

# 1101 Autopilot System

# Installation and Operation Manual

Version 6.0

Serial #

NOIE: 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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# Welcome

Congratulations on your purchase of ComNav Marine's 1101 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 1101. Developed as a result of ComNav's many years of experience in autopilot design, the 1101 system provides better performance and more features than any other autopilot in its class.

Yours truly,

Don morris Executive Vice President 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 10 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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# 1. About This Manual

This manual provides essential information for the safe and reliable operation of the 1101 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

1101 Control Head buttons and controls are placed in uppercase lettering. Example: the COUNTER RUDDER button.

#### System Component

Specific system components are capitalized. Example: the 1101 Control 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.

### "double-press"

Press and release the indicated button twice in rapid succession.

Although this sounds a little complicated, it is actually very easy to do. Many users familiar with desktop computers perform a similar function when they "double-click" their mouse pointer.

### "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. For example, pressing the SPEED button can, depending on system configuration, drastically alter the steering performance of the Autopilot.

### "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° (i.e. northeast). The Processor would compare this to the boat's actual heading of 315° (northwest), as indicated by the Compass, and calculate a difference of 90°. 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  $45^{\circ}$ , plus or minus  $1/2^{\circ}$ , until new instructions are received from the Control Head.

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

Your ConNav 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 ConNav 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 ConNav 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 nudder to starboard, the other button will move it to port. Using the buttons, the nudder 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 nudder movements.

# 3. System Overview

At the core of the Autopilot System is a microprocessor-based PID (Proportional-Integral-Differential) controller. This controller works from either a high quality, externally gimbaled magnetic ship's steering compass fitted with a Magnetic Compass Sensor, or a direct earth's field sensing Fluxgate Compass.

Heading information is compared against the commanded heading; from this information, the desired rudder position is calculated. The desired rudder position is then compared against the actual rudder position transmitted by the Rudder Follower. If they are not the same, either the port or starboard output line is activated.

Both the port and starboard output lines are active low (i.e. they switch to ground). Each is capable of driving up to a 3-amp load. These output lines are designed to drive solenoid valves in a hydraulic steering system.

A speed control signal is also available for use with variable speed rudder drives. All of the outputs, either by themselves or with an optional solid state relay box, can be adapted to operate a wide variety of power steering systems. If the Autopilot is installed as a retrofit, it is usually possible to use the existing steering installation.

The system is designed to operate on a wide variety of vessels operating with power systems of either 12 or 24 VDC.

The 1101 Autopilot is equipped to interface with a GPS, Loran C, or any other navigation device that outputs one of the NMEA 0183 formats at 4800 Baud.

The 1101 Control Head functions as the main interface between the Autopilot System and the user. It contains a number of buttons and an ADJUSIMENT knob through which the operator controls the functions of the Autopilot. A large Liquid Crystal Display (LCD) screen provides visual feedback of the operator's commands and shows the status of the Autopilot System at any given time while the unit is powered up.





The following section gives a brief description of the major components that comprise the 1101 Autopilot System, their function, and relationship to each other.



**1101 Control Head** Part # 20050002

# Control Head

The 1101 Control Head provides a means for the user to control the Autopilot and monitor the system while it is in use.

The 1101 Control Head may be secured using the stainless steel Angle Mounting Bracket included with the Autopilot System, or surface mounted onto a console panel.

The Control Head connects directly to the Signal Processing Unit, or `SPU" as it is sometimes known, via a twelve 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 Control Head should be plugged in to the Auxiliary Station receptacle only if there is already a separate 1101 Control Head connected to the Control Head receptacle.



- 1) LCD DISPLAY SCREEN
- 2) STBY/OFF button
- 3) POWER STEER button
- 4) AUTOPILOT button
- 5) NAV button
- 6) DODGE PORT button
- 7) SPEED button
- 8) ADJUSTMENT KNOB
- 9) TURN button
- 10) DODGE STARBOARD button
- 11) RUDDER button
- 12) CNTR RUDDER button
- 13) TURN RATE button
- 14) YAW button

#### 1) LCD DISPLAY SCREEN

When the Autopilot power is on the screen displays either the actual heading of the vessel or the commanded heading (depending on which mode it is in). It also displays additional information such as mode of operation and various menus.

#### 2) STBY/OFF button

When power is initially turned on, "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 Standby menu.

When pressed and held for approximately 2 seconds, this button turns off the Autopilot.

#### 3) 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 DODGE PORT and DODGE STARBOARD buttons.

#### 4) AUTOPILOT button

Pressing this button places your vessel in the hands of the 1101 Autopilot. You can control the vessel's heading by using the ADJUSIMENT KNOB. Obstacles can be avoided by using the DODGE PORT or DODGE STARBOARD buttons.

#### 5) NAV 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) DODGE PORT button

In **POWER STEER** mode pressing and holding this button moves the rudder to port. Pressing this button while in **AUTOPILOT** or **NAV** modes allows you to avoid obstacles in the vessel's path by turning to port, and then automatically recover your original heading or track afterwards.

#### 7) SPEED button

This button allows you to manually switch between FAST and SLOW steering parameters.

#### 8) ADJUSTMENT KNOB

Used to adjust course in **AUTOPILOT** mode. Also used to change various parameters stored within the 1101 Autopilot.

#### 9) TURN button

Pressing this button while in **AUTOPIIOT** 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 FORT 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 is selected during setup.

#### 10) DODGE STARBOARD button

In **POWER STEER** mode pressing and holding this button 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, and then automatically recover your original heading or track afterwards.

### 11) RUDDER button

In **AUTOPILOT** or **NAV** modes, immediately brings up the Steering Parameters menu and positions the cursor at the "Rudder" value. Use the ADJUSIMENT KNOB to change this value if desired.

### 12) CNTR RUDDER button

In **AUTOPILOT** or **NAV** modes, immediately brings up the Steering Parameters menu and positions the cursor at the "Chtr Rudder" (Counter Rudder) value. Use the ADJUSIMENT KNOB to change this value if desired.

### 13) TURN RATE button

In **AUTOPILOT** or **NAV** modes, immediately brings up the Steering Parameters menu and positions the cursor at the "Turn Rate" value. Use the ADJUSIMENT KNOB to change this value if desired.

#### 14) YAW button

In **AUTOPILOT** or **NAV** modes, immediately brings up the Steering Parameters menu and positions the cursor at the "Yaw" value. Use the ADJUSIMENT KNOB to change this value if desired.

# Signal Processing Unit

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.



1101 Signal Processing Unit Part # 20050003

## Compasses

The 1101 Autopilot will function with heading input from either a ComNav Fluxgate Compass or Magnetic Compass with a 12 KHZ Compass Sensor.

## Fluxgate Compass

Specifically designed for ConNav autopilots, the ConNav 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 3 m (10') cable plugs into the 1101 SPU.

## 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



Binnacle Mount Compass

(6" binnacle compass shown)



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 the 1101 SPU.

## Other Compasses

ComNav recommends the use of ComNav supplied compasses for best 1101 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 1101 Autopilot.



Fluxgate Compass Part # 20320004

# Rudder Follower



Medium Duty Rudder Follower Part # 20330008

The 1101 Autopilot is supplied with a ComNav Medium Duty Rudder Follower.

The Rudder Follower is used to transmit the position of the vessel's rudder to the SFU. 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 1101 Installations may use a ComNav Linear Feedback (Part # 81957) or a Heavy Duty Rudder Follower (Part # 83634). These units come with installation instructions.

# Distribution Box

The Distribution Box provides a neat and tidy way to wire the SPU to the power supply, output solenoids, navigation computer, Rudder Angle Indicators (RAls) and other accessories.



Distribution Box Part # 20010001

# 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 Rubber Angle Indicators (RAI).

### Heading Rate Stabilizer

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, particularily 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 # 92142).



Heading Rate Stabilizer Part # 20320005

# Rudder Angle Indicator (RAI) 3"



Rudder Angle Indicator Part # 20360014

The ComNav RAI is a brightly backlit 3 inch (76mm) gauge that displays the actual position of the vessel's nudder.

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 1101 Autopilot to accept an Auxiliary Station. This may be either a second 1101 Control Head functioning as a remote unit, or a ComNav Handheld Remote. By adding an optional Remote Expander, the Autopilot can support up to 4 Handheld Remotes, or three 1101 Auxiliary Stations. Combinations of Handheld Remotes and 1101 Control Heads are possible.



1101 Auxiliary Station Control Head Part # 20050002 (a component of Part # 10050001)

### Auxiliary Station

The 1101 Auxiliary Station is identical to the 1101 Control Head except that its cable is plugged into the auxiliary connector on the SFU. This reconfigures the Unit as an Auxiliary Station. It has all of the functions of a Control Head except that it cannot turn the system power on or off and therefore it cannot be used to do a full reset or initiate a Dockside Setup.

The Auxiliary Station comes as a kit (Part # 10050001).

### Remote Controls

Table 1 shows some of the Remote Control devices that are compatible with the 1101 Autopilot. In addition to remote control of the Autopilot, some of these devices provide the capability of remotely operating compatible engine control systems. 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.



Table 1-ComNav Remote Controls for use with 1101 Autopilot

# 4. Installation

## Technical Requirements

This subsection describes the technical requirements that should be met before installation of the ComNav 1101 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 volts or 24 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 outters, screwdrivers, wire, mounting bolts and wrenches will also be required.

## Control Head

The 1101 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 7.7m (25') cable with plug.

## Surface Mounting

- 1. Ensure that the location you choose for the 1101 Control Head has a behind-the-panel clearance of at least 51mm (2 inches) to allow for the cabling.
- Place the Angle Mounting Bracket face down on to the panel surface where the Control Head will be mounted. Use the bracket as a template to mark the location of the two outer holes and the centre of the large slot onto the panel surface.
- Drill out the panel using the two smaller holes to a diameter of 5.5mm (7/32"). Drill a 19 mm (3/4") hole where the center of the large slot is marked to accommodate the 1101 Control Head cable.
- 4. Feed the connector end of the Control Head cable through the large hole in the panel.
- 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 settle the Control Head so that it lies flush on the surface of the panel.
- Secure the Control Head with the washers, lockwashers, and hexnuts provided.
- 7. Route the Control Head cable to the SPU.

Figure 4-Flush Mount Diagram

### Angle Bracket Mounting

- 1. Ensure that the location you choose for the 1101 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 surface to which the bracket will be attached.
- 3. Drill out the mounting holes to the appropriate diameter for the type of fastener that will be used to secure the Angle Mounting Bracket.
- 4. Position the Angle Mounting Bracket over the mounting holes and secure it.
- 5. Ensure that the mounting screws supplied with the Control Head are threaded all the way in to the brass inserts on the rear of the Control Head. Line up the mounting screws with the corresponding holes on the Angle Mounting Bracket and settle the Control Head so that it lies flush on the surface of the bracket.
- 6. Secure the Control Head with the washers, lockwashers, and hexnuts provided.
- 7. Route the Control Head cable to the SPU.



### Figure 5-Angle Bracket Mounting Diagram

# Signal Processing Unit

The SPU should be mounted in a clean and dry area, away from heat, moisture and salt water.

- 1. Determine a suitable location for the SPU. Preassemble the Ubracket onto the SPU, and "dry fit" to ensure there will be adequate clearance for the cables.
- 2. Mark the position of the mounting holes of the U-bracket on the mounting surface, and drill them out for a 1/4" bolt or screw.
- 3. Secure the U-bracket to the mounting surface with 1/4" bolts or screws.
- 4. Slide the SPU into place between the bracket uprights, and attach it using the supplied screws. Be sure to use the nylon spacers and split washers supplied. The nylon spacer goes between the SPU and the bracket, while the split washer goes between the bracket and the screw head.
- 5. Note that the SPU is supplied with plastic caps installed onto the Auxiliary Station and the Heading Output receptacles. If your installation will not have an Auxiliary Control Head, Handheld Remote, or will not be using the Heading Output cable, leave these caps in place. The receptacles are weather resistant only with the caps on, or when cables are plugged into them.

Damage caused by exposing a receptacle to the elements cannot be repaired under warranty.



# Distribution Box

- 1. The Distribution Box cable is 3m (10') long and pre-wired onto the Distribution Box PCB. Position and mount the Distribution Box in a dry location so that it can easily reach the SPU unit.
- 2. Route any cables into the Distribution Box through the pre-cut openings in the cover. If necessary, file or cut out the pre-formed ports in the cover for any extra cabling. (To ensure a neat appearance, the cover has only had the minimum number of openings prepared in advance).

The suggested types and gauges of cables required to connect the Autopilot are shown in the following table:

Function/Use	Type/Gauge
SPU power supply	2 x 16 AWG
Steering Drive; 12 or 24 VDC Solenoid Valve	3 x 18 AWG
Steering Drive; CT2, CT3, CT4, & CT5 Drive Box	Refer to the instructions supplied with Drive Box
Rudder Follower	3 x 18 AWG shielded cable
Navigation device interface	2 x 24 AWG shielded cable, shield terminated at NAV device only
Rudder Angle Indicator	2 x 24 AWG

Table 2-Minimum Recommended Wiring Gauges

4 - 6 INSTALLATION

Up to three RAI units may be used

Figure 7-1101 Distribution Box Connections

Figure 8-1101 Drive System Options & Interconnections

### Distribution Box Connections

The functions of each set of connections to the Distribution Box (see Figures 7 and 8) are as follows:

### Autopilot Power

Terminals 1 and 2 should be connected to a source of DC power on the vessel. The DC power can be 12 or 24 volts DC. The maximum current requirement is less than 4 amps. The 1101 Autopilot System is configured for negative ground only.

For vessels with positive ground, or with multiple power sources (i.e. AC and DC power sources) the SFU should be electrically isolated from the vessel. This can be accomplished by mounting it to a nonconducting material, such as wood or fiberglass. This will prevent any damage from ground currents.

Power to supply the Autopilot System should be taken directly from a breaker or power distribution panel. The Autopilot should be wired into its own circuit, however, this circuit can also send power to the drive unit.

If the drive unit installed is for a Reversing Electric Motor, it should be wired back to the breaker separately from the rest of the Autopilot System (i.e. do NOT wire from the breaker to the drive unit, and then from the drive unit to the Autopilot). The combined current requirement of the Autopilot and any reversing electric drive unit manufactured by ComNav will not exceed 30 amps.

#### Unswitched Power

Battery voltage is available on Terminal 3 whenever the Autopilot circuit breaker is on.

If a solenoid-operated 4-way value is being used, wire this terminal to the common of the solenoid value to ensure adequate voltage supply (see Figure 8-A).

If Jog Levers are being used and are to be active even when the rest of the Autopilot System is turned off, wire this line to the common of the solenoid-operated 4-way valve.

### WARNING!

When the UNSWITCHED POWER terminal is used, and if there is a malfunction of the Autopilot or Jog Lever which causes the 4-way valves to be continuously activated, the only way to deactivate the 4-way valve is to turn off the breaker which supplies power to the system.

### Port/Stbd Out

Terminal 4 and 5 are the two main steering outputs from the Autopilot System. Each output line is driven by a solid state switch that is capable of handling up to 3 amperes of current.

These switches, when "on", make a closed connection to ground. When they are "off', the connection to ground is broken, and the output line is effectively open circuit. Due to this configuration, the solid state switches are said to be "open collector' circuits.

These outputs can be used directly to operate a solenoid operated hydraulic 4-way valve. They may also be used as inputs to a solid state drive box for electric steering systems (either hydraulic or mechanical).

Since these outputs are open collector, either of these output lines can be overridden with an external switched connection to ground (such as from a Jog Lever).

A pair of diagnostic light-emitting diodes (IEDs) are provided on the Distribution Box Circuit Board to confirm the correct operation of the PORT (red LED) and SIBD OUT (green LED) lines.

### Switched Power

The voltage at the Autopilot power terminals also appears on terminal 6 whenever the Autopilot System is turned on and is not in **STANDBY** mode.

The voltage at this terminal can be used to supply up to 3 amperes of current to activate a clutch assembly steering system, such as a Linear Actuator or Cable Drive.

A yellow diagnostic LED is provided on the Distribution Box Circuit Board to confirm the correct operation of this output.

### Speed Control

A linear signal on terminal 7 is used with variable speed drive systems. It is centered between +5 VDC and COMMON (terminals 8 and 9) when no change of rudder angle is required, and moves up or down from that point by as much as 2.5 VDC for maximum rudder position change to port or starboard respectively.

### +5 VDC/Common

+5 VDC appears across terminals 8 and 9 whenever the Autopilot System is turned on. These terminals are used by several of the drive boxes manufactured by ConNav as a reference for SPEED CONIROL (terminal 7). A yellow LED is provided on the Distribution Box Circuit Board to confirm the operation of the +5 VDC power supply in the Autopilot System.

#### WARNING!

COMMON (terminal 9) must not be used as the return for a motor field, the clutch, a Rotary Drive, or the lockup valve of a Linear Actuator. Instead, use JOG GND (Terminal 13) or PILOT POWER NEGATIVE (Terminal 2).

### Motor Monitor

Terminal 10 is used with some of the drive boxes manufactured by ComNav to monitor motor current draw. If the current drawn by the motor exceeds a maximum level, this line will be activated, which signals the SPU to sound an alarm.

### Jog Switch Inputs

If the Autopilot is to be configured with Jog Levers, they are connected to JOG PORT (terminal 11), JOG STBD (terminal 12), and JOG GND (terminal 13). If the Jog Levers are to be active all the time, even when the Autopilot System is turned off, connect the COMMON from the solenoid valve to UNSWITCHED POWER (Terminal 3).

### Rudder Follower

The Rudder Follower connects to the Autopilot System by means of a 3-wire shielded cable. The signal designations for this cable are +5V (terminal 14), RUDDER POSITION (terminal 15), and RUDDER COMMON (terminal 16). Connect the shield to the negative line of the Autopilot Power (terminal 2).

### NAV Signal/Return

Terminals 17 and 18 connect to the NMEA 0183 output of a GPS Receiver, Loran C, or other type of navigation device with an NMEA 0183 compliant output.

Whenever the Autopilot System is turned on, the LED labeled "DATA" next to these terminals will flash while data is being received.

### RAI Signal/Return

Terminals 19 and 20 are used to drive up to three ComNav Rudder Angle Indicators (RAls). Multiple RAls must be wired in series.

If all the indicators move to port when the rudder moves to starboard, reverse the connections to these terminals. If only one indicator moves to port when the rudder is moved to starboard, reverse the connections on the back of that particular RAI.

A ZERO ADJUST potentioneter is supplied on the Distribution Box Circuit Board. Use this potentioneter to ensure that all RALs read zero degrees when the rudder is in the dead-ahead position.

# Compass Installation

The 1101 Autopilot 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 1101 Autopilot 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.

## 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.

Temporarily mount the Fluxgate Compass. 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 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.

NOTE: DO NOT PERMANENTLY INSTALL THE COMPASS UNTIL SEA TRIALS ARE COMPLETE AS THIS PROCEDURE MAY INDICATE THE MOST APPROPRIATE LOCATION FOR ACCURATE INTERFACE WITH THE AUTOPILOT. Plug the end of the Fluxgate Compass cable into the "COMPASS" receptacle on the SPU. 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.

**Note:** Because of the sensitivity of Fluxgate Compasses to the earth's vertical magnetic field, it is recommended that a Heading Rate Stabilizer be added to the compass at latitudes greater than 50 degrees north or south. Consult the factory for special instructions for mounting Fluxgate Compasses and Heading Rate Stabilizers on steel vessels.

### Magnetic Compasses

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 `turbling' in rough weather, mount the compass as close as practical to the center of pitch. 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 1101 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

The Magnetic Compass 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.

Plug the end of the Magnetic Compass Sensor cable into the "COMPASS" receptacle on the SPU. 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. Outting 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.



Figure 9-Magnetic Compass Sensor Installation

# 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. If the Rudder Follower is connected directly to the rudder in this case, uncontrollable hunting of the rudder will result.

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 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 10).

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 10. Snap the rod assembly onto the ball joints. Be sure to close the release clamps on each socket. Refer to Figure 10, 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 ann has been loosened, or the ann removed from the Rudder Follower, re-attach the ann and check the potentioneter center position. When the rudder is deadahead, 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 Distribution Box, 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 Distribution Box, obtain a terminal strip and sufficient additional cable from your dealer. Mount the terminal strip in a convenient DRY location. Connect the Rudder Follower cable to the terminal strip and then add the additional length of cable. Strip the wires, and attach them to the terminals in the Distribution Box as shown in the table below:

Colour	Dist. Box Terminal	Signal
White	14	Rudder Power (+5V)
Green	15	Rudder POS'N
Black	16	Rudder com
Shield	2	Shield

#### Table 3-Rudder Follower Cable Connections



Figure 10-Rudder Follower Linkage Detail

## Other Rudder Followers

The ComNav Heavy Duty Rudder Follower and the ComNav Linear Feedback are also compatible with the 1101 Autopilot. If you have purchased one of these devices, follow the installation instructions supplied with the unit.

# Heading Output Interface

The 1101 Autopilot system provides heading information in both NMEA 0183 and Furuno AD-10S formats. The information is available in all modes of operation (except **DOCKSIDE SETUP**) whenever there is a valid signal from the compass. The Autopilot transmits the information at a fast repetition rate so that it can be utilized by compatible radar and ECDIS systems.

Included with every 1101 Autopilot system is a 3m (10') cable (Part # 81608) fitted with a connector that can be plugged into the HEADING OUTPUT receptacle on the SPU. Unused wires should have their tinned leads cut off and the wires should be taped back against the cable.

The following table lists the color and function of each lead:

Cable Plug Pin #	Wire Color	Function
1	Blue	AD-10S Clock
2	Red	Not used
3	Black	Not used
4	Shield Drain Wire	AD-10S Common/ NMEA 0183 Shield
5	White	Data (+) Signal for NMEA 0183
6	Yellow	AD-10S Data
7	Green	Data (-) Return for NMEA 0183

Table 4-Connections for Heading Output Cable

## NMEA 0183 Output

The 1101 Autopilot outputs the HDG sentence at the rate of 10 times per second.

HDG sentence structure provides for magnetic sensor reading, deviation and variation. However, since the Autopilot cannot know the deviation and variation for a given location, the information is transmitted as "null" (empty) fields, per the NMEA specifications.

## AD-10S Output

The 1101 Autopilot outputs AD-10S sentences. Like the NMEA output, this information is transmitted at a rate of 10 times per second.

When interfacing to equipment which is compatible with the AD-10S gyrocompass interface, AD-10S Clock corresponds to CLK-H, AD-10S Data corresponds to DATA-H, and AD-10S Common corresponds to both CLK-C and DATA-C. If your equipment does not support CLK-H and DATA-H, it may still be possible to interface to the 1101 Autopilot System. Contact your ComNav dealer or the factory for assistance.

# Post-Installation Checks

## 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 ConNav 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 ConNav 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.

# Electrical Check List

#### IMPORTANT

Before turning on the power, check that the cable from the Distribution Box is connected to the SPU connector labeled "Distribution Box". If this cable is connected to the SPU connector labeled "Control Head", damage to the SPU could result. This subsection explains how to verify that your Autopilot system 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 Distribution Box. The Autopilot in a minimal system nominally draws about 150 milliamperes of current by itself without the Drive equipment.
- 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 Distribution Box.
- 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.

# 5. Getting Started

# Introduction

Your ComNav 1101 Autopilot 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 unless you have a fluxgate compass which must be compensated with the vessel 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 at the end of the manual to assist you in getting the optimum performance from your Autopilot. Your ComNav 1101 Autopilot 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.

## STANDBY Mode



Display in STANDBY Mode

In case of emergency, press the STBY/OFF button to immediately restore manual control of your vessel. The Autopilot first turns on in **STANDBY** mode. The display will show the vessel's actual compass heading but the Autopilot has no control over the steering of the boat. Steering must be controlled manually.

#### On

To turn the Autopilot on, press and hold the SIBY/OFF button until the Autopilot beeps to indicate it is in the **SIANDBY** mode. If you release the button too soon, the Autopilot will turn itself off.

#### Off

To turn the Autopilot off from any mode, press and hold the STBY/OFF button for 2 seconds.

#### Changing Modes

To change modes, press and hold the required mode button (STBY/OFF, POWER STEER, AUTOPILOT or NAV) until the Autopilot beeps and the appropriate mode screen appears.

#### Menu

In **STANDBY** mode there are six parameters that can be changed. These parameters appear in a menu that can only be accessed from **STANDBY** mode.

Double press the STBY/OFF button while in **STANDBY** mode to enter the Standby menu. Turning the ADJUSTMENT KNOB will move the cursor (the arrow to the left of the parameter names) up and down indicating the parameter to be changed. To select the indicated parameter, press the SIBY/OFF button once. The value to the right of the parameter name will begin to flash. While it is flashing, the value may be changed by rotating the ADJUSTMENT KNOB. To save the new value, press the SIBY/OFF button once.

In the Standby menu there are two pages of parameters. If you are on the last parameter of the upper page, turn the ADJUSIMENT KNOB clockwise to move to the second page. If you are on the top parameter of the second page, turn the ADJUSIMENT KNOB counterclockwise to move up to the top page.

To exit the menu and return to **STANDBY** mode, press the STBY/OFF button once. The menu will time out and return to **STANDBY** mode after four seconds if no changes are made. Instructions for changing basic parameters follow. Speed Trip Point, Compass Offset, NMEA Checksum and Special Turns are addressed later in this manual.

#### Brightness

The brightness setting changes the illumination of the display. In well-lit areas you may want a lower brightness setting, while in darker areas you may want a higher brightness setting.

To change the brightness, use the ADJUSIMENT KNOB to move the cursor until it is pointing at "Bright", and press the SIBY/OFF button once. While the number is flashing you may change the brightness level.

For no illumination at all, turn the brightness setting to 0, and for full illumination turn the brightness to 7.

#### Contrast

To change the contrast, use the ADJUSIMENT KNOB to move the cursor until it is pointing at "Contrast", and press the SIBY/OFF button. While the number is flashing you may change the contrast level.

The contrast setting ranges from 5 (dark background) to 13 (light background).

#### Battery Voltage

Displays the battery voltage supplied to the Autopilot.

This is a "read-only" field, and cannot be changed.

# POWER STEER Mode

The next operating mode is **POWER STEER**. To enter **POWER STEER** mode, press and hold the POWER STEER button until a beep sounds. In this mode, the display still shows the actual compass heading, but now also has a graphical Rudder Angle Indicator (RAI) in the center of the display as well as a digital RAI in the bottom right corner.

The PORT and STARBOARD DODGE buttons are used to control the rudder while in **POWER STEER** mode.

With hydraulic steering, you may still manually turn the nucker. If you have mechanical steering, the only operating mode where you can manually turn the nucker is **STANDBY**.

Γ	
SPEED	0FF
COMPASS	0
BRIGHT	7
CONTRAST	11
STANDBY	
L	

STANDBY Menu

BATTERY	11.8
CHECKSUM	<b>ON</b>
SPEC TURN	UTurn
STANDBY	

STANDBY Menu



Display in POWER STEER Mode

#### Menu



Double press the POWER STEER button while in **POWER STEER** mode to enter the Power Steer menu. Turning the ADJUSIMENT KNOB will move the cursor up and down letting you select the menu item.

You will use the Power Steer menu to adjust the Offset and Rudder Travel settings for the digital nudder angle indicator during the setup procedure.

# Dockside Setup

The Dockside Setup procedures outlined below must be performed prior to using your Autopilot for the first time. After successfully completing the Dockside Setup, your Autopilot will be ready for Sea-Trials.

There are two methods of putting the Autopilot into **DOCKSIDE SETUP** mode. One method is simply referred to as a "Reset". A reset allows you to change specific memories, such as the type of compass that you have, without affecting other settings, such as rudder limits. The second method, called a "Full Reset", sets all internal memories to factory default values.

### To perform a normal "Reset"

1. Ensure that the Autopilot is turned off.

2. Press and hold the two DODGE buttons and the STBY/OFF button simultaneously until the Autopilot beeps. The display will show:

▶Set up	rudder
Set up Exit	compass
DOCKS	IDE SETUP

The Autopilot is now in the **DOCKSIDE SETUP** mode.

POWER STEER Menu

## To perform a "Full Reset"

 Place the Autopilot in STANDBY mode by pressing the STBY/ OFF button until it beeps and the Standby display comes up:

You should perform a Full Reset on the Autopilot after its initial installation is complete, and anytime it is replaced after servicing.

<b>124</b> °
COMPASS HEADING
STANDBY

2. Press and hold the TURN RATE, RUDDER and STBY/OFF buttons simultaneously until this display comes up:

FULL RESET Redo rudder	
setup.	
DOCKSIDE SETUP	
	-

3. The Autopilot is now in DOCKSIDE SETUP mode. After a few seconds, the display will automatically change to:



Proceed with the Rudder Drive Test as outlined below.

#### Rudder Drive Test

 If you have performed a Full Reset, the display will now look like the picture shown below. If instead of a Full Reset you performed only a normal Reset, then you must press the SPEED button to change the display to look like the picture shown here:



 Use the steering wheel and move the rudder until it reaches hard over to Starboard. Press the SPEED button once and the display will change to show:



3. Use the steering wheel and move the rudder until it reaches hard over to Port. Press the SPEED button once more and the display will change to show:



If the Autopilot comes up with this display:



followed a few seconds later by:

Move rudder
to hard over
starboard.
DOCKSIDE SETUP

then refer to "Problems in DOCKSIDE SETUP mode" in Section 9-Problem Solving.

Once you have identified and corrected the fault you need to perform another Full Reset and repeat the Rudder Drive Test steps 1 through 3 again.

4. Use the steering wheel and move the rudder to within a few degrees of the mid-ships position. Press the SPEED button once and the display will show the following:

Measuring rudder
movement
Please wait.
DOCKSIDE SETUP

The Autopilot will go through approximately 30 to 60 seconds of rudder movements. During this period, the Autopilot is learning the rudder steering response and the rudder limits. If the rudder drive test is successful, the Autopilot will stop the rudder at mid-ships and the display will come up as shown:

<pre>Set up compa Exit</pre>	ass
DOCKSIDE	SETUP

If after 60 seconds the display continues to show "Measuring rudder movement-please wait", then the rudder drive test was not successful. Turn the Autopilot off and refer to "Problems in Dockside Setup Mode" in Section 9-Problem Solving.

Once you have identified and rectified the fault, redo the Rudder Setup steps 1 through 4 again.

5. If rudder drive test is successful, proceed with Compass Configuration.

### Compass Configuration

To configure the Autopilot for the type of compass to which it is connected, perform these steps:

1. Starting from the display shown here:



press the SPEED button once and the following display will come up:



2. The first item on the display ("Magnetic") will be flashing. If you have magnetic compass, press the SPEED button once. The display will come up as:



After a few seconds this display will disappear, and the Autopilot will automatically go to STANDBY mode.

3. If you have ComNav Fluxgate compass, use the ADJUSTMENT KNOB to point the cursor to Fluxgate and press speed button once. The display will come up as:

Adjus Exit	st compass
DOCH	SIDE SETUP

Do not select "Adjust Compass" at this time (you will do this during Sea Trials).

4. If your compass was not supplied by ComNav, contact your ComNav dealer or the factory for assistance with Compass Configuration.

The Rudder Drive Test and Compass Configuration portion of the Dockside Setup are now complete.

Use the ADJUSIMENT KNOB and position the cursor to "Exit", then press the SPEED button. The Autopilot will exit DOCKSIDE SETUP mode and return to STANDBY mode. The display will change to:

ſ	<b>124</b> °
	COMPASS HEADING
	STANDBY

## Rudder Hard-over to Hard-over time

You need to check the rudder Hard-over to Hard-over time of the steering system to ensure that there is adequate rudder response which will achieve the best steering performance when using your Autopilot.

To check the Hard-over to Hard-over time of your vessel, perform the following steps:

 Place the Autopilot in Power Steer mode by pressing and holding the SIBY/OFF button until Autopilot beeps and comes up in STANDBY mode. Then press the POWER STEER button until the display changes to show Power Steer mode as shown here:



- Using the PORT DODGE button, move the rudder until it stops at the port Hard-over limit that was set during the Rudder Drive Test.
- 3. Press the STARBOARD DODGE button and note the time it takes for the rudder to travel all the way to the starboard Hard-over limit. This is the Hard-over to Hard-over time.
- 4. Compare the results obtained with the guideline chart shown below. If the results obtained are not within 20% of the guidelines, your steering system should be adjusted. If you are unsure or not able to make the necessary adjustments, contact your ComNav dealer or the factory for advice. Once you have adjusted the steering system for correct Hard-over to Hard-over timing, perform a RESET and redo your Rudder Drive Test.

Vessel Length (meters/feet)	Hard-over to Hard-over time (seconds)	Vessel Speed (knots)
5.5m-10.5m (18'-35')	8-12	Up to 30
10.5m-18m (35′-60′)	12-16	Up to 30
18m-30.5m (60'-100')	14-18	Up to 30
30.5m-70m (100'-200')	16-24	Up to 25

There are some exceptions to the above. Contact your ConNav dealer or the factory for assistance on vessels with unique characteristics.

## Digital Rudder Angle Indicator (RAI) Adjustment

Depending on your exact installation, the digital RAI on your Autopilot screen may not show the exact hard-over to hard-over angle for your nudder. To check this:

- P 31
   1. Place the Autopilot in POWER STEER mode.

   EL
   70
   2. Use the DODGE buttons to move the rudder hard-over to starbard. Note the work of the limit and motion the distribution of the limit and motion.
  - starboard. Note the angle displayed on the digital RAI (for example, "37S" would be 37 degrees to starboard of the center position).
  - 3. Use the DODGE buttons to move the rudder hard-over to port. Note the angle displayed on the digital RAI.
  - 4. If the total angle traveled by the nudder is different from what was displayed by the digital RAI, double press the POWER STEER button to enter the Power Steer Menu.
  - 5. Use the ADJUSTMENT KNOB to point the cursor at "RUD TRAVEL." Press the POWER SIEER button and the value will begin to flash.
  - 6. Use the ADJUSIMENT KNOB to change the value until it equals the total number of degrees traveled by your rudder from hard-over to hard-over.

You can adjust your digital RAI for rudder offset during Sea Trials.

# Check External Rudder Angle Indicators (RAI)

If you have one or more RALs connected to your autopilot, you should check that they are centered and properly connected to the Distribution Box:

- 1. Turn the Autopilot off.
- 2. Check that the needle of each RAI is pointing to 0 (zero). If not, adjust the centering screw on the back of the RAI. This allows you to move the needle by up to  $2^{\circ}$ .
- 3. Turn the Autopilot on in **STANDBY** mode.
- 4. Manually move the steering wheel back and forth while observing which way the RAI needle(s) move.
- 5. If the needle (s) move opposite to the steering wheel movement, switch the Autopilot off, turn off the power to the Distribution Box, then reverse the RAI Signal and RAI Return wires where they connect to the Distribution Box (terminals 19 and 20).
- 6. If you have several RALs and one RAI moves in the opposite direction, reverse the connections to that RAI.

You can adjust your external RALs for rudder offset during Sea Trials.



#### POWER STEER Menu

Sea Trials

Make sure your vessel is well clear of any obstacles and other marine traffic before commencing Sea Trials. You are now ready for Sea Trials which is the second part of the setup process. The Sea Trial procedures in this "Getting Started" section complete the basic setup of the Autopilot and must be done before attempting to operate in **AUTOPILOT** or **NAV** modes. You will find more Sea Trials procedures at the end of the "Basic Operation" section and the "Advanced Operation" section.

Be sure you read all the procedures before commencing Sea Trials, and follow the Setup and Sea Trials Checklist so as not to miss any steps. Sea trials should be performed in relatively calm seas away from obstacles and other marine traffic.

### Fluxgate Compass Compensation

If your Autopilot was supplied with a ConNav fluxgate compass, it must be "compensated" to eliminate the magnetic distortions from the vessel's environment. This is done electronically through a process called "auto-compensation". If you are using a magnetic compass or self-compensating Fluxgate compass, skip this procedure altogether.

- 1. Begin with the Autopilot turned off.
- 2. Perform a (normal) "Reset" as described at the beginning of this chapter. The display will show:



- 3. Select "Set up compass" by turning the ADJUSTMENT KNOB clockwise one position. The words "Set up compass" will start flashing on and off.
- 4. Press the SPEED button once and the display will change as shown here:



5. The second line "Fluxgate Compass" should be flashing. If not, use the ADJUSTMENT KNOB to select "Fluxgate".

If your Autopilot system includes a ComNav Heading Rate Stabilizer (HRS), skip the Fluxgate Compass Compensation completely. Follow the autocompensation instructions that accompany the HRS. 6. Press the SPEED button once more and the display will come up as shown:

<pre>Adjust compass Exit</pre>
DOCKSIDE SETUP

7. The words "Adjust Compass" will be flashing. Press the SPEED button again and the display will come up with:



- 8. Manually steer the vessel in a slow circle. Complete a full 360 degrees. The turn can be done in either direction, but it should be done slowly enough that the full turn takes approximately two minutes to complete.
- If the auto-compensation is successful, then when the circle is completed, the Autopilot will beep and display the following sequence (the numbers shown will vary depending on your specific environment):



#### and finally:



After this last display is shown for a few seconds, the Autopilot will automatically go into STANDBY mode. This indicates that the autocompensation was successful. However, if the North/South or East/West correction shown on the display is greater than 30, then the last display will not come up. Instead you will see this:

Error
move compass
and redo setup.
DOCKSIDE SETUP
{

If this display occurs, the Autopilot was not able to auto-compensate the fluxgate compass. Turn the Autopilot off and move the compass to a better location (away from ferrous metal, audio speakers etc). Repeat steps 1 through 8, above. If after several attempts you are still not able to auto-compensate the Fluxgate Compass, contact your ComNav dealer or the factory for assistance.

#### Compass Readout

The next thing to do when setting up the Autopilot is to synchronize the compass readout to match the vessel's steering compass.

1. Put the Autopilot in STANDBY mode.

124 °	
COMPASS HEADING	
STANDBY	

- Note the difference (in degrees) between the Autopilot display and the heading indicated by your vessel's steering compass.
- 3. Double-press the STBY/OFF button and the display will come up with the Standby menu as shown:

Δ	
\$PEED	0FF
COMPASS	0
BRIGHT	7
CONTRAST	11
STANDBY	
)	

4. Use the ADJUSTMENT KNOB to move the cursor until it is pointing at Compass, and then press the STBY/OFF button once.

Skip this procedure if you do not have another compass aboard your vessel.

- 5. While the number next to compass is flashing you may change it by turning the ADJUSIMENT KNOB. To add the offset, turn the knob clockwise and to subtract turn counter clockwise. An offset of 005 will add five degrees to the compass readout while an offset of 355 will subtract five degrees from the compass readout.
- 6. Once you have finished the offset adjustment, double press the STBY/OFF button to go back to STANDBY mode.

Now that the compass readout is synchronized to the vessel's steering compass, you are ready to begin some steering trials. These exercises are best done in an open area away from marine traffic and obstacles.

## Test POWER STEER mode

Put the Autopilot in POWER STEER mode by pressing the POWER STEER button until the display comes up as shown here:



In this mode, use the two dodge buttons to move the vessel's rudder to port or starboard. The Autopilot displays the rudder position in both digital and graphical form in addition to showing the vessel's current heading.

 Test out POWER STEER mode by using the PORT DODGE and STARBOARD DODGE buttons. It is important to gain an understanding of how the vessel responds in POWER STEER mode at various speeds.

This completes the basic portion of the Sea Trials. Additional Sea Trials procedures appear in the sections "Basic Operations" and "Advanced Operations". You may proceed directly to these Sea Trials or perform them later. Be sure to read all procedures before commencing Sea Trials and follow the Setup and Sea Trials Checklist.

# 6. Basic Operations

## Introduction

Now you have become familiar with the information and procedures in the "Getting Started" section, you are ready to learn about basic operations in **AUTOPILOT** mode. Be sure to complete all of the Setup and Sea Trial procedures in "Getting Started" before attempting the procedures given later in this section.

# AUTOPILOT Mode

To enter **AUTOPILOT** mode, press and hold the AUTOPILOT button until a beep sounds. When **AUTOPILOT** mode is first entered, the Autopilot will steer the last course which the vessel was on prior to entering **AUTOPILOT** mode. This safety feature prevents the vessel from executing any unexpected turns as you change modes. The number which appears on the display above the word "Course" is the course which the Autopilot is currently steering. To determine the vessel's actual heading refer to your steering compass or other navigational device.

To change the vessel's course, turn the ADJUSTMENT KNOB. A clockwise turn will result in an increase of your commanded course and the vessel will turn to starboard. A counter clockwise turn will result in a decrease of your commanded course and the vessel will turn to port. Rapidly turning the knob will result in a 10 degree course change, while slowly turning the knob will result in a 1 degree course change. The Autopilot will bring the vessel onto the new course at the turn rate set in the Steering Parameter menu.

Instructions on changing steering parameters appear in the Sea Trials procedures later in this section.



Display in AUTOPILOT Mode

## Dodge Function

When in **AUTOPILOT** mode, 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 DDDE 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 that 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 11-DODGE Maneuver

# Special Turns

A Special Turn is a series of preset turn commands the Autopilot uses to follow a specific course. To initiate a Special Turn you must be in **AUTOPILOT** mode. Press the TURN button. The LCD screen will come up with the type of Special Turn that was programmed in the STANDBY menu. You must press either PORT or STARBOARD DODEE buttons to instruct the Autopilot as to which direction to turn. **Once a turn has been started you can cancel the Special Turn by changing the mode or turning the ADJUSTMENT KNOB.** 

## **Emergency** Turn

The Emergency Turn, also known as the "Man Overboard" turn or Williamson turn, 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 initiate an Emergency Turn press the TURN button, while in **AUTOPILOT** mode, followed by one of the two DODGE buttons.

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 SIARBOARD DODGE button is pressed, then the 90 degree turn will be to starboard, and the following 270 degree turn will be to port.

A flashing "E Turn" will be shown in the center of the screen.



Figure 12-Emergency 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 initiate a U Turn press the TURN button, while in AUTOPILOT mode, followed by one of the two DODGE buttons.

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 13-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 initiate a C Turn press the TURN button, while in AUTOPILOT mode, followed by one of the two DODGE buttons.

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



Figure 14-Continuous Circle Turn

# Steering Response

When you receive your ConNav Autopilot, it will have been preprogrammed 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 '9', 3 degrees of rudder will be applied for each degree of course error. Every two-position reduction in the setting cuts the amount of connection applied in half.

## 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 '9', 10 degrees of rudder will be applied for a 1 degree per second rate of change of the course error. Every two-position reduction in the setting cuts the amount of correction applied in half.

## 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 rates corresponding to each control are:

TURN RATE SETTING	ACTUAL TURN RATE (DEGREES/SEC)
0	0.5
1	1.0
2	1.5
3	2.0
4	2.5
5	3.0
6	3.5
7	4.0
8	4.5
9	5.0

#### Table 5-Turn Rate Correlation Table

#### Yaw

Varying the rudder parameter controls the amount of deviation from the commanded course the Autopilot will allow before correcting the vessel's heading.

Increasing the setting will increase the amount of heading deviation allowed. The number shown on the display is the number of degrees of heading deviation allowed, centered on the commanded course.

# Fast/Slow Speed

The FAST/SLOW option on the 1101 Autopilot 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 1101 Autopilot can be set to use the slow settings, the fast settings, or it can be set to automatically switch between the two. For the latter to work, the Autopilot must be connected to a Navigation Device that outputs speed information in NMEA 0183 format.

To change between the fast Steering Parameters and the slow ones, simply press the SPEED button. To change back, press the SPEED button once more. You will see the lower right portion of the LCD display change to either "FAST" or "SLOW" to let you know which set of Steering Parameters the Autopilot is using.

To enable the Autopilot to automatically switch between fast and slow Steering Parameters, you must enter a Speed Trip Point. This is done in the Standby menu, and is covered under "Sea Trials in AUTOPILOT mode". Once a suitable Speed Trip Point is set and the Autopilot is switched to **AUTOPILOT** or **NAV** mode, the Autopilot will look at the speed information being reported by the Navigation Device. If the reported speed is below the Speed Trip Point, then the Autopilot will use the slow Steering Parameters. If the reported speed is above the Speed Trip Point, then the Autopilot will use the fast Steering Parameters.

If the Autopilot fails to receive speed data from the Navigation Device it will sound an alarm and display "No Speed Data" on the screen once every 20 seconds. In this case the Autopilot will use the last set of Steering Parameters. For example, if it was using the fast Steering Parameters before the "No Speed Data" alarm, then it will continue to use the fast Steering Parameters. If it was last using the slow Steering Parameters, then it will continue to use those.

You can manually override the Speed Trip Point by pressing the SPEED button. Two things will happen:

- a) The Speed Trip Point will immediately be set to "OFF". If you want to go back to automatically switch between fast and slow Steering Parameters again, you will need to once more set the Speed Trip Point in the Standby menu.
- b) If the Autopilot was steering using the fast Steering Parameters, it will switch to using the slow Steering Parameters. If the Autopilot was steering using the slow Steering Parameters, it will switch to using the fast Steering Parameters. You will see the lower right portion of the LCD display change to either "FAST" or "SLOW" to let you know which set of Steering Parameters the Autopilot is now using.

# Transfer to Aux/Remote Control

To take control at a Remote or Auxiliary Station that is not currently in command you must press and hold the two PORT/STBD DODGE buttons at the same time. The Autopilot will beep once and you should be able to use the Remote/Auxiliary Station to control the vessel. The Unit that was in control will now be flashing "NOT IN COMMAND". To reclaim command at another station, you must once again press and hold the two PORT/STBD DODGE buttons at the other station.

# Sea Trials in AUTOPILOT Mode

You are now ready to optimize steering performance in **AUTOPILOT** mode for your vessel. Ensure that you have completed all the setup and Sea Trail procedures in the "Getting Started" section before attempting these Sea Trials. In this section you will set the Speed Trip Point, adjust the yaw, rudder, counter rudder and turn rate settings, and select the type of Special Turn for your vessel.

Many ComNav owners choose to have their ComNav dealers conduct initial Sea Trials to optimize the performance of their 1101 Autopilot.

### Effects of Speed on Turning Performance

You will know from having steered your boat manually that it takes much less rudder movement to turn your vessel when traveling at high speed. Therefore, the Fast settings for rudder and counter rudder should be lower than the Slow settings. Turn rate should be set for the maximum safe turn rate when traveling at high speed. Your vessel is unlikely to be able to turn as quickly at low speed, so the same turn rate setting may be used for both Fast and Slow. Because vessels usually decrease their speed as the weather worsens (and the effects of wave action increase), the Fast setting for yaw normally should be lower than the Slow setting.

Larger vessels with displacement hulls and modest cruising speeds may not display much variation in turning performance as speed increases. Turning characteristics of small, fast vessels, particularly those with semi-displacement or planing hulls, can vary quite dramatically with speed. Before setting your speed trip point be sure that you understand how your vessel handles through its entire speed range and at what point the turning characteristics change noticeably. Set the trip point low to begin with; you may choose to increase it later as you gain experience using your ComNav Autopilot.

Make sure your vessel is well clear of any obstacles and other marine traffic before commencing Sea Trials Factory default settings for your ComNav Autopilot are listed in the table in the User Notes & Settings section at the end of the manual. Use this table to record all changes made to your Autopilot settings during Sea Trials.

## Set Speed Trip Point

The Speed Trip Point is the vessel speed at which the Autopilot steering settings automatically change from Fast to Slow and viceversa. To set the Speed Trip Point:

- 1. Put the Autopilot in STANDBY mode.
- 2. Double press the STBY/OFF button to display the menu.
- Use the ADJUSTMENT KNOB to move the cursor until it is pointing at the "SPEED" parameter.
- 4. Press the STBY/OFF button, the value will begin to flash.
- 5. Use the ADJUSTMENT KNOB to select a speed in range of 1 to 30 knots at which you want the autopilot to changeover from Slow to Fast settings. If you select "OFF" there will be no automatic changeover between Fast and Slow settings. You will still be able to toggle between Fast and Slow settings manually using the SPEED button.

1	
SPEED	OFF
COMPASS	0
BRIGHT	7
CONTRAST	11
STANDBY	J
/	

6. Press the STBY/OFF button to save the value.

7. Double press the STBY/OFF button to return to **STANDBY** mode.

To use the Speed Trip Point feature, the Autopilot must be interfaced to a navigation device supplying speed data in NMEA 0183 format. If the speed trip point is set and no navigation device is connected, the "No Speed Error" will flash every 20 seconds when in **AUTOPILOT** or **NAV** modes. To prevent this message appearing, set the Speed Trip Point value to "OFF."

	No Speed Error	
NAV		

### Steering Parameters Menu

You are now ready to "tune" your Autopilot's steering parameters. To change any steering parameter:

- 1. The Autopilot must be in **AUTOPILOT** mode (steering parameters can also be changed in **NAV** MODE).
- Press the button for the parameter you wish to change (YAW, TURN RATE, CNTR RUDDER or RUDDER). The Steering Parameter menu will appear with the cursor pointing to the parameter you selected and the value of that parameter flashing:



- 3. Use the ADJUSTMENT KNOB to change the value.
- 4. To save the value and return to **AUTOPILOT** mode, press the button for the parameter you just changed.
- 5. To select another parameter to change, press the button for that parameter. Any changes made so far will be saved.
- 6. After 5 seconds of no user input, the Steering Parameter saves all changes and returns to **AUTOPILOT** mode.

## Slow Settings

Adjust and fine-tune the steering parameters for Slow Speed operation as follows:

- Adjust the vessel's speed so that it is moving at its normal working speed or a slow cruising speed.
- 2. To enter **AUTOPILOT** mode, press the AUTOPILOT button until the display comes up as shown here:



#### IMPORTANT

Do not attempt to change Steering Parameters while the vessel is at or near the automatic Speed Trip Point. The Autopilot may switch from fast to slow Steering parameters (or vice versa) at this time. If the Speed Trip Point is crossed while the Steering Parameters menu is displayed, the Autopilot will automatically overwrite the new Steering Parameter menu over the old one, and you may inadvertently make unwanted changes.

- 3. If the display reads 'FAST" in the bottom right corner, press and hold the SPEED button until the display reads 'SLOW".
- 4. Monitor the Autopilot performance for a few minutes. It should maintain a steady course within the limits of the yaw setting. (Press the YAW button to enter the Steering Parameter menu so you can see what these limits are. Use the ADJUSIMENT KNOB to change the Yaw setting if desired).

If the Autopilot does not maintain a steady course and begins to "ess" back and forth, reduce the nudder gain. (Press the RUDDER button to enter the Steering Parameter menu and turn the ADJUSIMENT KNOB one click counter-clockwise to reduce the nudder gain by one level).

Proceed to step 5 once the Autopilot maintains a steady straight-line course within the yaw setting. This is often judged best by observing the vessel's wake.

- 5. Make a 40-degree course change. The vessel should settle onto the new course with one overshoot of 5 degrees or less.
- 6. If you were uncomfortable with how fast the vessel turned during the maneuver in Step 5, adjust your turn rate up or down before making more course changes in **PILOT** mode. (Press the TURN RATE button to enter the Steering parameter menu and turn the ADJUSIMENT KNOB counter-clockwise to reduce the turn rate, or clockwise to increase the turn rate. Refer to Table 5 for turn rate settings).
- 7. If the vessel stops turning before the new heading is reached and then approaches it slowly,

#### either

- a) Increase the rudder one level. (Press the RUDDER button to enter the Steering Parameter menu and turn the ADJUSIMENT KNOB one click clockwise to increase the rudder setting by one level).
- æ
- b) Decrease the counter rudder one level. (Press the COUNTER RUDDER button once to enter the Steering Parameter menu and turn the ADJUSIMENT KNOB one click counter-clockwise to decrease the counter rudder setting by one level).
- If the vessel overshoots the new heading, and then makes several turns across the new heading before settling down, then

#### either

a) Decrease the rudder one level. (Press the RUDDER button once

to enter the Steering Parameter menu and turn the ADJUSTMENT KNOB one click counterclockwise to decrease the rudder setting by one level).

œ

Increase the counter rudder one level. (Press the COUNTER RUDDER button once to enter the Steering Parameter menu and turn the knob one click clockwise to increase the counter rudder setting by one level).

9. Repeat steps 4 through 8 as often as necessary to achieve satisfactory steering performance.

### Fast Settings

Once you have achieved satisfactory steering performance using the Slow Settings, adjust and fine-tune the steering parameters for Fast Speed operation. Generally speaking, you should find that suitable Rudder and Counter-Rudder settings for Fast Speed operation are somewhat lower than those used for Slow Speed Operations.

- Adjust the vessel's speed so that it is moving at its normal passage speed or a fast cruising speed.
- 2. Enter pilot mode press the AUTOPILOT button until the display comes up as shown here:
- 3. If the display reads "SLOW" in the bottom right corner, press and hold the SPEED button until the display reads "FAST":



4. Monitor the Autopilot performance for a few minutes. It should maintain a steady course within the limits of the yaw setting. (Press the YAW button to enter the Steering Parameter menu and see what these limits are. Use the ADJUSIMENT KNOB to change the Yaw setting if desired).

If the Autopilot does not maintain a steady course and begins to "ess" back and forth, reduce the rudder gain. (Press the RUDDER button to enter the Steering Parameter menu and turn the ADJUSIMENT KNOB one click counter-clockwise to reduce the rudder gain by one level).

Proceed to step 5 once the Autopilot maintains a steady straight-line course within the yaw setting.



Figure 15-Vessel Responses

- 5. Make a 40-degree course change. The vessel should settle onto the new course with one overshoot of 5 degrees or less.
- 6. If you were uncomfortable with how fast the vessel turned during the maneuver in Step 5, adjust your turn rate up or down before making more course changes in **PILOT** mode. (Press the TURN RATE button to enter the Steering parameter menu and turn the ADJUSIMENT KNOB counter-clockwise to reduce the turn rate, or clockwise to increase the turn rate. Refer to Table 5 for turn rate settings).
- 7. If the vessel stops turning before the new heading is reached and then approaches it slowly,

#### either

a) Increase the rudder one level. (Press the RUDDER button to enter the Steering Parameter menu and turn the ADJUSIMENT KNOB one click clockwise to increase the rudder setting by one level).

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- Decrease the counter rudder one level. (Press the COUNTER RUDDER button once to enter the Steering Parameter menu and turn the ADJUSTMENT KNOB one click counter-clockwise to decrease the counter rudder setting by one level).
- If the vessel overshoots the new heading, and then makes several turns across the new heading before settling down, then

#### either

a) Decrease the rudder one level. (Press the RUDDER button once to enter the Steering Parameter menu and turn the ADJUSIMENT KNOB one click counterclockwise to decrease the rudder setting by one level).

#### a

b) Increase the counter rudder one level. (Press the COUNTER RUDDER button once to enter the Steering Parameter menu and turn the knob one click clockwise to increase the counter rudder setting by one level).

9. Repeat steps 4 through 8 as often as necessary to achieve satisfactory steering performance.

#### Yaw

The yaw setting tells the Autopilot how far off course the vessel may wander before the Autopilot corrects the error. At the default value of 1 there is 0.5 degrees of "dead band" on either side of the programmed course.

### Test Dodge Function

By testing the Dodge function you can familiarize yourself with an important safety feature of your 1101 Autopilot. Remember that the Autopilot executes a Dodge, it is not Turn Rate controlled.

- Adjust the vessel speed so that it is traveling at the normal working speed or a slow cruising speed. Ensure you are heading in a direction which leaves plenty of room for maneuvering.
- 2. Place the Autopilot in AUTOPILOT mode. Check that "SLOW" is displayed in the bottom right hand corner of the screen.
- 3. Press and hold either the PORT or STARBOARD DODGE button. The following screen will appear:



- 4. The vessel will turn rapidly in the selected direction. The turn will not be turn limited.
- 5. Release the DODGE button and observe that the vessel returns to its original heading. You will now be traveling parallel to your original track (see Figure 11).
- Repeat the Dodge in both directions and observe the performance of your vessel during these maneuvers.
- Repeat the Dodge maneuvers with the vessel traveling in AUTOPILOT mode at normal passage speed or a fast cruising speed. "FAST" should be displayed in the bottom right hand corner of the screen:


#### Setup and Trial Special Turns

Now that you are confident that the Autopilot steers accurately in AUTOPILOT mode, you should setup and trial a Special Turn. Review the descriptions of the Special Turns earlier in this section to decide which turn will be most useful to you in an emergency situation.

- 1. Place the Autopilot in **STANDBY** mode.
- 2. Double press the STBY/OFF button to display the menu.
- 3. Use the ADJUSTMENT KNOB to select the "SPEC TURN" parameter. Press the SIBY/OFF button and the value will begin to flash.



- Use the ADJUSTMENT KNOB to select "UTurn", "CTurn" or "ETurn".
- 5. Press the STBY/OFF button to save the value.
- 6. Double press the STBY/OFF button to return to  $\ensuremath{\mathsf{STANDBY}}$  mode.
- 7. Place the Autopilot in **AUTOPILOT** mode. Check that you are well clear of obstacles and marine traffic and that your vessel is on a course which leaves plenty of room to execute the type of turn you have selected.
- Initiate a Special Turn by pressing the TURN button. The type of turn to be executed will appear on the display:

U Turn	
AUTOPILOT	

 Execute the Special Turn by pressing either the PORT or STARBOARD DODGE button. The vessel will turn in the selected direction. The new course and the type of turn will appear on the display:



Note that for a UTurn, the Autopilot will display the reciprocal course, that is, your last course plus 180'. For E Turns and C Turns, the course will change as the Autopilot executes the preset series of maneuvers.

- 10. If you have selected a U Turn or an E Turn, the Autopilot will complete the Special Turn once the vessel is on a reciprocal course. If you have selected a C Turn, you vessel will continue to circle until you exit the Special Turn function.
- 11. To exit the Special Turn function, either turn the ADJUSIMENT KNOB or change modes.

#### Adjusting for Special Conditions

One of the advantages of the ComNav 1101 is that it gives you the ability to change the Steering Parameters easily while underway. Now that you have setup and trialed your autopilot in **AUTOPILOT** mode, it will give you consistent reliable steering performance but you should be aware of some special conditions under which you may wish to vary the Steering Parameters.

#### Wave Action

Should you encounter heavy weather, wave action may cause considerable swinging of your vessel's bow. If the bow travels through an arc wider than your yaw setting, you will observe the Autopilot trying to connect for waves. This will do little to improve steering performance but will add to the wear and tear on your steering system. If you expect to be in heavy weather for a period of time, increase the yaw setting. You should turn the yaw setting back down once the weather calms down.

#### Very Slow Speed

At very slow speeds the vessel's nudder effect is greatly reduced making it harder to execute turns. If you plan to make a passage at a speed which is below the speed of your "SLOW" settings, increase your nudder setting. This will provide a more exaggerated rudder movement for each course change, thereby offsetting the reduction in nudder effect due to slow speed. If necessary, you can also increase the counter nudder setting to improve slow speed performance.

#### Following Seas

When traveling with a following sea-the waves are approaching your vessel from astem-speed relative to the water is reduced as the vessel accelerates or surfs down the face of each wave. This has the same effect on steering performances as traveling at slow speed. To improve Autopilot performance in a following sea, increase your nudder setting and counter nudder setting.

#### Current, Tide and Wind

If you are traveling with a current, tide or wind at an angle to your desired course, the vessel will be pushed off course consistently in the same direction. After a period of time, the Autopilot will build up "trim" to deal with the cross tide, current or wind. You do not have make any adjustments as this is an automatic feature. If you have an external Rudder Angle Indicator, you will notice that the rudder will be offset from its normal center position. The Autopilot removes all trim each time it receives a new commanded course.

# 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 1101 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 1101 autopilot may be interfaced to navigation devices capable of transmitting autopilot sentences in NMEA 0183 format. Four types of information from the NMEA data provided by the navigation device are used by the autopilot:

- 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 VIG (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, BOD, or HSC. WBD, a proprietary sentence from Northstar Lorans, may also be used.
- **Cross Track Error** (XIE) 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 XIE.
- 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 "No Data From Nav Device" or "No Speed Error".

#### 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 crosstrack 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. ComNav 1101 Autopilot



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:

- 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:



 Bring up the NAV menu by double-pressing the NAV button twice in quick succession. Ensure that the value for XIE (cross-track error) is "Norm". Use the ADJUSIMENT KNOB to change it if necessary.

XTE Sens	se	Norm
Course	From	
XTE	From	
Speed	From	
NAV		

5. 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, bring up the NAV menu by double-pressing the Nav button twice in quick succession. Use the ADJUSTMENT KNOB to change the value of XTE Sense. 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, XIE 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:

 Bring up the NAV menu by double-pressing the Nav button twice in quick succession. Change the value for XIE Sense (cross-track error) to "OFF".

XTE Sens	se (	Off
Course	From	
XTE	From	
Speed	From	
NAV		

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 "No Data from Nav Device", then the Autopilot is not receiving the NMEA data from the navigation device properly. Refer to Section 9-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 Fluxgate 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:

ID) Check Autopilot operation in POWER STEER.

#### 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.

# 9. Problem Solving

Several different problems and possible solutions are outlined below. Often the problem is not with the Autopilot. In order to find and rectify problems, spend a few minutes performing the basic troubleshooting procedures given in this chapter. If the suggested solution does not solve the problem, return the Autopilot or affected printed circuit assemblies to a ComNav dealer or the factory for service. Be sure to include a description of the problem and what steps were taken to eliminate possible causes.

#### Problems in DOCKSIDE SETUP Mode

#### The Autopilot does not turn on. The display screen remains blank and does not light up.

- Check that the circuit breaker is turned on and that any in-line 1. fuses used are good.
- 2. Ensure that the cable from the Distribution Box is securely connected to the SPU receptacle labeled "Distribution Box".
- 3. Ensure that the cable from the 1101 Head is securely connected to the SPU receptacle labeled "Control Head".

If the problem persists, there may be a problem with either the 1101 Head or the SPU. Contact a ComNav dealer or the factory for service assistance.

#### The Autopilot turns on but will not go into DOCKSIDE SETUP mode.

Make sure the correct buttons are being pressed in order to enter DOCKSIDE SETUP mode. Refer to the sections on "Reset" and "Full Reset" in Section 5-Getting Started.

#### The Autopilot enters DOCKSIDE SETUP mode but immediately comes up with "Error - Redo rudder setup".

- 1. Check the rudder follower wiring for correct installation as per the instructions in the Installation chapter.
- 2. You may have set the rudder limits for port and starboard too close together. The Autopilot will not accept the rudder limits if they are less than about 10 degrees port and starboard. Redo the Rudder Setup.

If the problem persists, contact a ComNav dealer or the factory for service assistance.

The Autopilot accepts the rudder limits but does not move the rudder during the Rudder Drive Test.

- 1. Ensure that the hydraulic steering system has been bled properly.
- 2. Turn the Autopilot on and place it into **POWER STEER** mode. Remove the cover of the Distribution Box so that you can observe the LEDs. The yellow LED labeled "SWI FWR" should be lit. Press the PORT DODGE button. The red LED lamp labeled "PORT" should come on. Similarly, press the STARBOARD DODGE button, and the green "STBD" LED lamp should come on. If any of the LED lamps fail to come on when expected, the SPU might be defective.
- 3. Check for a possible short in the output cable to the rudder drive.
- 4. For DC solenoid systems (refer to the Installation chapter, "Drive Option A" wiring diagram)
  - a) If the common connection to these solenoids is wired directly into a circuit breaker, ensure that the breaker is turned on.
  - b) Ensure that all wire connections to the solenoids and to the 1101 Distribution Box are secure.
- 5. For AC solenoid systems (refer to the Installation chapter, "Drive Option B" wiring diagram)
  - a) Check all connections between the 1101 Distribution Box and the CT4 Drive Box.
  - b) Check all connections between the CT4 Drive Box and the AC solenoids.
  - e Ensure that the AC supply that feeds the CT4 Drive Box is turned on.
- 6. For Reversing Pumps and Rotary Drives (refer to the Installation chapter, "Drive Option C", "D", "E" or "F" wiring diagrams)
  - a) Ensure that the circuit breaker for the Drive Box is turned on.
  - b) Check all connections between the 1101 Distribution Box and the Drive Box.
  - check all connections between the Drive Box and the Reversing Pump or Rotary Drive.
  - d Most Drive Boxes are equipped with internal fuses for circuit protection. If these fuses blow, be sure to check all wiring before replacing them. Replace fuses only with the same type and rating.
  - e) If you have a mechanical clutch for your Rotary Drive, be sure to engage it before the Autopilot executes the "Measuring rudder movement - please wait" step in the Rudder Drive Test.
- 7. For Continuous Running Electric Pumps
  - a) Check to see if the pump is running when the Autopilot is in POWER STEER, AUTOPILOT or NAV modes.
  - b) Confirm the correct wiring using the manual supplied

with the pump. If after going through the pump instructions the problem cannot be identified, contact a ComNav dealer or the factory for service assistance.

The Autopilot will not auto-compensate a ComNav Fluxgate compass. (The autopilot continuously displays "Turn vessel 360 degrees" even though more than 1 complete circle has been made.)

- Make sure the compass is mounted horizontally and that the embossed arrow on the top is pointing towards the bow of the vessel.
- The compass sensor inside the unit is gimbaled. The sensor may become "stuck" at a severely tilted angle if the compass is not handled carefully. Gently shake the unit to "un-stick" the gimbal.
- 3. Check the position of the compass. Ensure that it is not too close to any ferrous metal objects or high-current cables.
- 4. Make sure that the compass is mounted using non-ferrous fasteners.

If auto-compensation is unsuccessful after several attempts, contact a ComNav dealer or the factory for assistance.

# Problems During Normal Operation of the Autopilot

#### The Rudder turns hard over to one side.

- 1. Check the Rudder Follower for correct operation.
- 2. Check the Rudder Drive and steering system for correct operation (i.e. sticking solenoid valves, relays, etc.)
- 3. If the rudder appears to move normally with the Autopilot in **POWER STEER** mode, but goes hard over in **AUTOPILOT** mode, recheck the Rudder Follower and the Rudder Drive connections in the Distribution Box for correct wiring. Perform a Dockside Setup again.

#### The Autopilot turns on, but does not operate properly.

- 1. Turn the Autopilot off and then on again.
- Check the voltage supplied to the Distribution Box for a minimum of 12 VDC between "PILOT PWR(+)" and "PILOT PWR(-)"
- 3. Check for problems in the cables leading to optional remote controls by unplugging them from the rear of the SPU and seeing if that clears the problem.

#### The displayed compass heading does not follow the actual compass heading.

For Fluxgate Compasses,

- 1. Check for and remove any "portable" magnetic material such as tools, tin cans, etc, near or directly underneath the compass.
- 2. If there is a magnetic compass located near the fluxgate compass, check for any compensating magnets, particularly heeling magnets that are placed too close to the Fluxgate sensor.
- Redo the auto-compensation routine in DOCKSIDE SETUP mode. See Compass Configuration in Section 5-Getting Started.

For Compasses equipped with a Magnetic Sensor,

- Check for and remove any "portable" magnetic material such as tools, tin cans, etc, near the compass, or directly underneath it.
- 2. The problem may lie in poor compass adjustment. Contact a qualified compass adjuster to have the compass compensated for deviation, including that caused by heeling error. Proper compass compensation is particularly important on steel-hulled vessels. Do not attempt to move any compensating magnets or spheres yourself, as this may make the compass dangerously inaccurate, especially if it is used as a steering compass.

# The Autopilot steers normally on some courses, but not on others, particularly north or south.

 This is a compass problem. Refer to the solutions above for "The displayed compass heading does not follow the actual compass heading."

#### The Autopilot steers poorly on all courses.

- 1. Check that hard-over to hard-over time is correct.
- 2. Check that rudder and counter rudder parameters are adjusted correctly.

For Fluxgate Compasses,

 Redo the auto-compensation routine in DOCKSIDE SETUP mode. See Compass Configuration in Section 5-Getting Started. For Compasses equipped with a Magnetic Sensor,

 Watch the card on the Autopilot Compass to make sure that it follows the vessel movements properly. If the card seems to turn with the vessel for a few degrees and then "sticks" for a while, either the pivot or the jewel in the compass needs repair. Contact a ComNav dealer or the factory for assistance.

#### The Remote Control does not work.

- Check the "Remote in Command" pip on the remote display to see if the Remote is in control. If not, you may take control by pressing the two DODGE buttons on the Remote.
- 2. Ensure that the Remote is plugged into the receptacle on the rear of the SPU labeled "Aux. Station".

#### Error Messages

The 1101 Autopilot monitors various parameters during its operation and continually checks them for faults. A detection of a fault will cause an error message to be displayed. Additionally, the audible alarm will sound. This section contains a list of error messages and the possible causes for them. The messages are listed in alphabetical order.

#### Button Error

One or more buttons on the 1101 Head are stuck in the closed position. Alternatively, a Remote unit may have a faulty button. Pressing the SPEED button will clear the error, but the function controlled by the stuck button will be unavailable until the fault is connected.

- Unplug the Remote unit from the SPU to see if the problem clears up. If it does, the Remote requires servicing from a ComNav dealer or the factory.
- 2. If the problem is not on a Remote, locate the stuck button on the 1101 Head. Gently prize out the button-cap using a small slot screwdriver. Carefully inspect the yellow gasket material under the button-cap. Return the unit to a ConNav dealer or the factory for servicing if there are any punctures or cracks in the gasket. Otherwise, clean the button-cap and gasket and reassemble.

#### Checksum Error

The Navigation Device connected to the Autopilot is sending data sentences with incorrect checksums.

- 1. Verify that the Navigation Device is functioning properly.
- Ensure that the cabling between the Navigation Device and the Autopilot is sound and that all wire connections are tight. Ensure that shielded cabling is used.
- 3. Consult the Navigation Device manual to determine whether there are any configurable options for the format of the data sentences. Generally speaking, if more than one version of NMEA 0183 is available, use the highest number version.
- If the above suggestions do not rectify the problem, the errorchecking feature on the Autopilot can be turned off. To do so, follow these steps:
- a) Turn the Autopilot on and place it in **STANDBY** mode.
  - b) Double-press the STANDBY button to enter the Standby menu.



# Checksum Error

- d Use the ADJUSTMENT KNOB to position the cursor at "NMEA checksum", then press the STANDBY button again. The parameter value for "NMEA checksum" will begin to flash.
- d Use the ADJUSTMENT KNOB to change the parameter to "OEF".
- e) Press the STANDBY button once more to deselect the parameter value. The word "On" will stop flashing.
- $\label{eq:standby} {\tt f} \quad {\tt Double the STANDBY button to exit the Standby menu and go back into {\tt STANDBY mode.}}$

#### Course Error

This alarm can occur in either **AUTOPILOT** mode or **NAV** mode. It indicates that the vessel has fallen off course by more than 20 degrees and has remained off course for at least 30 seconds.

- 1. The RUDDER and/or COUNTER RUDDER settings may be set too low for the Autopilot to bring the vessel onto course.
- 2. There could be a failure in the Steering System. Check for an inoperative Motor Drive, blown fuse, stuck valves, etc.
- 3. This error may also be caused by a failure in the Rudder Follower or it's linkage. Check both to make sure they are functioning properly.

#### Drive Box Overheated

If the Autopilot is being used with a Drive box (for example, a CT2 Reversing Motor Drive) that feeds its operating current and temperature back to the Autopilot, and these levels exceed safety margins for more than 4 seconds, then the above message will occur. This message will occur in **STANDBY** mode or **POWER STEER** mode only.

1. Check for a jammed rudder or similar problem that would cause an excessive load on the motor.

#### Faulty Compass Error

If this error occurs, the Autopilot will be operable only in **STANDBY** or **POWER STEER** modes.

- 1. Ensure that the correct type of compass has been selected using **DOCKSIDE SETUP**.
- 2. The connector for the Fluxgate Compass or Magnetic Sensor may be loose.
- 3. The Fluxgate Compass or Magnetic Sensor may be defective.

Course Error NAV

> Drive Box Overheated

PSTEER

Faulty Compass Error

NAV

#### Faulty Data From Navigation Device

Faulty Nav Data

NAV

This indicates that one or more of the alarm flags in the data sentences from the Navigation Device are set.

The Autopilot will continue to use this data, but will sound the audible alarm and display the error message shown above after every data sentence that is received until the error flags are cleared. Caution should be used if the Autopilot is left in NAV mode.

1. Check the front display of the Navigation Device for an alarm indication. If the alarm continues for more than 30 seconds, disengage the Autopilot.

#### Full Reset - Redo rudder setup

This error may occur when the Autopilot is first turned on.

FULL RESET --Redo rudder setup.

DOCKSIDE SETUP

The 1101 Autopilot performs a Power-On Self Test every time it is turned on. As part of this test, it verifies the memory where the steering parameter values are stored. If a piece of data is not correct, the Autopilot will set everything back to the factory default settings.

1. If this error occurs on a regular basis, return the Autopilot to a ComNav dealer or the factory for repair.

#### Ghost Rudder

If an error in the Rudder Follower is detected, the Autopilot will switch to GHOST RUDDER mode, wherein the vessel's rudder position is calculated by the Autopilot based on the rudder movements learned during the Rudder Drive Test in DOCKSIDE SETUP. The Autopilot will not work as well with the Ghost Rudder as with the Rudder Follower.

The Rudder Follower should be repaired or replaced as soon as 1 possible.

#### High Power Error

The voltage supplied to the Autopilot has risen above 35 VDC.

The Autopilot may become damaged if this condition continues. 1. Turn off the Autopilot, open the circuit breaker that supplies the Autopilot, and determine the cause of the over-voltage condition. Do not use the Autopilot until the problem is retified.

3**04**° Course GHOST RUDDER AUTOPILOT FAST



High Power

Error

STANDBY

#### Low Power Error

The voltage supplied to the Autopilot has dropped below 10 VDC.

- Low Power Error
- STANDBY

- 1. Check for proper alternator operation.
- 2. Test the vessel's batteries to ensure they are in good shape.
- 3. Check all wiring and connections for tightness and signs of corrosion.

Do not use the Autopilot until the problem has been rectified.

#### Motor Load Error



Similar to a "Drive Box Overheated" error, this error will occur if the level of operating current and/or temperature fed back to the Autopilot from a Drive box exceeds a safety margin. The difference is that this message can occur only in **AUTOPILOT** mode or **NAV** mode.

1. Check for a jammed rudder or similar problem that would cause an excessive load on the motor.

#### No Compass Error

The Autopilot is not receiving signals from the Magnetic Sensor or Fluxgate Compass. The Autopilot will only function in **STANDBY** mode or **POWER STEER** mode.

- Check that the Magnetic Sensor or Fluxgate Compass is securely connected into the receptacle on the rear of the SPU labeled "Compass".
- Check that the Autopilot is connectly configured for the type of compass. See "Compass Configuration" in Section 5-Getting Started.

#### No Data From Navigation Device

The Autopilot is not receiving any recognizable data from the navigation device.

- Check to see that the navigation device is turned on and in good working order.
- 2. Check to ensure that the navigation device is configured to output the required NMEA sentences. See "Navigation Interface" in Section 7-Advanced Operations for details on the required sentences.

No Compass Error

STANDBY

No Data From Nav Device

NAV

- 3. The navigation devices may not be transmitting any data. Some navigation devices transmit data only when there is an active waypoint programmed in to them. Remove the Distribution Box cover and check that the LED labeled "NAV" is blinking at a rate of about once per second. However, be aware also that some navigation devices output a "default' data sentence until such time as an active waypoint has been programmed in. The default data sentence may not contain any information useful to the Autopilot, but it will still cause the LED lamp in the Distribution Box to blink. Your navigation device manual may give more information.
- 4. Check the cabling between the navigation device and the Autopilot.

#### No Speed Error

This message will be displayed briefly once every 20 seconds if the following conditions are met:

- a) The Autopilot is in either AUTOPILOT mode or NAV mode.
- b) The Autopilot is configured to automatically switch between SLOW and FAST steering parameters at a specific 'trip point' speed.
- The Autopilot is *not* receiving any sentences from the navigation device that contain information about the vessel speed.
- 1. Check to see that the navigation device is turned on and in good working order.
- Check to ensure that the navigation device is configured to output the required NMEA sentences. Check that the navigation device is supplying the correct NMEA sentences. See Section 7-Advanced Operations for details on the required NMEA sentences.
- 3. The navigation devices may not be transmitting any data. Some navigation devices transmit data only when there is an active waypoint programmed in to them. However, be aware also that some navigation devices output a "default' data sentence until such time as an active waypoint has been programmed in. The default data sentence may not contain any information useful to the Autopilot, but it will still cause the LED lamp in the Distribution box to blink.
- 4. Check the cabling between the navigation device and the Autopilot.

No Speed Error

NAV

#### PROBLEM SOLVING **9** - 11

#### PROM Memory Error

This error may occur when the Autopilot is first turned on.

The 1101 Autopilot performs a Power-On Self Test every time it is turned on. As part of this test the Autopilot verifies that the program software encoded into an integrated circuit chip is intact. If any part of the program has become corrupted, then the Autopilot will not allow further operation.

1. The Autopilot must be returned to a ComNav Dealer or the factory for repair.

#### RAM Memory Error

This error may occur when the Autopilot is first turned on.

The 1101 Autopilot has detected a fault while testing the portion of memory used for calculations. The Autopilot will not allow further operation.

The Autopilot must be returned to a ComNav Dealer or the 1. factory for repair.

#### Rudder Follower Error

The Autopilot has detected a problem with the Rudder Follower.

The Autopilot will automatically invoke the Ghost Rudder feature when in AUTOPILOT mode or NAV mode.

The digital and graphical rudder angle indicators normally shown in POWER STEER mode will not work.

- 1. Check for broken, loose, disconnected, or shorted wiring between the Rudder Follower and the Distribution Box.
- 2. The Rudder Follower may be defective. Contact a ComNav dealer or the factory for service assistance.

Rudder Follower Error

NAV

RAM Memory Error

NOT IN COMMAND

PROM Memory Error

NOT IN COMMAND

#### Rudder Error

Rudder Error

Occurring only in **AUTOPILOT** mode or **NAV** mode, this message will be displayed if the Autopilot cannot detect any movement by the rudder in response to a command to move.

- 1. Place the Autopilot in **POWER STEER** mode. Measure how long it takes after pressing one of the DODGE buttons until the digital nudder angle reading begins to change, particularly when the last nudder movement was in the other direction.
  - a) If it takes longer than about 1 second for the rudder to begin to move, check for air in the hydraulic steering system, if so equipped.
  - b) Check for slack or worn parts in the steering system, particularly if it is a mechanical steering system.
- 2. If the digital nudder angle reading does not change, but the nudder is definitely moving, check for a broken Rudder Follower Linkage, or a defective Rudder Follower.

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NAV

# 10. 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:
  - by an authorized ComNav Dealer; or
  - by someone other than an authorized ConNav Dealer, and such installation has been inspected by an Authorized ConNav Dealer; and
- b the Limited Warranty Registration Card has been returned to ConNav 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 ConNav Dealer and returned to ConNav 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 inpart.

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 ConNav, by mail to the address for ConNav set forth above, or by facsimile to ConNav at 1-604-207-8008, and is received by ConNav 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 ConNav 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 ConNav 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 (nudder 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. ConNav's entire liability and the Purchaser's exclusive remedy against ConNav for the defective Equipment shall be, at ConNav'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:
  - 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
  - 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;
- If upon examination by either ConNav or an authorized ConNav 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 ConNav's sole option, without charge, and shall be returned to the Purchaser at ConNav'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 ConNav and are specifically excluded from the warranties set forth in this Agreement. ComNav may, under special circumstances, and with ConNav'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 ConNav. ConNav 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;
  - 0 shipping, alterations, incorrect and/or unauthorized service;

() 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

- () 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 Connercial 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 ConNav. 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.

# 11. Specifications

## General

The Specifications for the 1101 Autopilot System define the basic capabilities and operational limits of the equipment. These are as follows:

Operating Voltage:	10 VDC to 30 VDC For use with 12 or 24 VDC Battery Systems
Operating Current:	400 Milliamps (minimum)
Operating Temperature Range:	-15 to +60° C (5° to 140° F)
Heading Resolution:	0.25 Degrees
Heading Accuracy:	± 2.0 Degrees
Course Set Resolution:	1.0 Degrees
PORT/STBD Output Type:	Open Collector, 3 Amps Max
Speed Control Output:	2.50 VDC for No Movement 5.00 VDC for Maximum Speed to Port 0.0 VDC for Maximum Speed to Starboard (IOK ohm Source Impedance)
Navigation Input:	NMEA 0183 (4800 BAUD):RMA, RMB, RMC, APB APA, XTE, BOD, WBD, HSC, VBW, VHW, VTG
Navigation Output:	AD-10S (FURUNO) and the 0183 HDG sentence
Rudder Angle Indicator Output:	+/- 500 microamps maximum for Full Scale Deflection
Size of Control Head Width: Height: Depth:	178 mm (7 inches) 92 mm (3.625 inches) 35 mm (1.375 inches) {38 mm (1.5 inches) required behind unit for cabling}
Weight of Control Head:	450 gm (1 lb)
Size of Signal Processing Unit Width: Height: Depth:	210 mm (8.25 inches) 95 mm (3.75 inches) 57 mm (2.25 inches) {76 mm (3 inches) required behind unit for cabling}
weight of Signal Processing Unit:	1.8 Kg (4.0 Lbs)

### CE Compliance

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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

# 12. User's Notes & Settings

#### Notes & Records of Menu Settings

Parameter	Scale	Default Value	User Settings 1	User Settings 2	User Settings 3
Standby Menu					
Speed Trip Point	OFF, 1-30 knots	OFF			
Compass Offset	000-359 degrees	000 degrees			
Brightness	0-7	7			
Contrast	0-15	9			
Checksum	ON, OFF	ON			
Special Turn	U-Tun, E-Tun, Circle	U-Tum			

Power Steer Menu					
Rudder Offset	0-70 degrees	0 degrees			
Rudder Travel	0-70 degrees	70 degrees			

Autopilot Menu, SLOW settings					
Yaw	0-9 degrees	1			
Turn Rate	0-9	6			
Counter Rudder	0–9	5			
Rudder	0-9	5			

Autopilot Menu, FAST settings					
Yaw	0-9 degrees	1			
Turn Rate	0-9	6			
Counter Rudder	0-9	3			
Rudder	0-9	3			

Nav Menu				
XTE Sense	NORM, REV, OFF	NORM		

Comments