain | 43 degrees | | | |
| | Rudder Angle Indicator 2 - offset | 0 degree | | | |
| | Rudder Angle Indicator 2 - gain | 43 degrees | | | |
| Drive Setup Menu | Center rudder then Press ALM ACK. | --- | | | |
| | Drive test complete. Press SPECIAL TURN. | --- | | | |

# 13. Glossary

CIRCLE TURN- the continuous circle SPECIAL TURN will turn the vessel in a circle until the turn is disabled by changing modes or repressing the SPECIAL TURN key. It operates only in Autopilot mode and is initiated by pressing SPECIAL TURN then pressing STBD or PORT DODGE key to signal which direction the circle will occur. The type of special turn is preselected in the Main, User Config menu.

COUNTER RUDDER HI SPEED - Counter rudder controls the amount of rudder applied for a given rate of change of course error. If the course error is increasing, the counter rudder adds to the rudder correction applied, and if the course error is decreasing, the counter rudder subtracts from the rudder correction applied. This can be separately set in the 'HI SPEED' speed range for vessel characteristics. Changed in Main, Steering Menu.

COUNTER RUDDER LOW SPEED - Same as above except in the 'LOW SPEED' speed range of the vessel. See also HI/LOW SPEED BOUNDARY.

COURSE ALARM - will sound an alarm and indicate on the display when the vessel exceeds the yaw limit range or cross-track limit range. Can be adjusted or turned on or off in Main, Course Menu.

COURSE ERROR LIMIT - will cause an alarm to come on if it exceeds a preset course error or yaw limit. Limits can be set in Main, Course Menu from ±3 to ±20 degrees.

CROSS TRACK - is generally calculated by the Nav device and is the perpendicular distance that the Nav device is away from the track that was preset into the Nav device. It reads in fractions of nautical miles. Alarm limits can be changed in Main, Course Menu from 0.1 to 2.9.

DUTY CYCLE ADJUST - of the reversing motor limits the maximum power allowed to the motor. The potentiometer on the Reversing Motor Card can be adjusted if the motor/hydraulic pump combination moves the rudder too quickly ie. faster than 8 seconds for hard over to hard over.

EMERGENCY TURN - Man-overboard or Williamson Turn will turn the vessel around and follow the same path back. After pressing the SPECIAL TURN key, it will turn 90 degrees first to either the port or starboard depending on which DODGE key is pressed and then a 270° turn in the other direction so it can retrace its track back in the water. The type of special turn is preselected in Main, User Config menu.

FFU (Full Follow Up) CONTROL - provides a lever to control rudder position. This control generates a voltage corresponding to the desired position of the rudder.

FLUXGATE COMPASS - measures the direction of earth's magnetic field by directly sensing the gated magnetic flux flowing through the sensing coils.

FLUXGATE OFFSET VALUE - is used to offset the reading from a fluxgate compass so that the reading on the heading display will agree with the ship's primary compass.

GYRO STARTING VALUE - is required by most gyros to initiate a reference direction from which all heading directions are taken. This is generally set to correspond to the ship's primary compass.

GLANDS - plastic through-hole fittings used to seal and support a cable or cable bundle passing through a hole or opening.

HIGH RATE CUTOUT - sets the rudder angle at which the high speed solenoid is switched in or out.

HI/LOW SPEED BOUNDARY - above and below the HI/LOW SPEED BOUNDARY, two different sets of steering response parameters can be stored so that the best steering performance can be obtained under varying vessel speeds and/or loading conditions. Can be set to manual or automatic. Changed in Main, Steering Menu.

JOG SWITCH (NFU) - allows the operator to control the rudder position by pressing the jog lever in the port or starboard direction. When the lever is released, rudder changes from the NFU cease. When in Pilot or Nav mode, the vessel will automatically return to its original course when the lever is released, similar to a dodge function. The control is equivalent to two switch contacts; one for port and one for starboard.

LCD - Liquid Crystal Display has a CONTRAST control to optimize its viewability. This should be adjusted along with the BRIGHTNESS control, which varies the brightness of the backlight on the LCD.

MAGNETIC OFFSET VALUE - is the Magnetic Variation of the fluxgate compass.

NMEA INPUT or OUTPUT - National Marine Equipment Association (NMEA) produces an industry standard specification for communication between different marine electronic equipment. See Appendix for NMEA 'word' definitions.

OPERATIONAL RUDDER LIMITS - sets the maximum limit that the rudder is allowed to turn while in a specific mode. They can be separately set for power steering mode and for autopilot/navigation modes.

PHYSICAL RUDDER LIMITS - are set to stop the rudder swings at the absolute maximum limits that the rudder is allowed to go.

PILOT/NAV PORT LIMIT - sets the maximum rudder swing to port when in Pilot or Nav mode.

PILOT/NAV STBD LIMIT - sets the maximum rudder swing to starboard when in Pilot or Nav mode.

POWER STEER PORT LIMIT - sets the maximum rudder swing to port when in Power Steer mode.

POWER STEER STBD LIMIT - sets the maximum rudder swing to starboard when in Power Steer mode.

RS 232 COMMUNICATIONS PORT - is a digital serial data protocol often used to connect to and communicate with a computer.

RUDDER DEAD BAND - is a narrow inactive region built into the rudder response which helps to prevent rudder from chattering or excessively ‘hunting’ due to noise in the control system. It is also affected by the response time of the linkages in the steering system.This is adjusted in Setup, Config Menu.

RUDDER GAIN HI SPEED - controls the amount of rudder applied for a given amount of course error in the high speed range. This is adjusted in the Main, Steering Menu.

RUDDER GAIN LOW SPEED - controls the amount of rudder applied for a given amount of course error in the low speed range. This is adjusted in the Main, Steering Menu.

RUDDER LIMIT - is set so that the autopilot does not try to move the rudder further than it can mechanically move. The rudder travel limits can be separately set for POWER STEER mode and for PILOT/ NAV mode. Physical Rudder Limit is adjusted in the Setup, Dockside Setup Menu. Operational Rudder Limit is set in Main, Rudder Menu.

SPECIAL TURN - is a series of turn commands preprogrammed into the autopilot that will be carried out when commanded. Special Turns include ‘CIRCLE TURN’, ‘U-TURN’, and ‘W.RECOVERY’.

TURN - and can be preselected in the Main, User Config Menu.

SPEED RANGE CONTROL (auto/man) - allows selection of HI, LOW or AUTOMATIC speed range which causes the autopilot to use the steering parameters set for that speed range. In AUTOMATIC, the speed range is selected from the speed device input. See Main, Steering Menu.

SYNC STARTING VALUE - see gyro starting value above.

TILLER MODE - is basically the same as Power Steer or FFU where the rudder position is controlled by a lever or 'tiller'. The term TILLER - is used in some of ComNav's Remote Control Units. See also FFU.

TRIM COEFFICIENT - allows the user to set the gain or sensitivity of the integral term or offset bias on the autopilot to compensate for any long term non-symmetrical drift of the vessel to one side.

TURN RATE DELAY - sets a timer that defines how long the maximum turn rate can be exceeded before Turn Rate Alarm occurs.

TURN RATE LIMIT - controls the maximum turning rate under autopilot control that a vessel is allowed to change course in degrees per second.

2 SPEED SOLENOID - can be used in a solenoid controlled hydraulic system to increase the speed of the rudder when required for faster or smoother autopilot operation.

U-TURN - commands the autopilot system to make a 1800 turn and follow the same heading in the reverse direction. After pressing the SPECIAL TURN key, it can turn to the PORT or STARBOARD depending on which DODGE key is pressed. The type of turn is preselected in the MAIN, USER CONFIG menu.

YAW - setting tells the Autopilot how far off course the vessel may 'wander' before the Autopilot corrects the error. This value should be adjusted for sea conditions. As conditions worsen, the yaw setting can be increased. This will result in slightly worse steering but will reduce the amount of rudder movement and strain on the steering system. Yaw is adjusted in the Main, Steering Menu.

# MAIN Menu Structure

Adjust with MENU, ▲, ▼, and MENU EXIT — Adjust with KNOB

**MAIN MENU**

**Steering Menu**

| | |
|---|---|
| Speed range control | Automatic, Low speed, High speed |
| Hi/Low speed boundary | 0 to 10 |
| Rudder gain - low speed | 1 to 30 |
| Counter rudder - low speed | 0 to 30 |
| Trim coefficient - low speed | 0 to 30 |
| Rudder gain-hi speed | 1 to 30 |
| Counter rudder-hi speed | 0 to 30 |
| Trim coefficient-hi speed | 0 to 30 |
| Yaw 1 to 20 | |
| Turn rate limit 1 to 20 | |

**Course Alarm Menu**

| | |
|---|---|
| Course alarm | Off, On |
| Course error limit (+/-) | 3 to 20 |
| Cross-track limit (+/-) | 0.1 to 2.9 in 0.1 steps |

**Rudder Menu**

| | |
|---|---|
| Rudder limit | Off, On |
| Pwr Steer/STBY port limit | 5 to 90 |
| Pwr Steer/STBY stbd limit | 5 to 90 |
| Pilot/Nav port limit | 5 to 90 |
| Pilot/Nav stbd limit | 5 to 90 |

**Compass Menu**

| | |
|---|---|
| Sync gyro starting value | 0 to 359 |
| Step gyro starting value | 0 to 359 |
| Fluxgate offset value | 0 to 359 |
| Magnetic offset value | 0 to 359 |

**User Config Menu**

| | |
|---|---|
| Special turn | U-Turn, Circle, Emergency Turn |
| Compass source | Compass, Stepgyro, Syncgyro, Magnetic NAV1, NAV2, COMM PORT, RS-232 |
| Speed source | None, Ship's log, NAV1, NAV2, COMM PORT, RS 232 |
| Rudder follower | Follower 1, Follower 2 |
| Nav source | |
| XTE sense | |
| XTE enable | |
| Arrival alarm | |
| MAX XTE correction | |

# SETUP Menu Structure

Adjust with MENU, ▲, ▼, and MENU EXIT — Adjust with KNOB

**SETUP MENU**

| | | |
|---|---|---|
| **Device Menu** | | |
| | Rudder follower 1 | Off, On |
| | Rudder follower 2 | Off, On |
| | Compass | Magnetic, Fluxgate |
| | Step gyro | Off, On |
| | Sync gyro | Off, On |
| | Remote | Off, On |
| **Config Menu** | | |
| | Reset to Factory Settings | No, Yes |
| | Gyro ratio | 90X, 180X, 360X, 36X |
| | Fluxgate type | Floating Ref, Fixed Ref |
| | Compass output | NORM, REV |
| | Ship's Log type | 200 ppnm, 400 ppnm |
| | Follow Up type | NFU, FFU |
| | High-rate cutout | 0 to 30 |
| | Rudder deadband | 0.0 to 2.5 in 0.1 steps. |
| | Turn rate delay | 1 to 99 |
| | Drive type | Solenoid, Reversing, Proportional |
| | Solenoid 2 type | Copy drive 1, Off |
| | Backup Supply | Off, On |
| | COMM PORT type | Input, Output |
| **Dockside Setup Menu** | | |
| | Rudder 1 Setup Menu | Move rudder to max stbd, Press 'DODGE>'<br>Move rudder to max port, Press '<DODGE' |
| | Rudder 2 Setup Menu | Move rudder to max stbd, Press 'DODGE>'<br>Move rudder to max port, Press '<DODGE' |
| | Fluxgate Setup Menu | Press 'ALM ACK', Steer vessel in circle<br>Do two circles, Press - 'SPECIAL TURN' |
| | RAI Setup Menu | Rudder Angle Indicator 1 - offset<br>Rudder Angle Indicator 1 - gain<br>Rudder Angle Indicator 2 - offset |