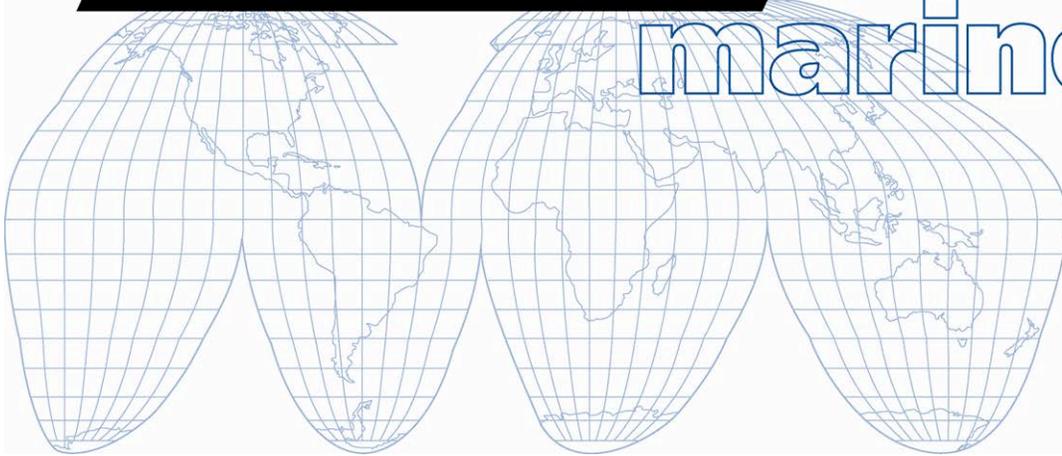


# ComNav<sup>®</sup>

# marine ltd



## ComNav P4 Autopilot Advanced Autopilot Systems

*Installation and Operation Manual*



ISO 9001

PN 29010100

## Welcome

Congratulations on your purchase of a ComNav Marine P4 Advanced Autopilot System. Developed using ComNav's many years of experience in autopilot design, the P4 Autopilot provides superior performance and advanced features, meeting or exceeding any other products in their class.

At ComNav, we are proud of our cutting-edge design and market-leading manufacture of marine autopilot systems. Our dedication to performance and reliability will ensure your satisfaction with your ComNav product for years to come.

### ComNav Marine Ltd.

#15 – 13511 Crestwood Place Richmond, B.C. V6V 2G1 Canada

Tel: 604-207-1600 • Fax: 604-207-8008

Web: [www.ComNav.com](http://www.ComNav.com)

E-mail: [sales@comnav.com](mailto:sales@comnav.com) - [service@comnav.com](mailto:service@comnav.com)

## Warranty

Prior to the installation and/or operation of any ComNav equipment, please take a moment to read and accept all warranty conditions as detailed in the Warranty Information section of this manual.

# WARNING

***This Autopilot is for navigation assistance only. Whenever underway, your vessel must always be under the control of a qualified and alert person who regularly and consistently ensures that the course and position of the vessel is correct and that the operating area is safe. You must always be in a position to resume manual control if the need to do so arises.***

***This equipment is not intended or designed to replace any person or persons on watch. A qualified individual should always be in a position to monitor the vessel's heading, and to monitor navigational hazards. The operator should always be prepared to revert to manual steering immediately if:***

- ***an undesired change of heading occurs***
- ***the heading is not maintained within reasonable limits***
- ***you are navigating in a hazardous situation***

***The performance of the Autopilot can be affected by many factors, including equipment failure, environmental conditions, and improper handling or use. Never place magnets or magnetic material near compasses connected to the autopilot system.***

***The Autopilot should never be used in areas where it is considered unsafe due to obstacles, other marine traffic, poor weather, or any other condition that could create a dangerous situation, or where it may be unlawful.***

## General Notice

This document, ComNav part number 29010100 Version 1 Revision 1, is the approved Installation and Operation Manual for use with the ComNav P4 Advanced Autopilot System.

Where versions of this manual exist in other languages, the English language version shall be considered authoritative.

## About this Manual

This manual provides essential information for the safe and reliable operation of the ComNav P4 Advanced 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.

## Typefaces, Common Phrases and Terms

Throughout this manual, you will see a number of different typefaces used, and several commonly-used words and phrases with very specific meanings, to describe concepts and actions that are fundamental to the operation of the autopilot. Please take a moment to become familiar with the following:

- System Component  
Specific system components are capitalized. Example: the Control Head
- Modes of Operation  
Specific “modes of operation” are placed in bold uppercase lettering. Example: **POWER STEER** mode.
- LCD Display  
Text that appears in the LCD display is in quotation marks. Example: “Waypoint Arrival”
- Button  
Control Head buttons and the knob are in bold small-caps lettering. Example: the **TURN** button
- Press or momentary press  
Press and release the indicated 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. If you use a personal computer, you will find that this is similar to a “double-click” when using a mouse.
- Press and hold  
Press and hold the indicated button for approximately 1 second.
- Press and maintain  
Press and hold the indicated button for as long as required to achieve a desired result.

**Manual Format**

Date	By	Description
16 August 2018	JL	First Release

This manual has been formatted to be printed on both sides of the pages, and on standard North American Letter-size paper (8.5" x 11").

If you have obtained this manual as a soft-copy, please note that it is in Adobe® Portable Document Format ("pdf"), and so may be viewed and printed with Adobe Reader®, or compatible pdf-format viewers.

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### Document History

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# Introduction



## How Autopilots Work

The purpose of this introductory section is to briefly describe what an autopilot does and some of the things you should expect when using an autopilot with your boat.

### Manual Steering

Every vessel has unique dynamics, which depend on its design, shape and dimensions, as well as current speed, loading, and sea conditions. The net result is that every boat (or rather, every unique boat *design*) “steers” in a unique way.

To understand what an autopilot does when it is steering your vessel, it is helpful to think for a moment about steering a boat by hand.

- When you are holding the boat on a given Heading, you know from instinct and experience how much rudder to apply, and how fast to apply it, to keep the boat on-course. Corrections are usually just a small, quick movement of the helm to one side, then back to the dead-ahead position.
- You won’t always try to correct when the boat rolls or accelerates off a wave, especially in heavy seas – because when the boat rolls back the other direction, it will usually come right back on-course.

Instead, your experience reminds you to allow the boat to yaw those necessary degrees on either side of the Heading, to reduce the fight.

- To turn the boat to a new Heading, instinct and experience again remind you how much rudder to use, and how fast, to get the boat turning at your normal rate of steer.

If the boat is not turning as rapidly as you want (for example, with a cross- or cross-current holding back the bow), you slightly increase the amount of rudder.

On the other hand, if the boat is turning too fast, you reduce the applied rudder a bit. You then gradually reduce the applied rudder, as the boat approaches the desired Heading.

You might even put the helm over opposite for a moment, to stop the boat swing more quickly – in order to come to the desired Heading without overshoot.

The single most basic purpose of an autopilot is to control the vessel the same as a human operator would ... to let the boat “work with the seas”, yet still maintain as straight a Track as possible in the current conditions, on the desired Heading or Course.

The P4 Autopilot System uses the latest generation of ComNav’s carefully-designed, well-proven steering control algorithms, which are based on many years of designing and manufacturing autopilots.

There are a number of parameters used in the steering algorithms, collectively referred to as “Steering Parameters.” The P4 Autopilot system has been tested on a wide variety of boats, of different types and sizes. The default settings for the Steering Parameters are average values derived from that testing, and provide a good starting place for most boats.

During sea trials, and later on normal operation, you may want to adjust some of those values, so that they better match your boat’s unique design dynamics.

However, the information in this section can be applied in general to any ComNav autopilot, and is not necessarily specific to the P-Series.

## Basic Autopilot System

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

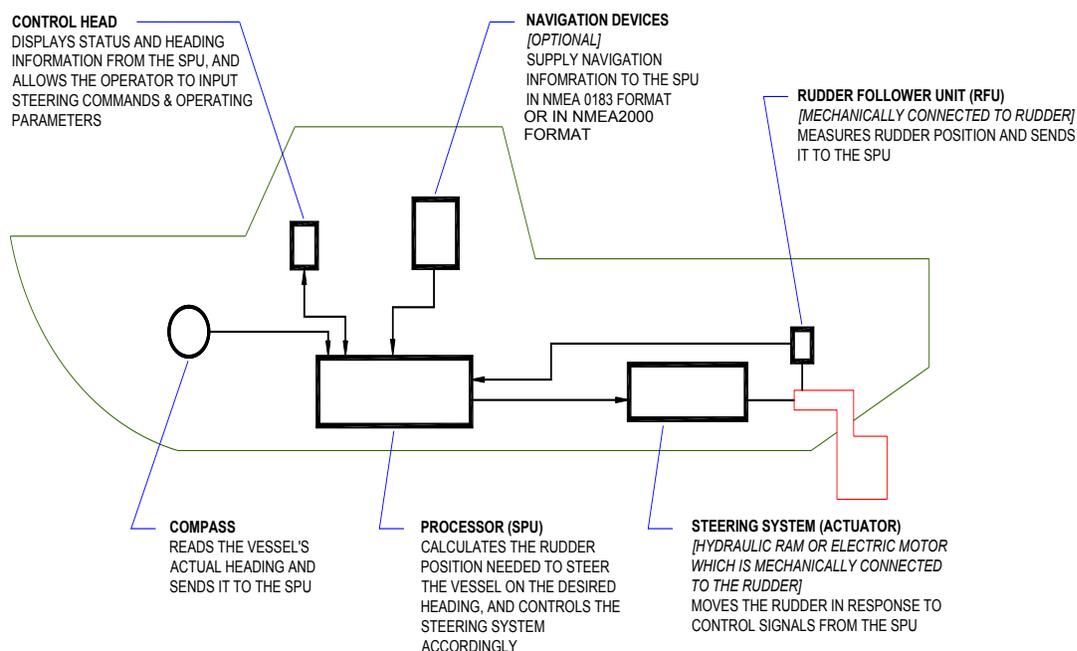


Figure 1 – Basic Autopilot System

The Compass indicates the direction in which the boat is pointed, often referred to as the Actual Heading. Depending on the type of boat and installed equipment, the Compass may be a magnetic compass, an electronic fluxgate compass, a gyroscopic compass, or a GPS Compass.

- A reliable compass is absolutely vital to the autopilot; without a trusted compass, the autopilot has no way of knowing where the boat is, or which way it is headed.

The actual heading is fed electronically from the Compass to the Signal Processor Unit (SPU), which is the heart of the autopilot. The SPU contains the microcontroller(s), electronic hardware, and the sophisticated control software necessary to steer the boat on any *desired Heading*.

The Control Head, normally located in the wheelhouse, is the interface between the vessel's operator and the autopilot. The Control Head displays information about what the autopilot is doing, and it has various controls (buttons and/or knobs) that allow you 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 a steering system capable of moving the rudder independently of the ship's helm. This might be a hydraulic ram that is connected to the rudder post or tiller quadrant, or an electric motor connected to the steering cables.

However, no matter what type of steering system the boat uses, electronic signals from the SPU tell the system to move the rudder, when needed – how far and in which direction.

Your autopilot may also have a Rudder Follower Unit (also called a Rudder Feedback Unit, or just “RFU”), a device that tells the SPU what position the rudder is in at any given time.

## Autopilot Operation

### Maintaining a Heading: AUTO Mode

With a ComNav Autopilot, following a Track or Course that you want to be on is very simple:

- Set the autopilot into **AUTO** mode.
- Using the Control Head, input the Heading you want the autopilot to follow.
- The autopilot then moves the rudder (as required) to initiate and keep the vessel on that Heading ... just like you would if you were steering manually.

### Here's how it works:

The steering control algorithms running in the firmware on the SPU's microcomputer are constantly comparing – multiple times per second – the boat's actual Heading (as indicated by the Compass) to the desired Heading you have input.

If there is a difference, the algorithms then calculate how much to move the rudder, to bring the boat back onto the desired Heading. The amount of corrective rudder movement is based on:

- How much the Headings differ.
- How long there has been a difference and by how much.
- How rapidly the difference is changing.

Here is an example which illustrates how the autopilot maintains a Heading in **AUTO** mode. Imagine the boat is a few degrees off-course to Port:

- The SPU will signal the steering system to move the rudder to Starboard, by a few degrees.

How many degrees the rudder moves depends on the type of vessel, and its dynamics (which you have specified and tested when you set up the autopilot).

**Note:** *On a P4 Autopilot with an RFU, the SPU verifies that the rudder has moved, by reading its position from the RFU.*

- The boat begins to turn to Starboard.
- As the boat turns, the difference between the desired and actual Heading gets smaller, and as it does, the SPU then starts to ‘back off’ the rudder – i.e., move it back to centre – so that the boat does not overshoot the desired Heading.
- If the boat isn't coming back on-course very quickly, the SPU's algorithms will not back the rudder off right away, and might even move the rudder a bit farther to Starboard for a while.

- On the other hand, if the boat is coming back too quickly, the rudder will be moved quickly back to dead-ahead – or maybe even a bit to Port for a few seconds.
- Eventually, the actual Heading will match the desired Heading.
- If-and-when the boat falls off-course again, the same sequence will be repeated.

In summary, this is all very similar to steering the vessel manually, it's just happening multiple times per second, much more precisely and rapidly than a human could – and without the lapse in focus sometimes attributed to a human operator.

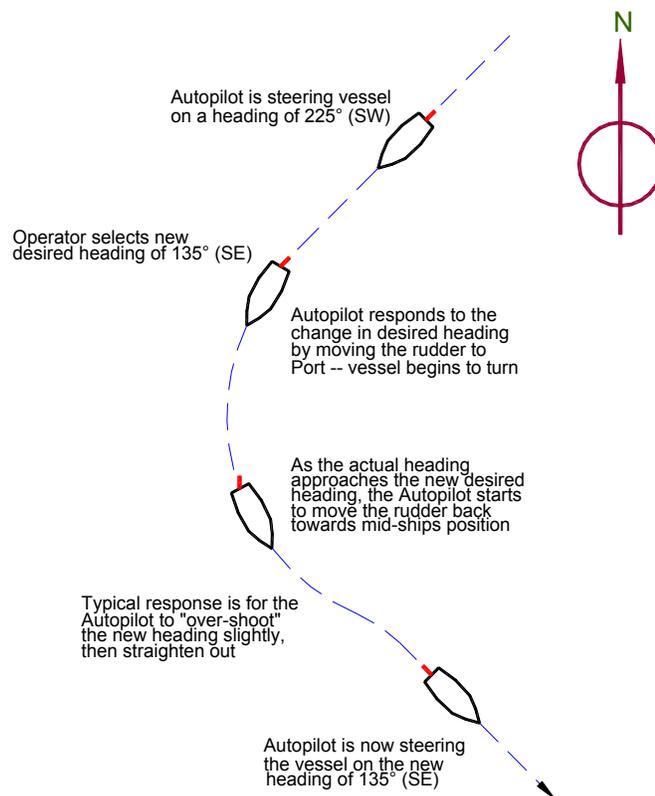
## Changing Heading

Heading changes are very simple with a ComNav autopilot as well. Imagine for example, that the autopilot is steering your boat Southwest, and you now wish to change direction to Southeast (see [Figure 2](#)).

To initiate the turn in **AUTO** mode, you would simply turn the knob on the Control Head to set the desired Heading (as shown on the Control Head's display screen) to 135°... Southeast.

After that, the autopilot behaves much the same as when maintaining a Heading – but with an initially large "Heading error" (90° to Starboard, in this example) that must be dealt with:

- When the SPU moves the Rudder to Port, it will probably be by quite a bit, maybe even all the way to the stops – but not immediately so the boat doesn't turn too rapidly.
- Eventually, the actual Heading will match the desired Heading ... and the boat will then be going Southeast.
- The SPU will keep steering the boat on the new 135° Heading, and maintaining that Heading until another Heading is selected.



**Figure 2 – Heading Change in AUTO Mode**

## Wind and Current Effects

If your vessel encounters a crosswind, and/or a tidal current at any given angle to the desired Heading, it will be pushed away, in the direction of the wind or current. At this point, the autopilot will constantly be making Heading corrections with the rudder, as it tries to maintain your desired Heading.

If that condition persists, the SPU will gradually begin to alter the rudder a few degrees to Port or Starboard of the centred position, to counter the effect of the wind and/or current. This feature, known as *Automatic Rudder Trim*, will keep your boat pointed in the right direction, despite the wind or current.

However, one side-effect of Auto-Trim is that your boat may not follow the Track you want; it will maintain your desired Heading, but the Track may “slip” sideways in the direction of the crosswind and/or current. This potential problem can be solved by using another mode that ComNav Autopilots provide, which is the NAV mode.

## Following a Track: NAV Mode

So far, we have seen how an autopilot operates in AUTO mode, whereas a new desired Heading must be selected on the Control Head each time you wish to change direction. This is useful for short trips or when you know the direct course to your destination.

But for longer trips, which often involve a number of “legs” at different headings, it would be useful to be able to have your autopilot steer your boat along all the legs, in sequence.

ComNav autopilots allow you to do just that, with NAV mode.

The autopilot must be connected to an external source of navigation information (commands and data), such as a chart plotter, or a Navigation program running on a PC. A source of position data is also required, it may be built into the external Navigation System, or it may be another device or system, like a GPS receiver (such as a ComNav GPS Compass), a LORAN C receiver, etc. (all such external devices are in general referred to in this manual using the generic term *Navigation System*).

ComNav Autopilots implement the industry-standard NMEA 0183 protocol for reception and transmission of navigation information. Almost all modern Navigation System equipment complies with NMEA 0183, so interfacing with a ComNav autopilot is relatively simple.

A long voyage will consist of a series of waypoints, which are specific locations on the Earth’s surface, as defined by their Latitude and Longitude. These waypoints define the route you want the boat to travel on, from your starting position to your destination. You enter them into the external Navigation System when creating the route.

The system determines the current location of the boat (from the position data source), and then calculates the course that must be steered in order to reach the next waypoint.

When the Autopilot is switched into NAV mode, it begins to look for some specific navigation information from the Navigation System: the course to steer to the next waypoint, and the Cross-Track Error (which is the distance from the boat to the desired Track, from the last waypoint to the next one). Using these two pieces of information, the autopilot steers the boat on the shortest possible Track to the next waypoint.

Cross and/or currents are compensated for automatically each time the Navigation System updates the Cross-Track Error. This is why **NAV** mode is the answer to the “track slip” problem that can occur in **AUTO** mode, when a cross/current exists.

When a waypoint is reached, the Navigation System sends the SPU the next set of navigation information – for the next waypoint – and the SPU then turns the boat to head to that next waypoint.

## Following a Track: AUTO/ALC Mode

Some ComNav autopilots (including the P4), provide another way to keep your boat on a specific *Track*: Automatic Leeway Correction.

This feature can be turned on in **AUTO** mode. **ALC** is similar to **NAV** mode, in that it uses NMEA0183 or NMEA2000 Latitude and Longitude data to sense if the boat is following the desired Track.

Unlike **NAV** mode, however, a ComNav autopilot with the **ALC** feature only needs Latitude and Longitude data in **AUTO/ALC** mode. It does not need Cross-Track Error data from the external Navigation System, nor to have any waypoints set in the system. The **ALC** feature calculates the Cross-Track Error on its own, using the desired Heading active at the point in time when **AUTO/ALC** mode is first engaged.

## Power Steer: “Drive by Wire”

Most ComNav autopilots have a **POWER STEER** mode, which provides a way for the user to control the rudder directly. In effect, the autopilot acts as a sort of “electronic steering wheel”, allowing the operator to steer the boat manually, in a similar way as when using a standard manual steering wheel or tiller – but instead steering the boat with the autopilot’s Control Head, or any remote controls it is equipped with.

Steering, when using the autopilot in this mode, is done with two buttons and/or a knob on the Control Head. Button 1 and/or a clockwise turn of the knob, will move the rudder to Starboard, causing the boat to turn that way; the other button, and/or a counter-clockwise turn of the knob, will move the rudder to Port so that the boat turns that way.

Using the buttons/knob, the rudder can be placed in any desired position where it will remain. This feature is useful when docking or manoeuvring, because the person steering the boat can take their hands off the controls between rudder movements.

## Additional Technical Information

Mathematically, the autopilot’s steering algorithms are based on a control method known as a “PID Loop” ... an acronym for a “Proportional, Integral, Derivative” error-correction technique.

The amount of rudder movement to correct for any Heading error (or to make a turn), is continuously re-computed, in a processing loop, as a value that is:

- Proportional to the error (or how much more of the turn is still to be done).
- An Integral of the error/turn ... how big for how long.
- A Derivative of the error/turn ... how fast it is changing.

Many references can be found on PID Loops, on the internet and elsewhere, if you want to know more. ComNav also occasionally holds training seminars – check with your dealer for more information.

# System Overview

## System Overview

This chapter provides a brief description of the major elements of the P4 Advanced Autopilot System, its functions, and their relationships to each other.

**Figure 3** shows a block diagram of a typical example of the P4 system, showing the interconnections between the elements of the system:

- The Signal Processor Unit (SPU)
- The Main Control Head
- A Compass or other Heading Sensor
- Solenoid(s), Reversing Motor, or Cable Drive, which move the Rudder
- The Rudder Feedback Unit
- Optional Auxiliary Control Head(s) and Remote Controls
- Various optional accessories and external equipment
- Other Navigation equipment

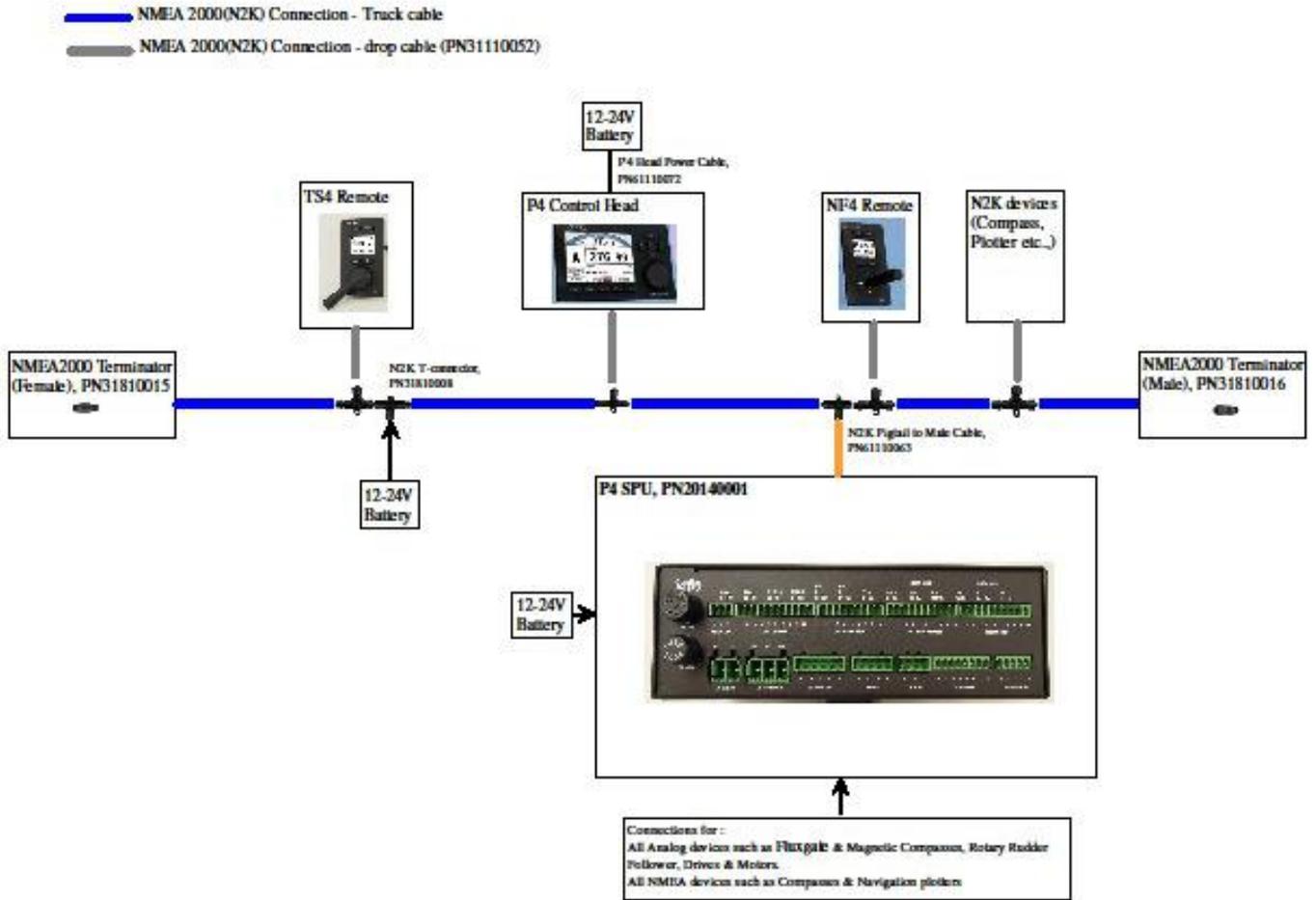


Figure 3 – P4 System Block Diagram

## P4 Control Head

**PN 20140001 (P4 Second Station Kit, Colour Head)**

**PN 30140001 (P4 Colour Head only)**

The P4 Control Head ([Figure 4](#)) connects to a NMEA 2000 network or standalone with a supplied T-connector to the Signal Processor Unit (SPU), via a supplied 6m NMEA 2000 standard light cables.

P4 Control Head incorporates a state-of-the-art, high visibility/high resolution QVGA TFT colour LCD display.



**Figure 4 – P4 Control Head**

The Control Head, when shipped as part of a complete P4 system, is a “core” module, with accessories for mounting option: bracket for bracket mounting. All required hardware is included, except for two fasteners needed to fasten the bracket to a mounting surface.

## Signal Processor Unit

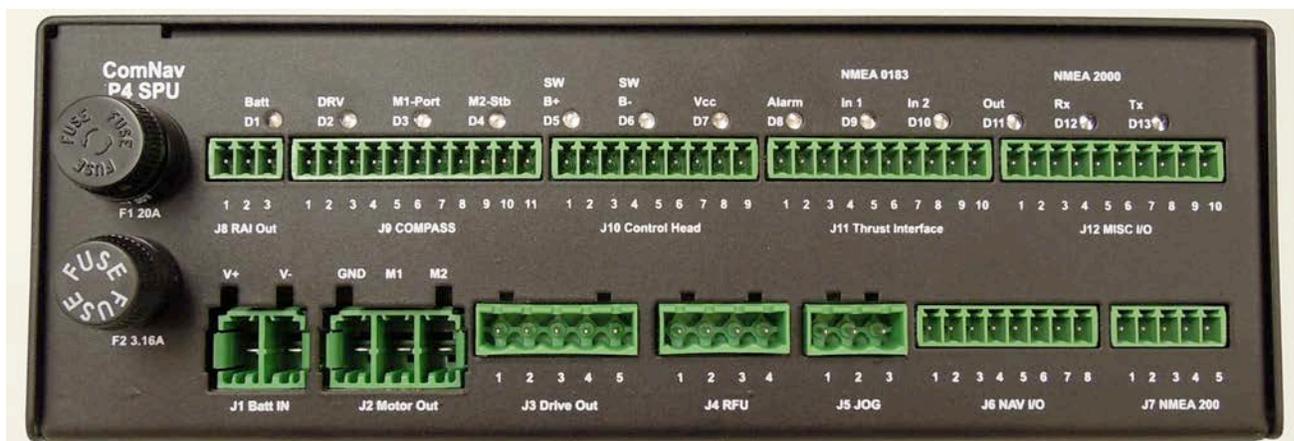
### PN 20140002

As seen in [Figure 5](#), the Signal Processor Unit (SPU) accepts a number of inputs from the other components of the autopilot system, and then processes them as necessary to control the movement of the vessel’s rudder 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 encountered.

The SPU is the central hub for all the wiring for ComNav analog or NMEA0183 devices in the system, with 12 connectors for all power and input/output signals (such as DC power, ComNav Rudder Feedback, ComNav RAI, NMEA 0183 Interfaces and Rudder Drives and Interfaces). The P4 SPU connects to a NMEA 2000 network or standalone with a supplied T-connector to the P4 Head, via a supplied 1m NMEA 2000 (Pigtail & Male End) cable at the Network Port of the SPU.

It also contains a diagnostic section, containing several status and activity LEDs, some test-points for service use, adjustment controls, and the system’s two fuses. The diagnostic section has a metal cover with screws, which can be easily removed to view the LEDs and the status of the fuses.

**Figure 5** – The P4 Signal Processor Unit (SPU) showing wiring details



## Compasses

The Compass is a critical component in the proper operation of the P4 Autopilot System. The autopilot system's ability to steer the vessel to a given Heading desired by the Operator can only be as accurate as the Compass.

The P4 system is capable of using a variety of different compasses. These are discussed below. Various combinations of these compasses, and related accessories, are often required.

*Note: It is always a wise and safe choice to have at least two compasses, and/or other Heading sensing devices, on board.*

### GNSS G2 and G2B GPS Compasses

**PN 11220008 (G1)** – NMEA2000 model

**PN 11220005 or PN 11220009 NMEA 0183 15m or 30m cable**

**PN 11220006 G2 NMEA 2000 model**

**PN 11220001 or 11220002 (G2)** – NMEA0183 model with 15 or 30 metre cable

**PN 11220003 or 11220004 (G2B)** – NMEA0183 model with 15 or 30 metre cable

The ComNav GPS Compasses are state-of-the-art devices which can provide accurate 2D Heading and Position data to autopilots, sonar, chart-plotters, AIS transponders, and other NMEA 0183 and NMEA2000 devices.



**Figure 6 – GNSS G2 GPS Compass**

Built-in DGPS processing capability provides sub-meter Position accuracy. DGPS source options in the G2 and G2B include standard SBAS systems (WAAS, EGNOS, MSAS, GAGAN, etc.), and external RTCM SC-104; the G2B can also use terrestrial DGPS Radiobeacon signals (IEC 61108-4), via an internal Beacon receiver module.

The GNSS compass features fast start up times, Heading and Position updates at up to 20 Hz, and will work correctly at sustained turn rates up to 90° per second.

The GNSS compass comes with a choice of mounting styles: a flat-surface base, a pole-mount base and bracket mount. The entire unit is fully waterproof. The GNSS NMEA N2K/0183 compass provides dual, independently configurable, NMEA 0183 data outputs, each available at both the NMEA 0183 Standard's output voltages, and at PC-friendly "COM port" voltages. The GNSS NMEA2000 provides Heading, Altitude, Pitch, Roll, Position, Turn Rate, Local and UTC time, Magnetic Variation NMEA2000 output data. It is possible to be configurable, but is not available currently.

One feature that is especially useful in marine applications, is that Heading is determined by mathematical computation, directly from the RF signals from GPS satellites, rather than sensing the Earth's magnetic field – and thus there are no local magnetic deviation effects from metal objects, electrical devices, wiring, etc. As well, Heading is available at high Latitudes.

The GNSS compass contains a solid-state Gyro sensor, which is used to provide short-term Heading data in situations where GPS signal reception is subject to transient interference and/or blockage. The GNSS also measures the boat's pitch (or roll, depending on which way the unit is mounted), and the data is available for use by other equipment on board.

The GNSS NMEA0183 model is connected to the P4 Autopilot at one of the SPU's two NMEA Input ports. The standard cable lengths are 15 metres (50') or 30 metres (100'); custom lengths are also available.

The GNSS NMEA2000 model is connected to the NMEA2000 network via a 6m NMEA2000 cable.

## Navigator G2 GPS Compasses Display

**PN 20130003** (monochrome) or **20130004** (colour)

**PN 10130056** (system with G2 and 15 or 30 m cable, monochrome)

**PN 10130051** or **10130053** (system with G2 and 15 or 30 m cable, colour)

The ComNav Navigator G2 GPS Compass Display is an optional control and status display unit for the NMEA0183 model of G2 and/or G2B GNSS Compass.

The Navigator G2 option consists of a Display Head seen in [Figure 7](#), that is identical in shape, size and overall appearance to the P4's Control Head, and a Distribution Unit that provides a convenient way to connect the GNSS G2/G2B compass (NMEA0183 model) to the P4 and to power. The Display Head is available with a monochrome or colour LCD display; it uses the same mounting methods and cover, as the ComNav P4 Control Head.

The Display Head provides graphical and textual information about the boat's position, heading, speed and turn rate. The Head also can display several menus, which are used to control the configuration and operation of the G2/G2B. Up to two Heads can be used at once.



**Figure 7 – Navigator G2 Display Head**

The Distribution Unit (**Figure 8**) connects the Display Head(s) to a GNSS G2/G2B, and has a convenient set of terminal strips for connecting power, the signals to and from it, as well as the signals to the P4's SPU. It also has a connector for the cable to a PC's COM port.



**Figure 8** – Navigator G2 Distribution Unit

## Fluxgate Compass

**PN 20320008**

Specifically designed for ComNav autopilots, the ComNav Fluxgate Compass directly senses the Earth's magnetic field. The unit incorporates a heeling coil for better performance when the vessel is either rolling or heeled. The Fluxgate Compass is a sealed, waterproof unit which may be mounted on a deck, shelf, or bulkhead. This compass outputs the traditional analog Sine and Cosine compass signals. It is supplied with a 12 metre (40') cable with flying leads to wire it into the P4's SPU.



**Figure 9** – Fluxgate Compass

## Magnetic Compass Sensor

**PN 20320002**

The ComNav Magnetic Compass Sensor (**Figure 10**) detects the position of the compass card of an externally gimballed magnetic compass. The sealed unit can be attached to the bottom of any of ComNav's Magnetic Compasses, or the bottom or top of many other brands of externally gimballed magnetic compasses. It is wired directly to the SPU, with the attached 25' cable.



**Figure 10** – Magnetic Compass Sensor

## Magnetic Compasses

ComNav offers several high quality externally gimballed Magnetic Compasses, of either 5" or 6" diameter, which are directly compatible with the ComNav Magnetic Compass Sensor. These compasses are available in either bracket mount or binnacle mount (**Figure 11**). Compensating spheres and arms are also available. Consult your ComNav Dealer for more information.



**Figure 11** – Externally Gimballed Magnetic Compass with Binnacle

## Other Compasses

For the very best performance of the P4 Advanced Autopilot system, ComNav recommends the use of their own branded compasses— but you certainly may decide to use either a fluxgate compass or a magnetic compass from another manufacturer. See your ComNav Dealer or consult the factory for information on interfacing these compasses with the P4 system.

## Rudder Followers

### Standard Rotary Rudder Follower and Rudder Linkage

**PN 20330008 and 20330007**

The ComNav P4 is normally supplied with a ComNav Medium Duty Rotary Rudder Follower.

The Rudder Follower is used to transmit the position of the vessel's rudder to the SPU. It should be connected to the part of the steering system that the autopilot controls. Normally, it would be the vessel's rudder. However, if the vessel has two-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.

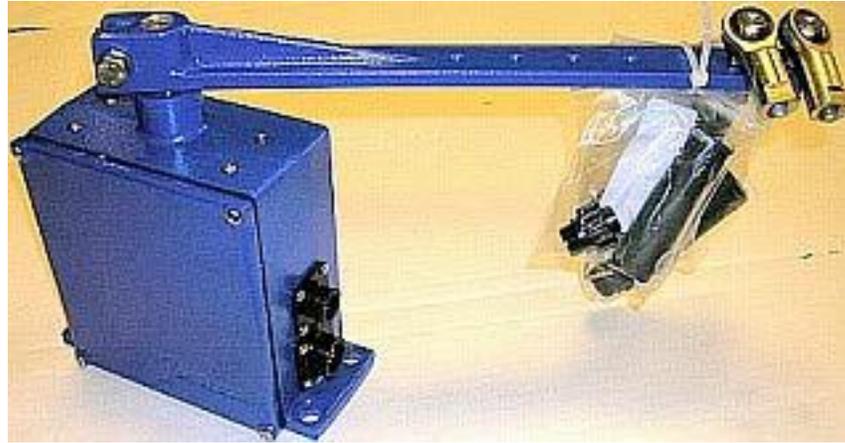


**Figure 12 – Rotary Rudder Follower**

### Heavy Duty Rotary Rudder Follower

**PN 20330012**

A Heavy Duty Rotary Rudder Follower is available for special applications. Check with your ComNav Dealer to determine whether this product is suitable for your application. Separate installation instructions are provided with this Rudder Follower.



**Figure 13** – Heavy Duty Rotary Rudder Follower

## Other Controls, Indicators and Sensors

### Jog Levers

**PN 20310002 (1 set of switches)**

**PN 20310003 (2 sets of switches)**

ComNav's Non-Follow-Up (NFU) Jog Lever is a permanently mounted, watertight, electrical switch specifically designed for marine use. The spring-centered lever is moved port or starboard as desired to provide non-follow-up (time dependent) electrical control of the vessel's steering system.



**Figure 14** – Jog Lever

### Rudder Angle Indicator (RAI) – 3"

**PN 20360023**

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

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



**Figure 15** – External Rudder Angle Indicator - 3" Model



## Other Drive Boxes

The P4 system is capable of directly operating steering systems utilizing reversing DC motors or single speed solenoids.

ComNav also manufactures a complete line of Drive Boxes that will interface the steering outputs from the P4 system to almost any type of steering system.

Contact your ComNav Dealer for information and specific part numbers.



**Figure 17** – Drive Boxes to meet all needs

### Pumps and Drives

ComNav offers several types of electric-motor Hydraulic Pumps, matching Solenoid Values and related equipment, as well as a number of high-quality Cable Drives and accessories.

Each drive comes with its own Installation Manual.

Please contact your ComNav Dealer for information and details.



**Figure 18 – Hydraulic Pump and Solenoid Valve**



**Figure 19 – Cable Drives**



**Figure 20 - Continuous Running Electric Pump**

### Other Equipment

Besides the optional equipment described above, there is a wide choice of other equipment available for use with the P4 Advanced Autopilot system.

Contact your ComNav Dealer for information and details.



# Installation

## Installation

This chapter describes all the steps you must follow to physically install a P-Series Autopilot System into your vessel. Each of the standard components of the system are described, both physical mounting and electrical wiring, and then some final checks are provided. Commonly-used accessories are also described. Many components come with their own specific instructions, which also require close attention.

## Basic Requirements

Please refer to the Warranty Information section of this manual before proceeding with installation.

### **Hazard warning!**

**Caution!** *Extreme caution is necessary whenever using tools powered by alternating current (AC), and/or from main AC supply circuits, regardless of whether the supply circuits are indoor, outdoor, ground-fault protected, marine or industrially rated. Water, especially sea water, is an excellent conductor of electricity, and can complete a path to ground through a person's body, causing injury or death, if a tool or component malfunctions or short-circuits.*

### **Battery powered tools are STRONGLY recommended!**

*If 120v AC tools are to be used, they must be plugged into a circuit that is adequately protected against ground faults and safety hazards, in accordance with local electrical codes.*

## Steering System

To obtain the best performance from your autopilot system, your boat's steering system must be in good working order. The hydraulic system should be bled, and should operate with minimal play.

When installing a Reversing Motor Pump, a Constant Running Pump, or an Engine Driven Pump, it is recommended that you install shutoff valves on all hydraulic lines between the pump and the steering system.

## Power Supply

For reliable operation of your Autopilot, your boat's power supply system must have an DC (direct current) power supply, with an adequate breaker and/or fuse, at a nominal voltage of either 12 or 24 volts. If the circuits are fused, a power switch should also be installed. Ensure that adequate wire sizes are used to handle the expected maximum currents.

## Special Tools

A slot screwdriver with a tip size of ~2.5 mm (0.1") is required, for tightening the small screws of the wire clamps in the plugs which mate with the SPU's pin-receptacle connectors.

## Fasteners

In general, fasteners are not supplied with the system – since different surfaces need various types of fasteners. However, no matter which types are best suited to your vessel, ComNav strongly recommends that you use stainless steel and/or non-corroding hardware to secure all equipment in the system.

## Control Head

The P4 Control Head is typically mounted in the vessel's wheelhouse. It can also be mounted in more exposed locations, such as on a flying bridge, since it is fully splash-proof (however be advised that the P4 Control Head is not submersible).

When ordered as part of a P-Series System, each Control Head is supplied with a flush mounting kit, including a bracket for flush mounting. The flush-mount is meant to be used when the Control Head is installed inside the boat. If using the optional Deck Mount or commonly known "Trunnion Mount" bracket kit; the unit is generally mounted on the console or in an overhead bulkhead location.

Complete instructions, including drilling and cutting templates for each type of mounting, are included with each kit.

## Electrical Connection

Route the Control Head cable to where the SPU will be located. Avoid running the cable parallel to antenna cables, AC power, or DC wires/cables carrying heavy current to minimize interference. Excess cable can be coiled up, or the cable can be trimmed to a suitable length.

See the **Control Head** section for details on connecting the cable to the SPU.

## Signal Processor Unit

The SPU should be mounted in a clean and dry location inside the vessel, and away from heat, moisture, and liquids of any kind. It should be somewhere central: ideally between the Control Head, the main electrical panel, and the rudder drive system. It need not be visible during normal operation, but it should be located so that there is easy access to it during wiring and maintenance operations. Typical locations are next to the electrical panel, at (under or above) the Navigation station, or in a dry storage locker in or around the wheelhouse.

The SPU should also be mounted far enough away from your boat's magnetic compass or compasses, so as to minimize any electrical/magnetic interference. A good rule-of-thumb is at least 1 metre (3') away, but see the **Compass Safe Distances** section for specific values, if you do not have that much space.

The SPU can be mounted vertically on a bulkhead, or horizontally on a deck or shelf.

- If mounted vertically, the SPU should be positioned so that all wires and cables will exit from the top of the unit running left and/or right as appropriate, from the SPU connectors, secured with terminal strip or tie wraps (customer supplied).
- If mounted horizontally, all wires and cables should have a drip loop formed in them.

Each SPU is shipped with a package of four (4) mounting feet and an instruction sheet that includes dimensions for drilling holes to fasten the feet to the boat.

See the **Wiring the System** section for SPU wiring details.

## Compasses

ComNav P4 autopilot systems are typically supplied as a complete System Kit, with one of several types of available compasses; the compass type chosen typically depends on the type and intended use of the boat.

- a Fluxgate Compass
- a Magnetic Compass Sensor (for use with the traditional type of externally-gimballed magnetic compass, such as the ComNav 5" and 6" Binnacle Compasses)
- a Tri-Axis Rate Gyro Compass-SSRC1
- a GNSS G2 (or G2B) GPS Compass or other NMEA compass

Refer to the appropriate section below for specific installation instructions for your Fluxgate or Magnetic Compass.

*NOTE: if you have a Rate Gyro compass, a G2/G2B or other NMEA compass, please also refer to the Installation and Operation Manual that came with it.*

### Compass Deviation

When first installed, some Fluxgate and Magnetic Compasses will exhibit deviation effects. Magnetic Deviation is an error between the compass reading and the boat's actual Magnetic heading. Deviation is a result of magnetic fields induced in the boat's hull (especially on steel boats) as well as by other various factors. It can also be caused by electromagnetic fields from objects such as engines, davits, galley equipment and the like, from the boat's electrical/electronic systems and wiring, or even from ordinary electronic items such as PCs, cell phones, CD/MP3 players and AM/FM radios.

If you have a ComNav Fluxgate Compass, the P4 can electronically compensate for the Hard-Iron portion of the Deviation. The compensation procedure is done during the Sea Trials.

If you have a magnetic compass, it will have to be manually compensated for deviation. A person who specializes in professional compass adjustment can (and should) do this job.

If you have a Tri-Axis (SSRC1) Rate Gyro Compass, you can calibrate the compass during the Sea Trials.

If you are using a fluxgate compass other than a ComNav Fluxgate Compass, or a magnetic compass not supplied by ComNav, you should contact the dealer or manufacturer you purchased it from, for instructions on how to install it, set it up, and compensate it.

*NOTE: The ComNav and the G2 and G2B GPS Compasses, are not affected by deviation. Soft-Iron effects must be dealt with by installing the compass far enough away from sources of deviation.*

**Caution!** *Do not permanently install any compasses until Sea Trials are complete. You may have to relocate the compasses, during the trials.*

### Common Installation Considerations

Avoid running the cable(s) from any Fluxgate Compass or Magnetic Sensor, parallel to antenna cables, AC power, or DC wires/cables carrying heavy current.

Any excess cable or cables should be individually coiled up, in a suitable location near the destination. ComNav recommends that compass sensor cables NOT be shortened (unless specifically stated otherwise, in the next sections).

## Electrical Connections

Route the Compass Transducer cable from the compass to the location where the SPU will be. Avoid running the cable parallel to antenna cables, AC power, or DC wires/cables carrying heavy current.

Excess cable should be coiled up. The cable may be shortened if desired to avoid excess coils. If the cable is too short, additional cable may be ordered from your ComNav Dealer.

See the **Compasses** section for further details on connecting the cable to the SPU.

## Magnetic Compass and Sensor

The ComNav Magnetic Sensor can be mounted to ComNav's standard Magnetic Compasses, and also to a wide variety of other brands of externally gimballed 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 and the vessel's vertical magnetic fields (due to its inertia), it is recommended for use only at latitudes higher than 50° (North or South), and for use only on steel vessels when optional quadrantal spheres are included.

Locate and mount the compass in a position that minimizes magnetic interference. The compass should be at least 1 metre (about 3') away from such equipment as radios, radars, depth sounders, and engine instruments.

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

**Caution!** *It is important to remember that the compass is a vital part of the autopilot system. Locating it properly, particularly on steel-hulled vessels, is essential to ensure proper operation of the autopilot. ComNav strongly recommends 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 ferrous masses such as an engine block or winches, the use of a pair of compensating quadrantal spheres is recommended.

**Note:** *the ComNav Magnetic Sensor should not be attached to an internally gimballed compass (that is, where the compass card is gimballed and the bowl of the compass is not), as this will result in large errors between the compass and the autopilot. This is because the compass card does not remain parallel to the sensor when the vessel rolls or pitches.*

## Mounting

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

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

It is also possible to mount the sensor above the compass. This reduces the possibility of interference from the compensating magnets, but also reduces the visibility of the compass.

Optimum positioning of the sensor can only be accomplished once the Autopilot system has been installed and powered up.

See the **Getting Started** chapter of the manual to perform this procedure.

## Electrical Connections

Route the Magnetic Compass Sensor cable from the Compass to the location where the SPU will be. Avoid running the cable parallel to antenna cables, AC power, or DC wires/cables carrying heavy current.

Ensure that there is sufficient slack in the cable to allow the compass bowl to tilt and rotate freely in all directions.

Excess cable should be coiled up (ComNav recommends that the cable NOT be shortened). If the cable is too short, plug-in Compass Extension Cables are available in various lengths from your ComNav Dealer. Cutting and splicing the Magnetic Sensor cable is NOT recommended.

See the **Compasses** section for further details on connecting the cable to the SPU.

## 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 a two-stage steering system where the Autopilot drives a control or servo ram, the Rudder Follower should be mounted to the servo ram rather than to the rudder.

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

**Note:** *If you are connecting the P4 to a mechanical Cable Drive (for vessels that use cable steering instead of hydraulic steering), the rudder follower is built into the Cable Drive. See the Cable Drive Installation Manual for details.*

## Rotary Rudder Follower

### Mounting

Install 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 21](#)).

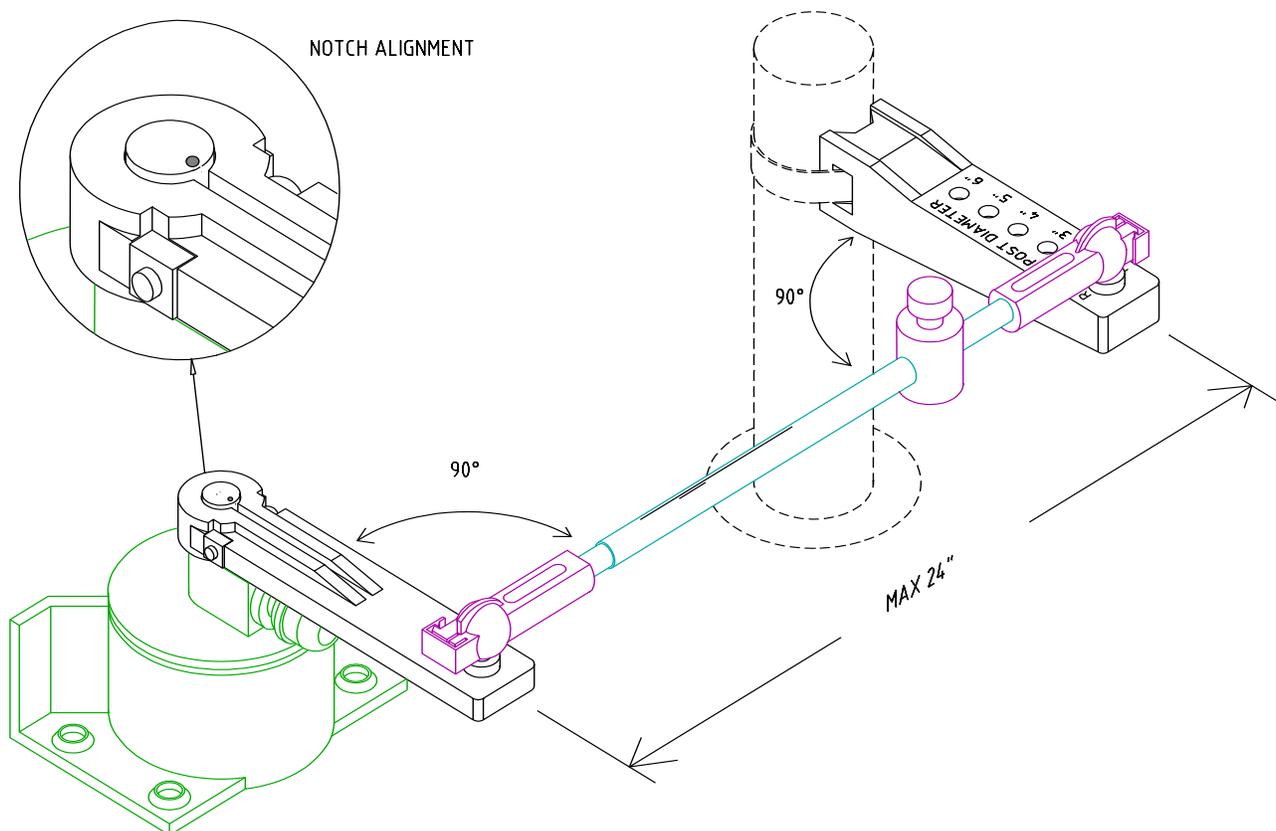
The distance between the centerline of the Rudder Post and the Rudder Follower must not exceed 24 inches. Make sure that the ball joints on the Rudder Arm and Rudder Follower arm are facing upwards as shown.

Snap the rod assembly onto the ball joints. Be sure to close the release clamps on each socket, and then adjust the length of the rod to get the correct geometry with the rudder dead-ahead.

If the locking screw in the Rudder Follower arm has been loosened, or the arm removed from the Rudder Follower, re-attach the arm and check the potentiometer center position.

When the rudder is dead-ahead, the electrical resistance between the wires of the black and green wire pair, and the wires of the white and green wire pair, 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.



**Figure 21** – Rudder Follower Linkage Geometry

## Electrical Connections

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

If the length of cable supplied is too short to reach all the way to the SPU, obtain a terminal strip and sufficient additional cable from your ComNav Dealer. Mount the terminal strip in a convenient and dry location where it will not be subjected to moisture of any kind.

See the **Rudder Follower** section for further details on connecting the cable to the SPU.

## Heavy Duty Rotary Rudder Follower

The ComNav Heavy Duty Rotary Rudder Follower is also compatible with the P4 Advanced Autopilot System. If you have purchased one of these devices, follow the installation instructions supplied with the unit.

See the **Rudder Follower** section for further details on connecting the cable to the SPU.

## Other Equipment

You should install the remaining components of your P4 system according to the installation instructions that come with that equipment:

- Auxiliary Controllers-CR203/TS203
- TS4, NF4 or WS4
- Jog Levers
- Rudder Angle Indicators
- CT7 Thruster Interface or a Drive Box
- Pumps and Drives, etc.

Electrical wiring instructions for all these is a combination of the information in the individual equipment's manual, and specific information for the P4 which is given in the following sections of this chapter.

## Signal Processor Unit

### Mounting

The SPU should be mounted in a clean and dry area, away from heat, moisture, and liquids of any kind. The SPU should be centrally located, and mounted far enough away from your vessel's compasses so as to minimize any possible electrical interference; a good rule-of-thumb is at least 1 metre (about 3'), but see the

**Compass Safe Distances** section for specific values, if you do not have that much space.

The SPU can be mounted vertically on a bulkhead or horizontally on a deck or shelf.

- If mounted vertically, it should be positioned so that all wires and cables will exit from the bottom of the SPU (after running sideways, left and/or right as appropriate, from the SPU connectors under the SPU's wiring cover).
- If mounted horizontally, all wires and cables should have a drip-loop formed in them.

Each SPU is shipped from the factory with a package of four (4) mounting feet and a separate instruction sheet that includes dimensions for drilling holes to fasten the feet to the vessel.

### Wiring the SPU – General Information

Due to the relatively high current requirements of an autopilot compared to many other types of electronic equipment, Using the correct size of wire to connect the various components is very important. Undersized wiring will result in power losses which can affect overall efficiency and performance. Refer to the table below. If in doubt, contact your ComNav Dealer for help.

Once the SPU is securely mounted, you can begin wiring the various components of the system, one at a time.

Function / Use	Type / Gauge
SPU Power Supply	2 X 12 AWG
Steering Drive: 12/24 VDC Solenoid Valve	3 X 18 AWG
Steering Drive: Reversing Motor	2 X 14 AWG <i>(refer to the instructions supplied with the Drive Motor)</i>
Rudder Follower	3 X 18 AWG Shielded cable
GPS, Chart-plotter, Navigation Computer	2 X 24 AWG Shielded cable
Rudder Angle Indicator	2 X 24 AWG

**Table 1 – Minimum Recommended Wire Gauges**

### Connectors on the SPU

Each connector is a pin receptacle, with the pins sized according to how much current will be carried (bigger pins for higher current). Each pin has a signal name, rather than a number, to make it easier to match wires with pins (see connector label, below).

Each pin receptacle mates with a matching plug, which in turn has screw-clamp terminals, into which the wires from the external equipment and devices (battery, drive system, compasses, etc.) are inserted. The plugs allow quick installation and removal of system wiring, yet are fully secure, once the various cables are strain-relieved and the wiring cover is re-installed.

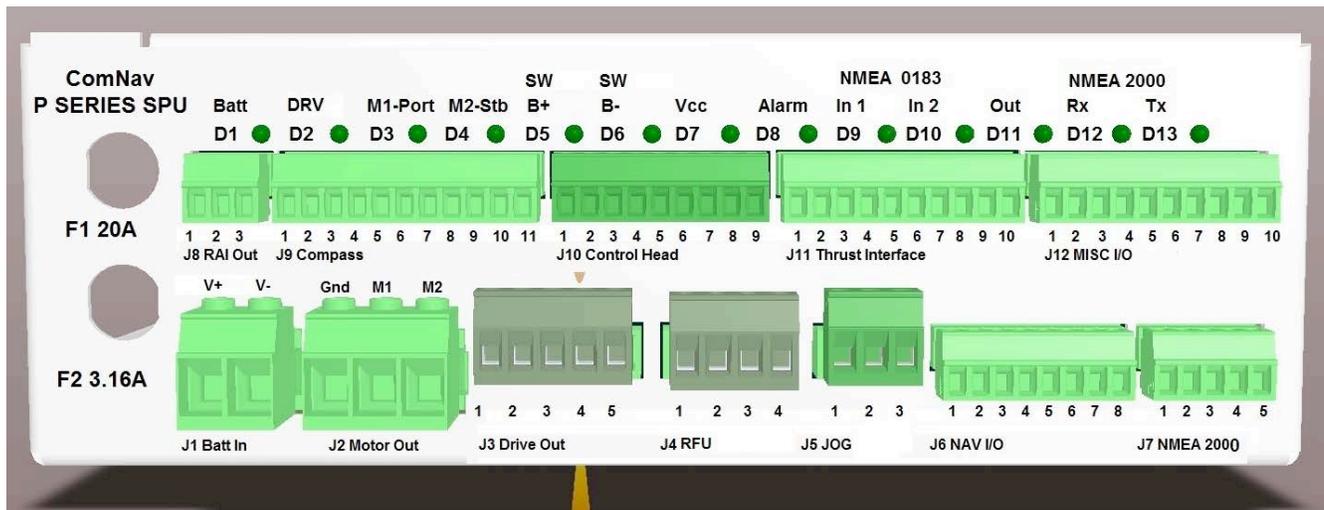
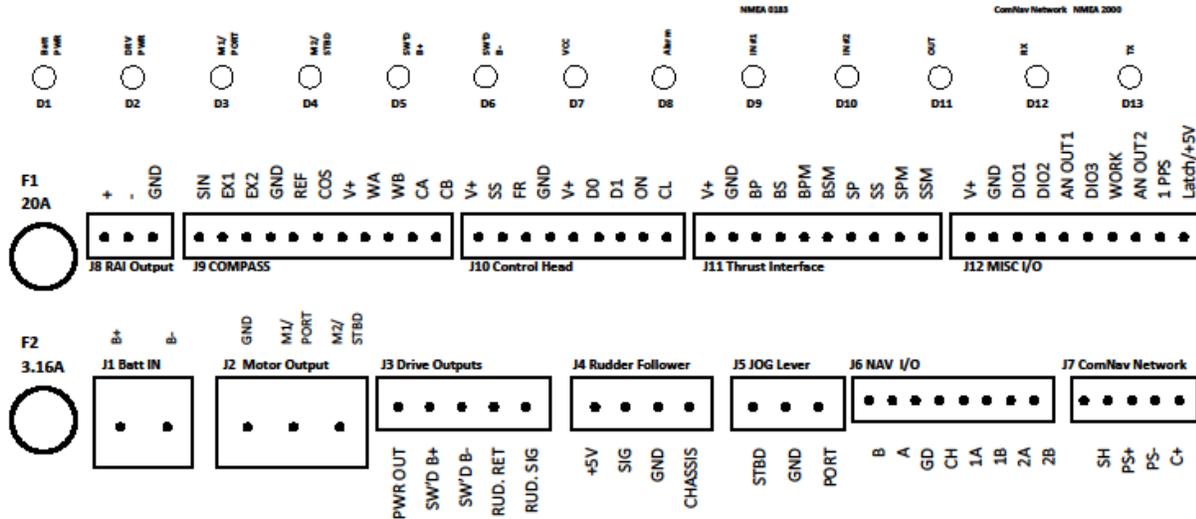
The SPU is shipped with all the plugs required, pre-installed on the matching receptacles.

ComNav P4 Installation and Operation

Note that the plug screws must be turned counter-clockwise several turns (using a small slotted screwdriver), to open up the plug's wire clamp, before a wire is inserted into that clamp; the screw must then be turned clockwise until the wire is tightly held in the clamp.

All connectors and pins are labelled, as shown in **Figure 22**.

# ComNav<sup>®</sup> P SERIES SPU



**Figure 22** – SPU Connector Wiring Signal names & Label

## Wiring the System

### Auxiliary

#### Power Supply

The ComNav P4 will operate on any voltage of 12 VDC and 30 VDC. This allows operation with vessel battery systems of nominal voltages from 12 to 24 VDC.

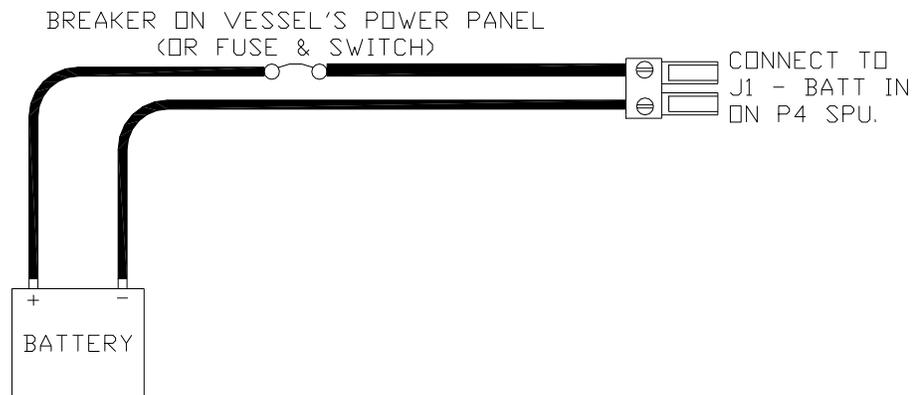
**Caution!** *Do not power up the SPU until you have completed the installation, and performed the steps outlined in “Post-Installation Checks.”*

Generally, wiring for the positive leg of a DC system will be red or white, while wiring for the negative leg (usually referred to as Ground) will be black.

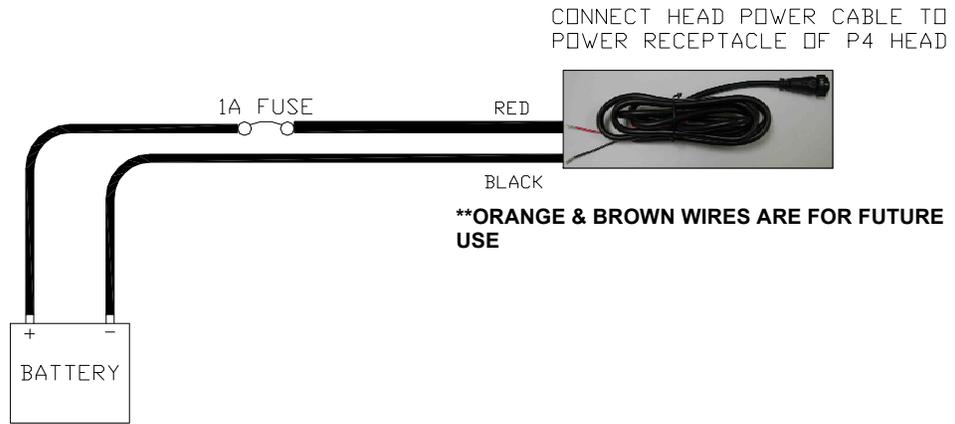
Power to supply the autopilot should be taken directly from a breaker or distribution panel. The autopilot should be wired into its own individual breaker or fuse. For the P4 SPU, using appropriately sized wire or cable (see [Table 1](#)), wire the battery connections to the connector plug and receptacle labelled **J1 - BATTERY INPUT OF THE SPU**. For the P4 Control Head, connect the Head Power Cable to the 4 pin receptacle on the back of the Head. Double-check the wiring polarity before inserting the plug into the receptacle.

**Caution!** *The P4 SPU & the P4 Head are NOT reverse-polarity protected. If you wire the wrong voltage polarity at J1, you will damage the SPU and Control Head! This will void the warranty.*

Refer to the following diagram of a typical power supply circuit:

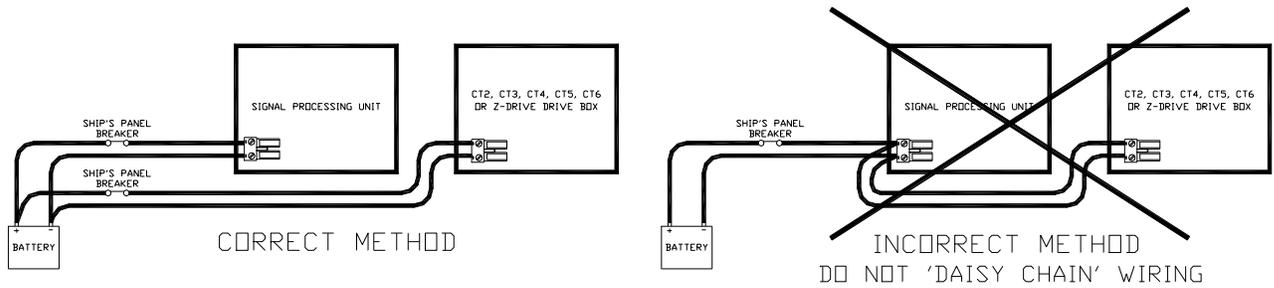


**Figure 23** – Typical Battery Connection to SPU



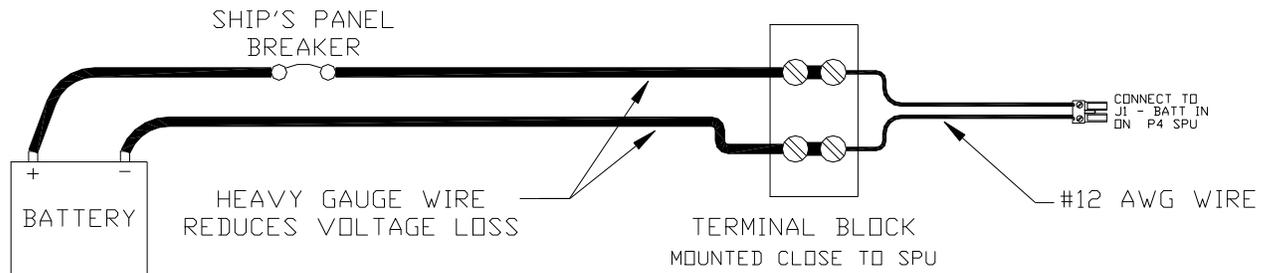
**Figure 24** – Typical Battery Connection to Head

**Note:** If your autopilot system utilizes one of ComNav’s CT Drive Boxes, it should be wired back to the breaker or fuse separately from the rest of the autopilot system. Do not “daisy-chain” the power wires.



**Figure 25 – Typical Battery Connection to Drive Boxes**

If the SPU is mounted a long distance from the ship’s breaker panel, it is recommended that heavy gauge wire be routed between the breaker panel and a terminal block mounted in close proximity to the SPU. #12 AWG wire can then be used between the terminal block and the SPU. This minimizes any voltage drop between the breaker panel and the SPU.



**Figure 26 – Reducing Supply Voltage Losses**

## Input and Output Connections

**NOTE:** An analog or NMEA0183 connection to the SPU requires the wiring diagram in [Figure 27](#) below to be followed. All N2K Network connections from the P4 Control Head, P4 SPU, P4 Remote & N2K devices are done through a standard Female or Male end N2K drop Cable to the N2K network.

### P4 SPU to N2K Network

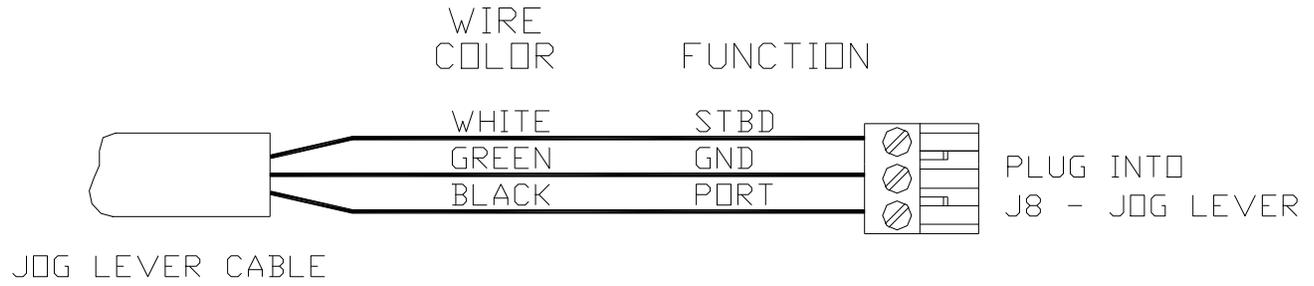
ComNav Network is an NMEA 2000 port. A 1m Pigtail (flying end) and Male End Cable is provided to connect the SPU to NMEA 200 network through J7. [Figure 27](#) shows the color code and pin outs.



**Figure 27 - Wiring Connections for SPU to N2K network**

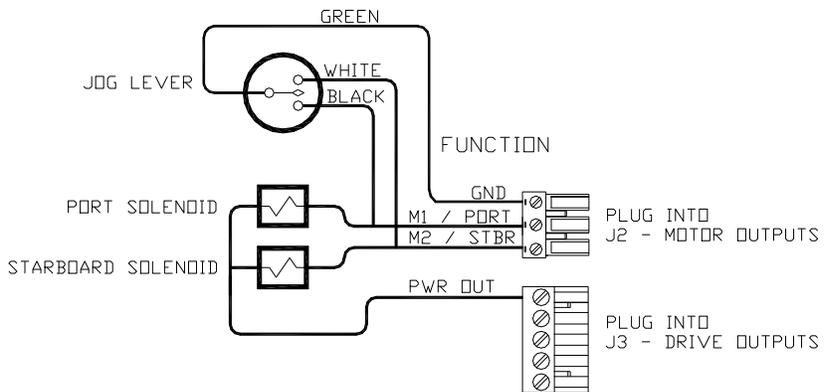
### Jog Levers

Any number of Non-Follow-Up (NFU) Jog Levers can be connected to the P4 SPU. They are simply wired in parallel to each other. Connect them to the terminal labelled **J5 - JOG LEVER** as per the following diagram in [Figure 28](#):



**Figure 28 – Wiring Connections for Jog Levers**

In order to use the Jog Levers connected in the above manner, the autopilot must be turned on. The autopilot will then move the rudder either port or starboard for as long as the Jog Lever is held activated. However, the autopilot will stop the rudder when it gets to the (user-adjustable) rudder limits programmed into the autopilot. This reduces stress on the steering system.



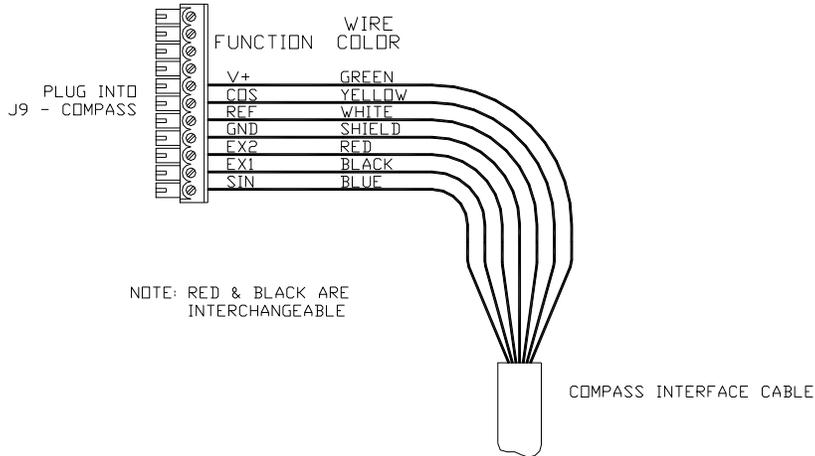
**Figure 29 – Wiring Connections for Four-Way Valves with Jog Levers**

### Compasses

All compasses, other than NMEA 0183 compasses, are connected to the SPU receptacle labelled **J9 – COMPASS** (see the **Compass** section for how to connect NMEA compasses).

If you ordered your P4 system with a ComNav Fluxgate Compass, the cable wires connect to the **J9** receptacle, as per the diagram in **Figure 30**.

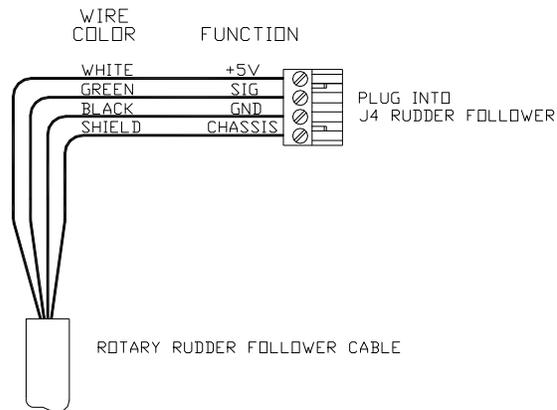
If you ordered your system with the Magnetic Sensor, and mounted it on the bottom of your magnetic compass, you will also need to wire the flying-lead end of the sensor cable as per the diagram in **Figure 30**. If you mounted the sensor on top of the compass, simply exchange the blue and yellow wires.



**Figure 30 – Wiring Connections for Analog Compasses**

### Rudder Follower

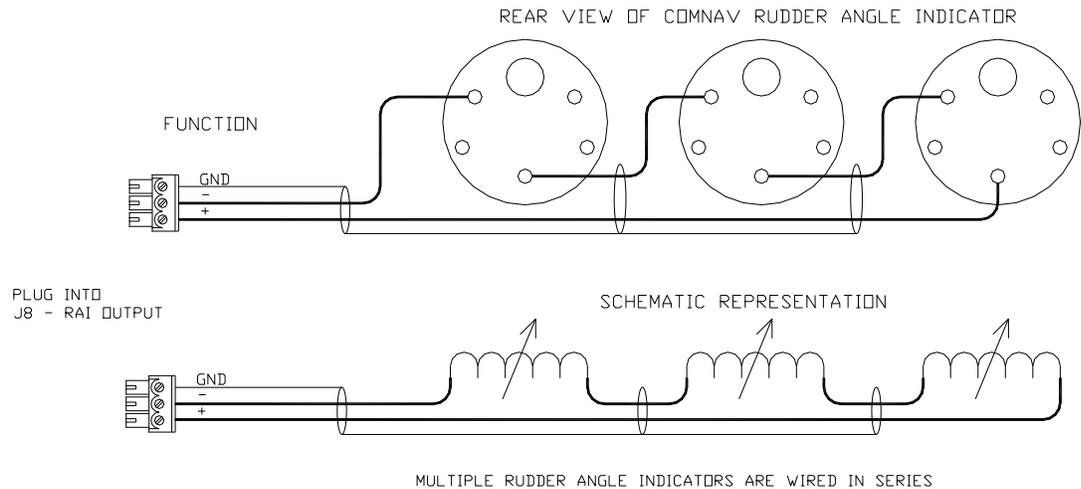
The Rudder Follower is connected to the four-position receptacle on the SPU labelled **J4 – RUDDER FOLLOWER**. Wire the Rudder Follower to the plug-in connector as per the following diagram in **Figure 31**.



**Figure 31 – Wiring Connections for Rudder Followers**

## Rudder Angle Indicators

The P4 system will drive up to five 500 microampere Rudder Angle Indicator (RAI) meters, such as those supplied by ComNav (PN 20360014). Mounting instructions are included with each meter. Wire the meter to the plug for the SPU receptacle labelled **J8 – RAI OUTPUT**. If you have more than one RAI meter, they should all be wired in series, as shown in [Figure 32](#):



**Figure 32 – Wiring Connections for Rudder Angle Indicators**

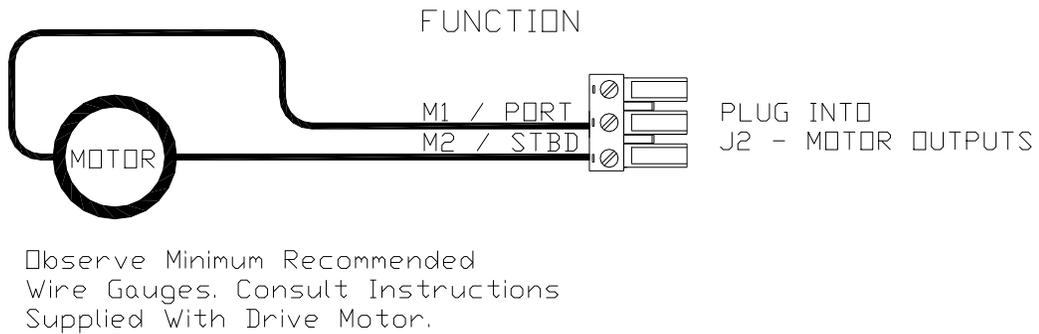
## Drive Outputs

The P4's SPU is capable of directly driving a variety of steering systems. Optional Drive Boxes are available for those systems not handled directly by the P4. Contact your ComNav Dealer for more information.

## Reversing Direct Current (DC) Motor Hydraulic Systems

The P4 SPU can directly handle reversing DC motor hydraulic pumps drawing up to approximately 20 amps. For larger current requirements, the ComNav CT2 Drive Box should be used. To connect the pump motor directly to the SPU, use the diagram in [Figure 33](#). Note that wire polarity is not important, since the P4 will automatically make the necessary adjustments internally when the system is set up.

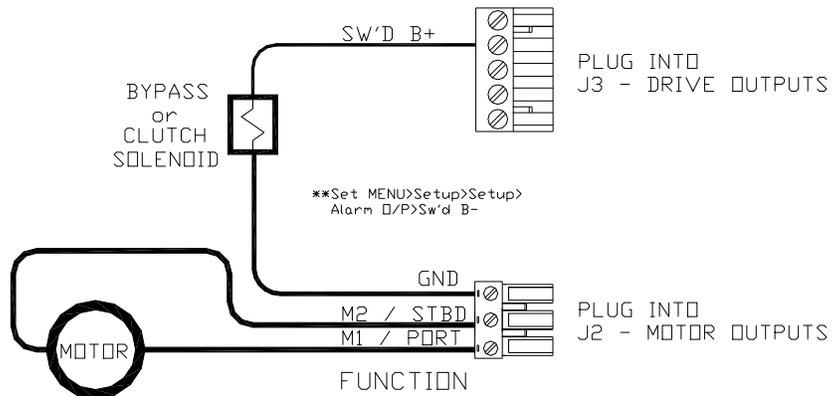
*Note: Two very important steps when installing any hydraulic system are to bleed it of any air trapped in the fluid, and to check for fluid leaks.*



**Figure 33 – Wiring Connections for Reversing DC Motors**

### Linear Actuators or Mechanical Rotary Drives

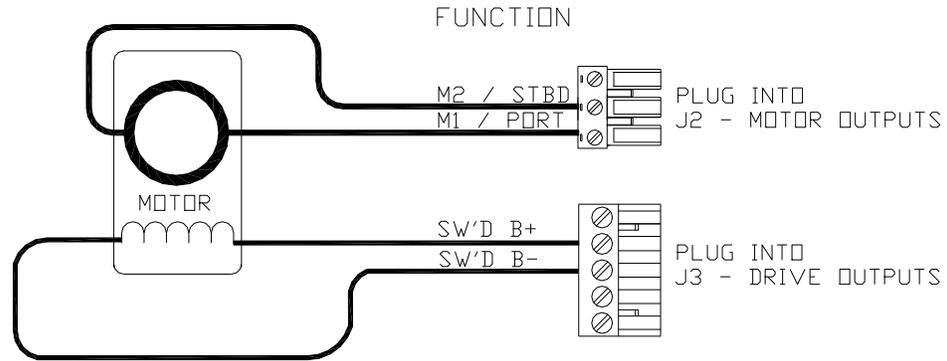
Some Linear Actuators incorporate a bypass valve. To operate properly, the bypass valve should be activated by the **SW'D B+** output on the SPU. Similarly, most mechanical drives incorporate a solenoid-activated clutch. The clutch solenoid should also be activated by the **SW'D B+** output. Refer to the following diagram in **Figure 34**:



**Figure 34 – Wiring Connections for Linear Actuators or Mechanical Rotary Drives**

### Shunt-Field Reversing Motors

For shunt-field reversing motors, connect the shunt field coil positive terminal to the **SW'D B+** output, and the coil negative terminal to **SW'D GND** as per the diagram in **Figure 35**:



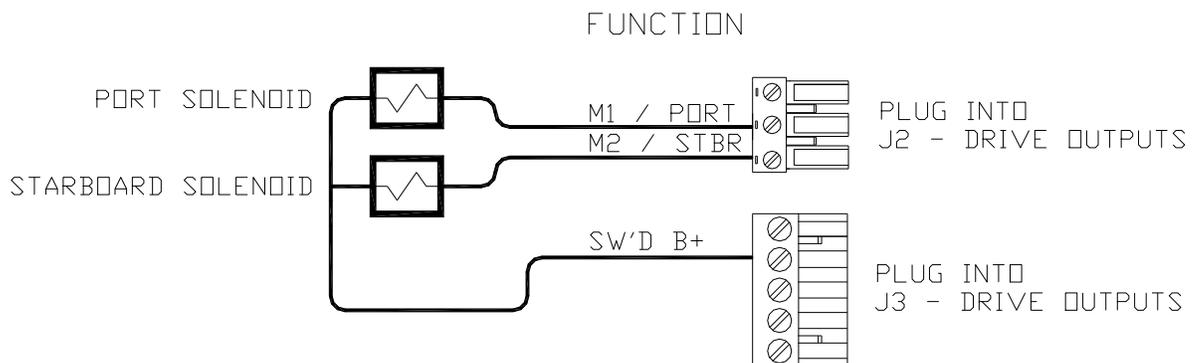
**Figure 35 – Wiring Connections for Shunt Field Reversing Motors**

### Standard Four-Way Solenoid-Activated Hydraulic Valves

Connection to 12 VDC or 24 VDC solenoids should be made as per the diagram in **Figure 36**.

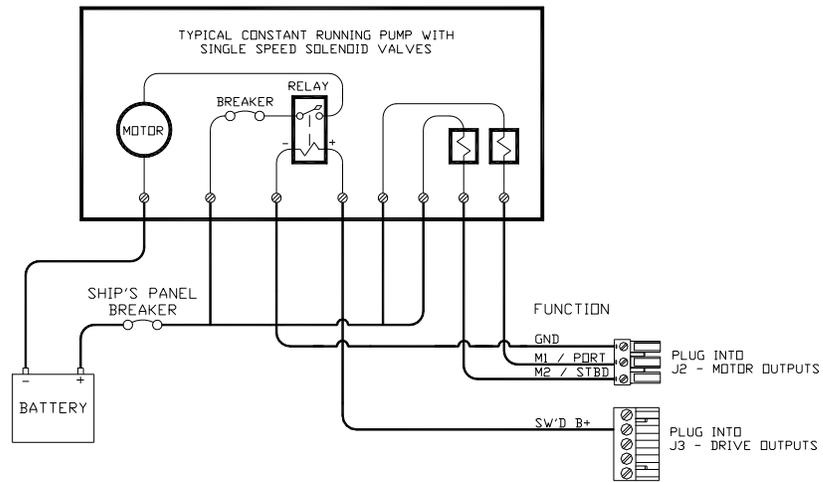
In this configuration, the autopilot supplies the positive voltage (**SW'D B+**) whenever the autopilot is in **POWER STEER, AUTO, or NAV** modes. **SW'D B+** is turned off in **STANDBY** mode, thus providing an extra measure of safety.

*A warning should be here : do not wire an external JOG Lever directly to M1 M2, otherwise you may damage the drive output circuits in the SPU and void the warranty on your P4 system, and/or the warranty of other equipment.*



**Figure 36 – Wiring Connections for Standard Four-Way Solenoid Valves**

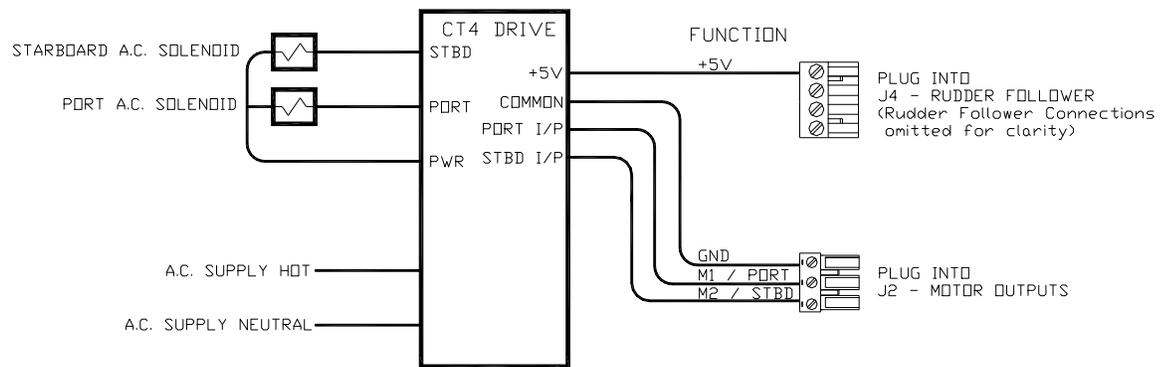
**NOTE:** The wiring of Jog levers directly to standard 4-way valves is possible. Refer to the diagram in [Figure 28](#) for the proper way to wire Jog Levers. The diagram in [Figure 36](#) above assumes that an engine driven pump is used for the hydraulic system. In the case of an electrically powered constant running pump, use the following connection, shown in [Figure 37](#):



**Figure 37 – Wiring Connections for a Constant Running Electric Pump**

### Alternating Current (AC) Solenoids

ComNav’s CT4 Drive Box (PN 20350003) should be used to interface between the P4 SPU and AC solenoid systems. Connect the CT4 to the SPU as per the instructions shipped with the CT4, and the diagram in [Figure 39](#):



**Figure 39 – Wiring Connections for AC solenoids**

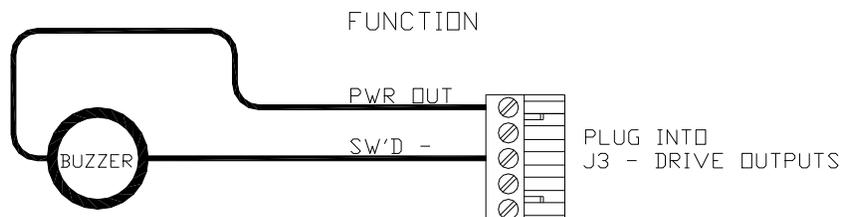
### Azimuth Drives, Surface Piercing Drives and Jet Drives

The ComNav CT7 Thruster Interface is used with Azimuth Drives, Surface Piercing Drives and Jet Drives requiring a 10 Volt +/- proportional analog command signal. See the CT7's Installation and Operation Manual for wiring instructions, in the Rudder Drives and Interfaces section referencing **Figure 16**.

### External Alarm Output

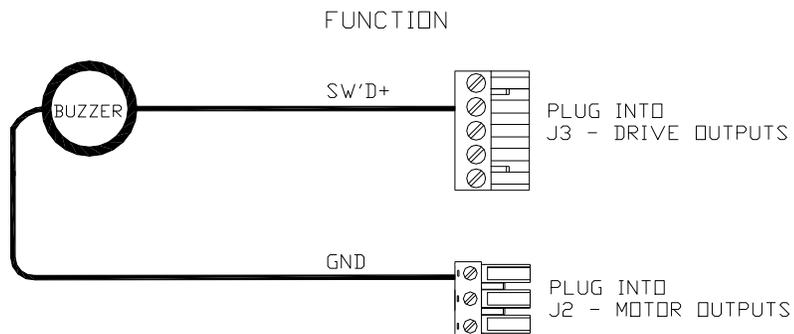
An external alarm can be connected to the P4 SPU. The autopilot can be configured to activate this alarm whenever an alert or error message appears on the Control Head. You can modify the configuration to activate the external alarm only if the Watch Alarm is not answered (as opposed to activating it for all alarms).

One of two outputs can be used for the external alarm. Typically, you would choose to connect the external alarm between Battery Positive (**PWR OUT**) and the Switched B- (**SW'D B-**) outputs on **J2**. See the diagrams in **Figure 40** and **Figure 41** for information on how to select these options.



**Figure 40 – External Alarm, using SW'D B- Output**

Alternatively, you may choose to use the **SW'D B+** and **GND** outputs as shown here:



**Figure 41** – External Alarm, using SW'D B+ Output

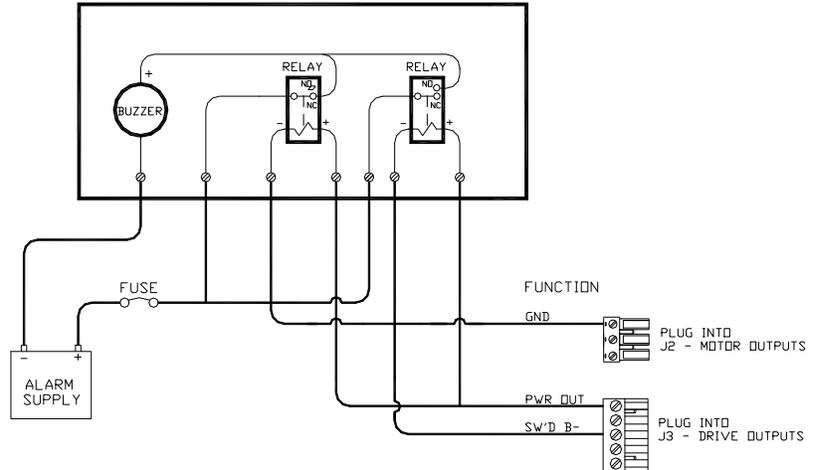
**Note:** when using the External Alarm configuration shown in **Figures 40 & 41**, there is a small current which will be flowing constantly between the pins, even when the alarm is off. This will not be a problem with many types of alarms; however, with certain types of sensitive Piezo-electric audible alarms, the leak current can cause a constant low-level tone from the Piezo device.

An Application Note is available which describes this potential problem in detail, with suggested remedies. The Note also lists a number of Piezo alarms which are known to work well with P4 systems.

Please ask your ComNav Dealer (or go to ComNav's web site) for Application Note 2007-01.

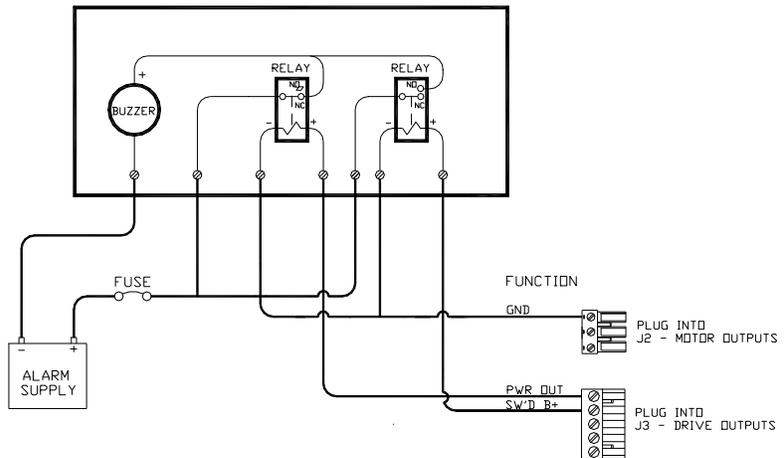
### Power Failures

Some installations require separate monitoring for power failures. This can be accomplished with the circuit in **Figure 42**, which utilizes two relays. The coil voltage of the relays should match the supply voltage for the autopilot. The power for the Alarm Supply, which must be a separate, dedicated supply from the autopilot supply, should match the voltage of the alarm.



**Figure 42 – External Alarm, SW'D B- Output – with Power Fail Option**

The alternative circuit, using Switched B+ (**SW'D B+**) as the alarm output:



**Figure 43 – External Alarm, SW'D B+ Output – with Power Fail Option**

## Speed Mode and Timing Outputs

The P4 SPU outputs two status signals on the **J12 – MISCELLANEOUS** connector. The receptacle is supplied with a 10-pin mating plug.

In addition, a 1 pulse per second (PPS) timing signal is output on **J12**. It is about 5% accurate, and is meant for general-purpose use. For example, some brands of Radar and other navigation equipment require a “1 PPS” timing signal for proper operation.

These two status signals indicate:

- If the system is operating with the Hi or Lo speed steering parameters in effect, in **AUTO** or **NAV** modes
- If the system is operating in **WORK** mode

The status signals are meant to be used to allow indication of those conditions on an external alarm or indicator. While both conditions are indicated on the Control Head’s LCD display, but it is also sometimes useful to have them alert with an external alarm or lamp at locations other than where the Control Head is located.

These two outputs can also be used to control automatic deployment (and retrieval) of external “stabilizer” equipment, to enhance the vessel’s steering and stability when it is moving at a slow speed, or when **WORK** mode is in effect. In both these situations, the boat is moving slowly, and so there is not as much steerageway (i.e., less water flowing over the rudder, so it does not generate as much sideways force).

All three outputs are logic-level, open-drain outputs direct from the SPU’s microcontroller, and must be used only within the following voltage/current limits:

- Each output requires its own external pull-up resistor, which **must** be wired **only** to the SPU’s logic power supply (5 VDC, created by a linear regulator on the SPU, and available at the V+ pin of **J12**), and to the external alarm, lamp and/or control circuit. The resistor value plus the impedance of the load must total **no less than 3K3 Ohms** (to limit the current into the pin in the “0 V” state to **less than 1.6 mA**).
- If needed, the SPU’s ground reference for these signals is on the GND pin of **J6**.

Signal	J12 Pin	When at 0 V	When Open-circuit
WORK MODE	WORK	Normal mode	WORK mode engaged
SPEED MODE	HI SPD	Lo Speed	Hi Speed
1PPS	1PPS	(1 pulse per second, ~50% duty cycle)	

**Table 2 – Speed Mode and Timing Outputs**

All outputs are ESD-protected – but you still must use them with care:

- Do not use more than about 0.5 m of cable to connect them to the external alarm/indicator or stabilizer-control circuit.
- If you must connect to something farther away than that, use a suitable buffer or isolator circuit – a transistor, a relay or (preferred) an opto-isolator block. With a relay, be sure to wire a flyback-suppressor diode across the coil.
- If shielded wire is used, connect the shield only at the SPU – to the GND pin of **J6**.

**Note:** *unused pins on J12 are reserved for possible future use.*

## Navigation Data

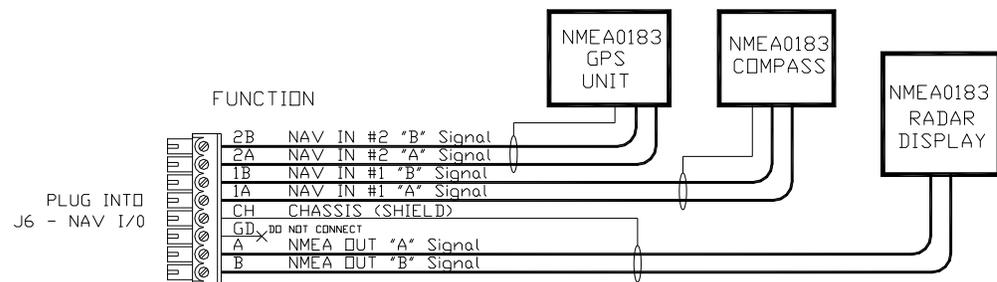
The P4 has the ability to accept Navigation Data and information formatted according to the NMEA 0183 standard (version 3.00) or N2K in network configuration.

Many marine electronics devices (such as digital compasses, GPS receivers, chart-plotters, and electronic charting systems, to name a few) have outputs complying with NMEA 0183.

Two such devices can be connected directly to the P4's SPU, by wiring them into the plug mated to the receptacle labelled **J6 – NAV I/O**.

The SPU also has an NMEA0183 output; it transmits the autopilot's real-time Heading Data and status information, for use by devices such as a radar display, a chart plotter or a navigation program on a PC.

Refer to [Appendix 1](#) for more information on the NMEA 0183 sentences accepted and sent by the system.



**Figure 44 – Typical NMEA 0183 Connections**

For proper operation, the connected device(s) must fully comply with NMEA 0183 Standard (version 3.00):

- RS-422 electrical levels
- Baud rate: 4800
- Serial data format: 8 data bits, no parity, 1 stop bit
- Correct NMEA sentence structure
- Checksums are optional, but must be valid if present

It may also be possible to use RS-232 electrical levels, in some cases, such as when using a PC.

**NOTE:** The **NAV2** port can optionally be run at 9600 Baud. To do so, you simply need to set the other device to transmit at that rate. The SPU automatically sets the rate for this port, by looking for "valid NMEA data" at all possible Baud rates.

## Signal Names

The names of the NMEA data signals, and of the paired wires carrying them (see [Table 3](#)), are specified in NMEA 0183: `A` and `B`. The SPU's wiring label uses those names, on the **J9- NAV I/O** connector (see [Figure 30](#)). However, sometimes other equipment will use different names:

NMEA Name	J6 Connector Label	Function	Alternative Names
`A` signal	<b>IN 1A or IN 2A OUT A</b>	Positive voltage with respect to `B` is a logical 0 (aka Active or Space or ON <sup>17</sup> )	<b>+ or NMEA + SIG or SIGNAL POS or +VE</b>
`B` signal	<b>IN 1B or IN 2B OUT B</b>	Positive voltage with respect to `A` is a logical 1 (aka Idle or Mark or OFF)	<b>- or NMEA - RTN or RETURN NEG or -VE</b>

**Table 3 – NMEA Signal Translation Guide**

## RS-422 Electrical Interface

The RS-422 electrical interface specified in the NMEA 0183 Standard uses a pair of balanced signals (also known as “differential signals”), in paired wires, with the `A` signal on one wire and the complementary `B` signal on the other.

It is necessary to maintain the correct signal polarity, when connecting one of the P4 SPU's RS-422 input or output wire pairs to another NMEA 0183 device:

- The P4 input port's `A` signal pin must be connected to the `A` output terminal of the other device; similarly, the P4's `B` input pin must be connected to the `B` output terminal of the other device.
- Similarly, the P4 output port's `A` and `B` signal pins must be connected to the `A` and `B` input terminals of the other device.

### Other points to be aware of:

- There is no ground wire for the P4's **NAV1 - IN** ports. Both ports are NMEA Listeners (as defined in the Standard), and so are optically isolated from the rest of the SPU circuitry; they need only the `A` and `B` signal pair to function properly.
- The P4's **NAV - OUT** port (an NMEA Talker) is not optically isolated from the rest of the SPU circuitry. However, since the other device will have an optically-isolated input (if it is a fully-compliant NMEA Listener), no ground wire for the **NAV - OUT** port is necessary.
- The **CH** pin on **J6** is connected directly to the SPU chassis, and is also AC-connected to the SPU's Signal Ground, via a 100 nF capacitor. If the cable carrying the NAV signal wires from/to the other NMEA device is shielded, the shield should be wired to the **CH** pin (the cable's shield must not be connected at the other end, or anywhere else but to the **J6 CH** pin).

*NOTE: An NMEA 0183 serial data stream is inverted by the transmitter, and inverted again by the receiver, and so a logical "1" in the data appears as a logical "0" on the A/B wire pair. The "ground reference" voltage for the output signals is available on the GD pin of J6 – but note that this is **not** the SPU's Signal Ground, rather it is a synthesized reference voltage, and so it must **not** be connected to **any** other ground.*

### Typical RS-422 Signals

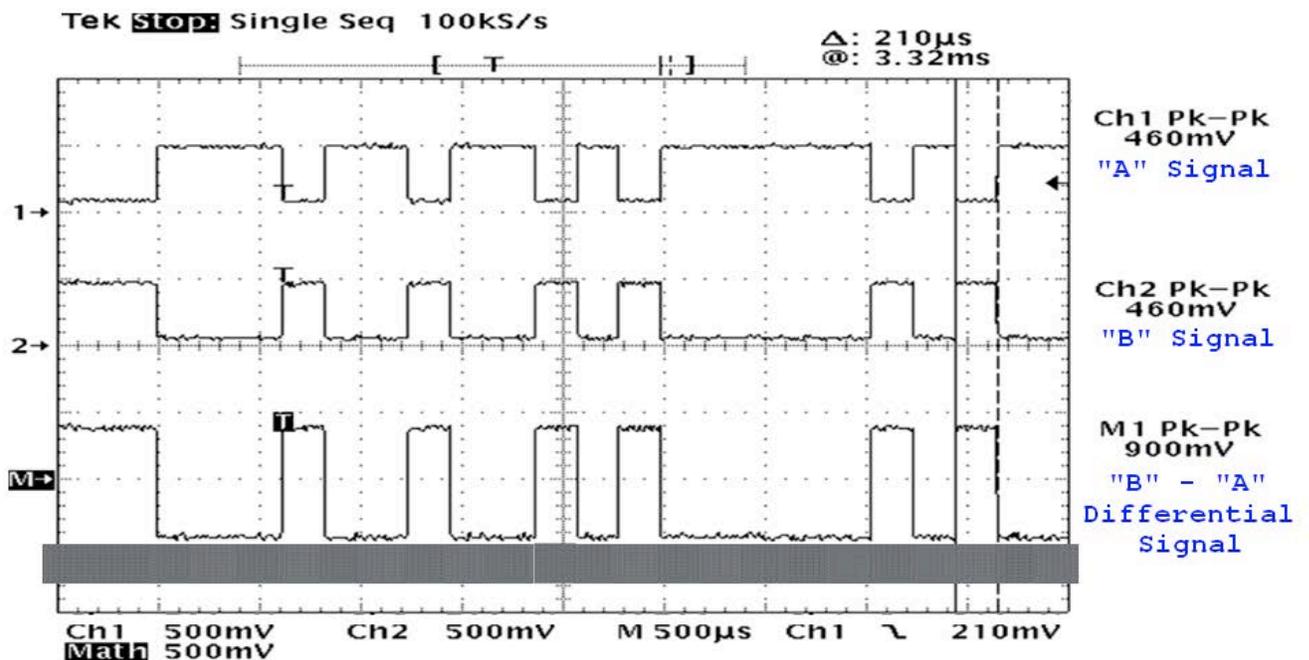
The only way to troubleshoot problems with the RS-422 NMEA signals to-and-from the P4 is with an oscilloscope, due to the fact that a multimeter is essentially useless for differential signals. **Figure 45** shows an example of a typical NMEA 0183 RS-422 transmission, captured on a dual-trace oscilloscope.

The data stream is from a P4 SPU's **NAV - OUT** port. Channel 1 is the RS-422 "A" signal, Channel 2 is the "B" signal, and the math trace is the differential voltage between "A" and "B." The oscilloscope probes were manually set at 10x, so the voltages of the signals are 10 times larger than measured below. The Ground Reference for the oscilloscope's inputs was the GD pin of the **J6 – NAV I/O** connector. The Baud Rate was 4800 (or ~208.3 msec per bit).

The data being sent is the first two characters at the start of the NMEA sentence: \$A (the full sentence might have been \$APHDM,346.5,M\*37 or something similar).

In hexadecimal, \$A is: 0x24, 0x41; in binary: 0b00100100, 0b01000001. Following the rules of NMEA 0183, that binary data was transmitted starting with the least significant bit of the first character, in 8-bit groups: 00100100, then 10000010 (as shown in the blue overlay in the figure below). The transmitter circuit demarked each group ("byte") by a leading '0' Start bit and a trailing '1' Stop bit. Finally, the train of bits was sent to the RS-422 differential driver output circuit, which put inverted bits on the 'A' signal line, and non-inverted bits on the 'B' line. Before transmission from the RS-422 driver started, the signals were in the Idle state: 'A' was at a low voltage with respect to 'B' (the same state as a '1' bit). After all the bits of the full sentence had been transmitted, the signals would have returned to the Idle state.

**Figure 45 - A typical NMEA 0183 RS-422 transmission**



## RS-232 Electrical Signals

It is common for non-marine equipment (especially PCs) to be able to transmit and receive NMEA-formatted data, but not using the RS-422 electrical interface specified in the NMEA Standard. Instead using another electrical interface, RS-232. A prime example is the “COM port” on a Personal Computers, which is always at RS-232 levels.

An RS-232 interface, in contrast to RS-422, does not use differential-signal wiring. Instead, a single wire is used for each of the main signals – Receive (usually labelled “Rx”) and Transmit (“Tx”) – and for the Signal Ground (“Gnd”). The voltage levels are also different than RS-422 (There are also several RS-232 status signals, but these are not used in the P4).

Such equipment (often described as being “NMEA compatible”) can usually be connected directly to the P4, although there is some risk of reduced electrical noise immunity. See the PC COM Ports section in [Appendix 1](#) for more details.

## LED Status Indicators

When the autopilot is turned on, the Status LED labelled **NMEA 0183 IN #1** in the SPU’s diagnostic section will be flashing whenever the autopilot is receiving data on **NAV1 - IN**. Similarly, the **NMEA 0183 #2** LED will be flashing whenever the autopilot is receiving data on **NAV2 - IN**.

Typically, an LED will flash at a rate of about once per second for regular data from a GPS or Chart-plotter. It will typically flash at a rate of about ten times per second when connected to a Heading source, such as the G2 GPS Compass.

If the LED for a given port is flashing, but you are seeing INVALID or NO DATA Navigation (Heading, Speed, Course, NAV) error messages for that port on the Control Head, and yet you are sure the other device is in fact sending valid data, try reversing the wires connected to **NAV1 – IN**, or **NAV2 – IN**. It is possible that the other device’s signal names are not NMEA’s ‘A’ and ‘B’ (see [Table 3](#)), and so might have been connected the wrong way round; reversing the wire pair at **J6** often solves this situation.

*NOTE: The LEDs only show that data is being received on the associated Nav1 (or Nav2) port. They do not mean that the data received is valid. If you are still seeing error messages, something else is wrong. Contact your ComNav Dealer for assistance.*

## Other Connections

### Thruster Interface

The **J11 – THRUSTER I’ FACE** connector is used with the CT7 Thruster Interface. The receptacle is not supplied with a mating plug, since the required plug is supplied with the CT7.

## Final Steps and Post-Installation Checks

Before using the P4 for the first time, please verify that the entire system and all its components are safely and securely mounted, and will not shake loose from the vibrations that can be expected in a marine vessel.

### Electrical Checks for SPU

Only after all these checks have been completed should you connect the power plug into the **JI BATTERY INPUT** receptacle on the SPU.

1. Check the power supply wiring (from the battery/breaker).
2. Verify that the polarity and voltage are correct (use an accurate voltmeter for this).
3. Check for correct wire size, tightness of all connections, fusing, and proper operation of the battery power breaker or switch.
4. Check the connections from the Compass(es) to the SPU.
5. Check the connections from the Rudder Follower Unit to the SPU.
6. Check that when the rudder is manually moved from full Starboard to full Port (and vice-versa), that the RFU moves completely freely, and is not being restricted in any way.
7. Check the connection(s) from the Control Head(s) to the SPU.
8. Check the connections to the drive equipment from the SPU.
9. Check that all cables are neatly routed and secured.
10. Ensure that extraneous materials (bits of insulation, wire pieces or strands, etc.) have been removed.

**Caution!** *During the first few weeks of operation, repeat the checks above at least once.*

### WIRING FOR P4

#### Completing the Wiring

1. Many potential problems can be avoided by ensuring that cabling and wiring do not cause strain on the connectors.
2. Route all the wires and cables sideways out from the SPU (to the left and/or right, as appropriate). Use external tie-downs or cable holders to keep the wires and cables secure, with no excess strain on them, or on the plugs that are mated to the SPU's receptacles.
3. If the SPU is mounted on a vertical surface, route all wires and cables downwards, within a few centimetres of the edge of the SPU. If the SPU has been mounted on a horizontal surface, form drip loops in all wires and cables, close outside the edges of the SPU.
4. Finally, carefully re-install the Wiring Cover on the SPU. Be sure not to pinch any of the wires or cables between the Wiring Cover and any other part of the SPU.
5. Secure the Wiring Cover with the two knurled thumb-nuts.
6. Ensure that the cabling and wiring to all system components, *especially Remote Controls*, are well secured with clamps or alternative fasteners.



# Getting Started

## Getting Started

This chapter describes all the basic concepts you need to be familiar with when using your P4 Advanced Autopilot System, and the steps needed to prepare it for use.

### Autopilot Operations

After it is installed, almost all of your interaction with your autopilot system will be done by means of the Control Head. These include:

- selecting an operating mode
- setting up the parameters you wish to use in each mode
- monitoring your vessel's Heading
- setting a desired Heading to be followed
- making Special Turns
- monitoring the various system status items

### System On/Off

The P4 SPU, once wired to a battery, will always be in power on status. It can only be powered down by remove the power supply.

This is also true for P4 control Head and P4 series of remote controllers. The pwr button on the P4 Control Head is used to turn the system to a sleep mode where the display is turned off and minimum current is consumed.

### First time power on

The first time you power on your system, the P4 Controller will search for a P4 SPU. P4 SPU will also search for suitable data sources it needs in various operations from the NMEA 2000 network. The following table shows what data are used for SPU

Data Source	Required in Operation modes	Where to select/change a source
Heading	All modes	
Rudder	P.Steer, AUTO, NAV	Fixed from RFU port
Navigation	NAV	
Position	AUTO ALC mode	

If you have more than one NMEA 2000 device that can provide the same type of data, you can turn off all devices except the one you want P4 to use before you power on your SPU.

Once SPU has found and saved a device, it will use the same device in the next power cycle. You can only change this source through the Network Configuration menu (refer to Network Config Menu for more details), or through a network reset to allow the SPU to pick a new one.

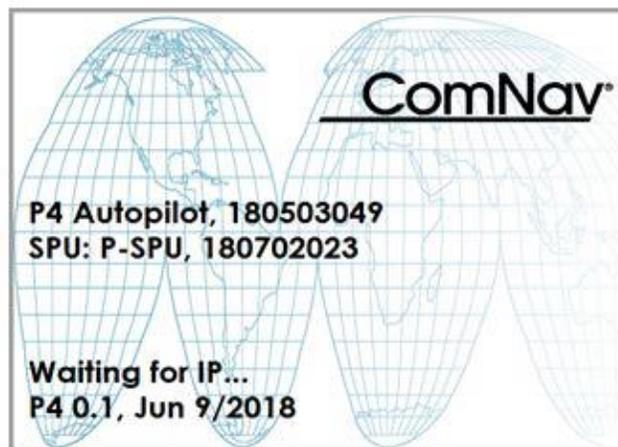
If you want to use an non-NMEA 2000 data source, for example a fluxgate compass for heading, you can change the source port from the SPU configuration menu. The following table shows available ports

Source	Available port options	Menu to change it	Accessed through when P4 is in command
Heading	NMEA 2000, Analog compass port (fluxgate and magnetic), NAV1, NAV2	SPU User menu	Double click STBD button
Speed	Nmea 2000, NAV1, NAV2	SPU AUTO menu	Double click AUTO button
Navigation	Nmea 2000, NAV1, NAV2	SPU NAV menu	Double click NAV button
Position			

**Table 3a - Turning off P4 system**

To turn off the P4 (at any time), press and hold the red STANDBY/ON/OFF button. The autopilot will switch first to **STANDBY** mode, if it was not already in that particular mode.

At that point, if you keep pressing the button, the autopilot will start a 3-second power-down sequence. Once the countdown has expired, the display will go blank. All outputs from SPU will stop. Other P4 stations and remote controllers in the network that are linked to the same SPU will also blank out. The whole system is in Sleep mode.



**Figure 46 – Introductory display**

If you release the STANDBY/ON/OFF button before the 3-second countdown has completed, the autopilot will abort the countdown, and remain in **STANDBY** mode.

**Turning on P4 system**

Press and hold the PWR button on a P4 will wake up the P4 system. All installed controllers for the same SPU restart as if they are powered on.

## Using the Control Head – LCD Screen and Buttons



**Figure 47 – Using the Control Head**

The elements of the Control Head (with reference to the identifiers above) are:

- 1) **LCD Screen.** As long as the P4 system is powered on, the LCD screen normally displays the compass heading, rudder angle, and mode of operation; it can also be displaying desired heading, system status, other information, and various menus. The overall set of items being displayed changes in response to the various command buttons listed below (the screen shown above is the initial screen, which appears for a few seconds after Power On).
- 2) **STANDBY/ON/OFF button.** To power on the system, press and hold this button until the LCD screen lights up, and then release the button (the P4 can be put into STANDBY mode anytime by pressing and holding this button for approximately ½ second; it always powers up in STANDBY mode). While in STANDBY mode, the autopilot will not exert any control over your vessel. This button will also turn off the autopilot when pressed and held for approximately 2 seconds. During regular operation, double-pressing this button brings up (or cancels) the Standby menu.
- 3) **PORT ARROW button.** Pressing and maintaining this button while in POWER STEER mode moves the rudder to port for as long as the button is held. Pressing and maintaining this button while in AUTO, NAV or WORK modes allows you to avoid obstacles in the vessel's path, by turning to port. Releasing the button automatically recovers your original Heading or Track.
- 4) **TURN button.** Pressing this button once while in AUTO or WORK mode queues the default pre-programmed turn. Subsequent presses of the TURN button scroll through all of the available turn-types. The pre-programmed turn sequence is then initiated by pressing either the PORT or STARBOARD ARROW button to indicate the direction in which the turn will be executed. See the **Default Turn** section for more details on setting the default turn from the Special Turns available.
- 5) **STARBOARD ARROW button.** Pressing and holding this button while in POWER STEER mode moves the rudder to starboard for as long as the button is

held. Pressing and maintaining this button while in AUTO, NAV or WORK mode allows you to avoid obstacles in the vessel's path, by turning to starboard. Releasing the button automatically recovers your original Heading, Track or Angle.

- 6) **COMMAND (CMD)** button. This is a multi-function button:
  - On all vessels this button invokes WORK mode while in AUTO or NAV modes. Double-pressing the button will bring up (or cancel) the Work mode menu.
  - Pressing this button when an alarm condition occurs in the autopilot, suppresses the alarm.
  - This button is also used during Dockside Setup to initiate the automatic learning features of the autopilot.
- 7) **COURSE CHANGE** knob. This is used in various ways:
  - In POWER STEER or AUTO mode, one 'click' changes the rudder angle by approximately 1 degree. A quick spin moves the rudder approximately 10 degrees.
  - The knob is also used to change parameters in the various menus.
- 8) **POWER STEER** button. Pressing and holding this button places the autopilot into POWER STEER mode. This mode allows you to steer the vessel by using the COURSE CHANGE knob, or by pressing and holding the PORT or STARBOARD ARROW buttons. A double-press of this button brings up (or cancels) the Power Steer mode menu.
- 9) **AUTO** button. Pressing and holding this button places the autopilot into AUTO mode, and then the autopilot will automatically control your vessel's steering system so as to keep the vessel on the Heading that you select with the COURSE CHANGE knob. Obstacles can be avoided by using the PORT and/or STARBOARD ARROW buttons. A double-press of this button brings up (or cancels) the Auto mode menu.
- 10) **NAV** button. Pressing and holding this button places the autopilot into NAV mode, and then the autopilot will steer your vessel from NMEA data provided by a GPS, Chart-plotter, or some other compatible Navigation System. A double-press of this button brings up (or cancels) the Nav mode menu.

## Operating Modes and Menus

Your ComNav P4 Advanced Autopilot System has four basic operating modes, known as **STANDBY**, **POWER STEER**, **AUTO**, and **NAV**; a fifth operating mode, known as **WORK**, is a sub-mode of **AUTO** and **NAV** modes, and is available on all vessel types except sailboats.

Each of these modes has its own set of parameters that you can adjust, to configure and fine-tune how your P4 system behaves in the respective mode. These parameters are stored in the system's non-volatile memory; you can view and change them with the Control Head, via sets of menus that appear on the LCD screen.

There is one more menu, called Setup, which is used for setting up a number of the parameters that are common to all the operating modes.

In total, there are six different menus. The menus of the four basic operating modes (**STANDBY**, **POWER STEER**, **AUTO**, and **NAV**) are accessed by using the respective mode buttons: the STANDBY/ON/OFF button, the POWER STEER button, the AUTO button, and the NAV button. The WORK button is used to access the WORK or modes' menus.

- To access a particular operating mode menu, double-press the button associated with that menu (e.g., the NAV button for the **NAV** mode's menu).
- To quit viewing a particular operating mode menu, double-press the associated button again, or wait about 10 seconds. The display will then revert to the active display of whatever mode the P4 is operating in.

Using the operating mode menus is fully described in the related sections, later in this manual.

## Advanced Operations

This chapter describes the advanced modes of operation and features of a P-Series system, and shows you how to use them.

### WORK Mode

WORK mode is a special mode, for use in conditions that are different than normal autopilot operation; prime examples are dragging, trawling, and pair trawling. It is also useful for towing or when traveling at very slow speeds. WORK mode can be activated in either AUTO or NAV mode. You can also switch from AUTO to NAV mode or vice-versa, while WORK mode is active.

Initial set up of WORK mode is easily accomplished. Only two parameters need to be adjusted: a Work Trip Point and the Rudder Scaling Factor. Some other parameters can be used to monitor and fine-tune the operation of WORK mode as well.

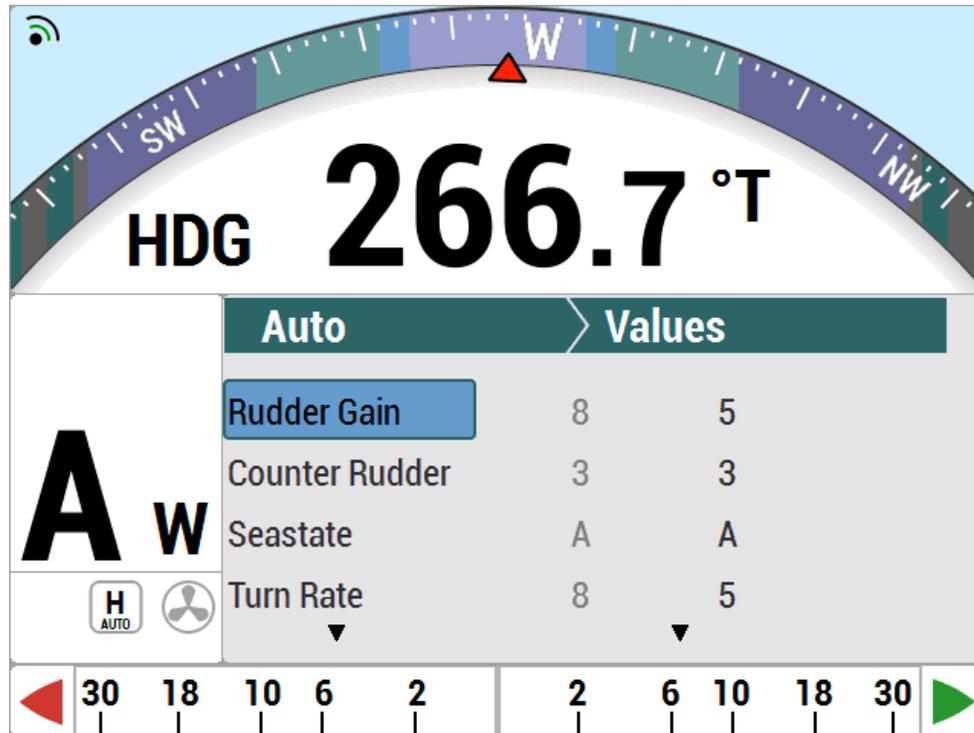
The autopilot has an automatic Off-Course Alarm that will be activated should the boat fall off the Commanded Heading by more than 20°. There is a 32 second delay on this alarm.

### Automatic WORK Mode

Although WORK mode can be used manually, it works best if a valid NMEA source for the boat's speed is also interfaced to the autopilot. The speed source must also be properly configured (see the **Auto** menu). With a valid NMEA speed source, WORK mode can be engaged automatically when the boat's speed falls below the Work Trip Point, and disengaged when the boat's speed increases beyond the Work Trip Point.

To use Automatic WORK mode, first go into either AUTO or NAV mode. Then press and hold the WORK button for approximately 1 second, until a confirmation beep is heard. A small letter 'W' will appear beside the bigger mode-indicator letter ('A' or 'N') in the upper left portion of the LCD screen, to indicate that the WORK mode feature is enabled (See [Figure 48](#)).

If the boat's speed is above the Work Trip Point, the 'W' will flash slowly, about once per second, indicating that WORK mode is enabled – but not yet engaged. If the 'W' appears continuously (not flashing), the boat speed is below the Work Trip Point, and WORK mode is actually engaged.



**Figure 48 – Typical WORK Mode Screen (Engaged)**

To disable WORK mode, press the WORK button again, for approximately 1 second, until a confirmation beep is heard and the letter 'W' disappears from the display. WORK mode can also be cancelled by switching to either STANDBY or POWER STEER mode.

When WORK mode is engaged, the Rudder Scale Factor changes the amount of corrective rudder movement which the steering algorithms calculate using the Rudder Gain setting. In WORK mode, that calculated amount (i.e., proportional to the course error) will also be multiplied by the Scale Factor, resulting in larger rudder movements for a given course error. The Rudder Scale Factor is entered on the Work menu.

Other effects take place in WORK mode as well.

The corrective rudder movement calculated for Counter Rudder is reduced to the minimum possible for the Vessel type (i.e., as if the Counter Rudder parameter was set to 0), which enhances the effect of the Rudder Gain and Rudder Scale Factor.

Turn Rate is limited to 10° per second while WORK mode is active, for all changes of Heading controlled by the autopilot, and for Special Turns.

Particularly useful for pair trawling, the autopilot also disables the automatic course trim unless Autotrim (in the Work menu) is specifically turned on.

Finally, the built-in off-course alarm will be disabled the entire time WORK mode is engaged.

If the user is not satisfied with the fixed helm bias determined by the Autopilot at the onset of WORK mode, manual adjustments can be made “on-the-fly” while WORK mode is engaged. A double-press of the WORK button will bring up the regular Work menu, but with an additional line. Rudder Bias will be the first line on the list, and will show the current helm bias. You can change this value to suit, using the COURSE CHANGE knob. This feature is useful in order to accommodate changing load or sea conditions.

As mentioned previously, WORK mode will automatically be disengaged if the vessel's speed rises above the Work Trip Point set by the user. While it is disengaged, all normal features such as automatic trim and off-course alarm will be operational.

### **Manual WORK Mode**

Even if no NMEA source of speed data is available, WORK mode can still be used, by manually initiating it.

To do so, switch to AUTO or NAV mode, and then press the WORK button for ~1 second until the letter 'A' or 'N' in the upper left portion of the display stops flashing, and a small letter 'W' appears beside it.

Then, double-press the WORK button to bring up the Work menu. Highlight "Work Mode State," and then use the COURSE CHANGE knob to change the selection to "M\_On" (Manual On).

WORK mode is now engaged.

*Caution! When manual WORK mode is engaged, large rudder movements may occur. If your boat is traveling too fast, these rudder movements may affect the stability of the boat. Do not engage manual WORK mode without first ensuring that it is safe to do so and that the boat speed is appropriate for using WORK mode.*

To disengage WORK mode, again select "Work Mode State" in the Work menu and change it to "A\_Rdy" (Automatic Ready).

To cancel WORK mode completely, press and hold the WORK button for 1 second, or switch to STANDBY or POWER STEER mode.

You can also manually disengage WORK mode, if it has been engaged in the automatic mode. Double-press the WORK button to bring up the Work menu. If WORK mode is engaged, the "Work Mode State" will show "A\_On" beside it. Highlight "Work Mode State," then use the COURSE CHANGE knob to change it to "M\_Rdy" (Manual Ready).

### **Work Menu**

The Work menu has all of the adjustable parameters that are involved with WORK mode. To access the Work menu, double-press the WORK button.

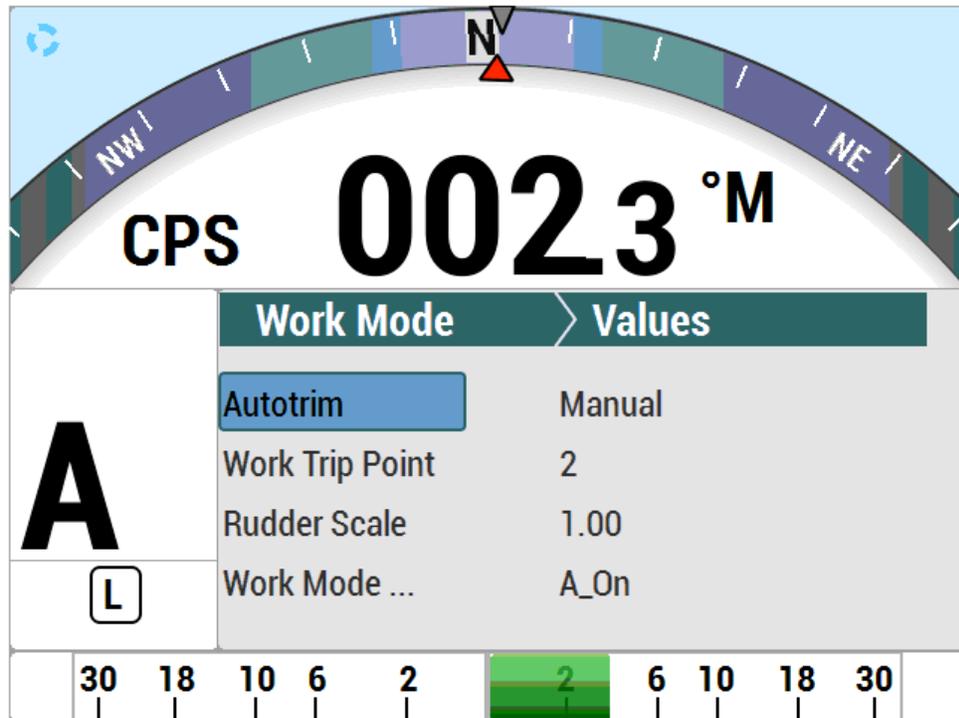


Figure 49 – WORK Mode Menu

**Rudder Bias**

This menu line only appears when WORK mode is active. It shows the current rudder bias, which can be adjusted if desired.

**Autotrim**

The autopilot’s WORK mode can be configured to use manual or automatic rudder bias trim when in WORK mode (the default is to use automatic bias).

Manual rudder bias is fixed by the position of the rudder when the autopilot first enters WORK mode, but can be adjusted by the user if desired.

Automatic rudder bias is initially set to the position of the rudder when the autopilot first enters WORK mode, but is automatically adjusted on a continual basis thereafter to ensure that the vessel remains on-course.

**Work Trip Pt. (Work Trip Point)**

This is the speed below which WORK mode can be engaged, and above which WORK mode will be disengaged automatically. The value can be 1 to 10, and these units refer to the information the Speed Source is providing (see the **Auto** menu).

**Rudder Scale (Rudder Scale Factor)**

When WORK mode is engaged, the “Rudder Scale Factor” will multiply the Rudder Gain setting in the Auto menu. Normally, the rudder is moved an amount proportional to the course

error detected (i.e., the error times the Rudder Gain, and using some constants which depend on vessel type), but in WORK mode that amount will also be multiplied by the Scale Factor. This will always result in larger rudder movements for a given course error.

### Work Mode State

This parameter shows the current status of WORK mode. It is also a means to force WORK mode to be active or not. Normally, WORK mode is engaged or disengaged depending on the speed of the boat as given by a Navigation System. In cases where this information is not available, WORK mode can still be made to function by forcing it on.

The states shown are “Off”, “A\_On” and “A\_Rdy” (abbreviations for Automatic On and Automatic Ready, respectively), or “M\_On” and “M\_Rdy” (Manual On and Manual Ready).

Accessing and using the Dockside Setup Menu is described in the next section.

## Operating Modes and Menus Continued



**Figure 50 – A Typical Menu**

All menus are arranged with the parameter names on the left side of the screen, and the current value for each parameter on the right side.

Note that in each menu, one item is always highlighted, it indicates which parameter is currently selected (for example “Network Config” is the highlighted line in [Figure 50](#)).

You can move the highlight to other items on the menu by pressing the PORT ARROW button (moves the highlight up) or STARBOARD Arrow button (moves the highlight down).

Some menus have more items than can be shown on a single screen. In this case, when the highlight has been moved to the last item on a screen, each subsequent press of the STARBOARD button will cause the menu will scroll up by one item, revealing a new high-lit item. Similarly, when the highlight has been moved to the first item on a screen, each subsequent press of the PORT button will scroll the menu down one item. These long menus are arranged in a circular fashion, so that the scrolling action can be carried on indefinitely.

Use the COURSE CHANGE knob to change the value of the currently high-lit parameter. For parameters with numbered values, a clockwise turn of the knob will increase the value; counter-clockwise movements will decrease the value. Non-numerical values are generally arranged in a circular list for ease of use.

Note that every time a menu is accessed, there is a little icon at the top of the display that looks like the COURSE CHANGE knob, but with a line drawn through it. This is a reminder that the COURSE CHANGE knob is not available for its normal function of changing the vessel's course, because the knob is now being used to change parameter values.

All menus (except Dockside Setup) have a time-out feature that is triggered after about 10 seconds of inactivity. If no button presses or movements of the COURSE CHANGE knob are detected during that interval, the menu will time-out.

When a menu times out, the display simply reverts to the previously active display, just as though you had double-pressed the menu button again.

## Alarm Clear

Whenever an alarm or error message occurs on the P4, an audible alert will sound, both at the SPU and at the Control Head. A message will also be displayed on the LCD. The alert will remain activated until the condition that caused it is remedied, or the alarm/error is cleared manually.

To clear the alarm/error manually, press the **ENTER** button once. If the condition that caused the alert remains, the alert will reappear after approximately 20 seconds.

## System Set-up

For the P4 Autopilot system to work properly, it requires two main items; a Heading Source and/or Navigation Source, plus a Rudder Follower Unit or Interface.

The Heading can be obtained from several different Heading sources; a ComNav N2K GNSS GPS Compass on N2K network, a ComNav Magnetic Compass, a Fluxgate compass, an Airmar Rate Compass or GNSS compass through the SPU. The Feedback or Interfaces (Pumps, Motor, Solenoids and Thrusters) to the P4 Autopilot must be wired to the SPU. Check the **System Overview** for details.

In order to connect the Heading Source and Feedback, the P4 system needs two parts, the P4 Control Head and the P4 SPU.

For Analog compasses such as Magnetic and Fluxgate, a NMEA 0183 compass such as an Airmar, and NMEA 0183 Navigation devices such as a plotter, these get connected through the P4 SPU with a specially designated wiring diagram to either "Compass" connector on the P4 SPU or "Nav I/O" connector on the P4 SPU.

You can also power up the P4 Control Head and SPU simply by connecting to a N2K network through a drop cable. To access the Main Menu, be familiar with the button combinations as follows:

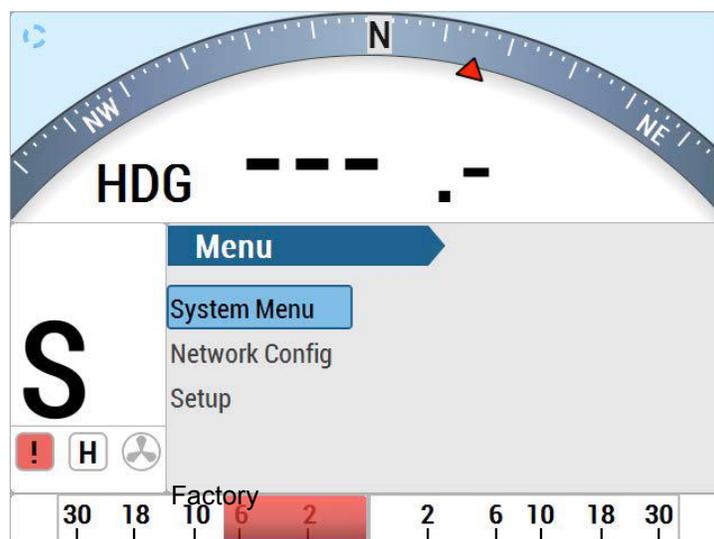
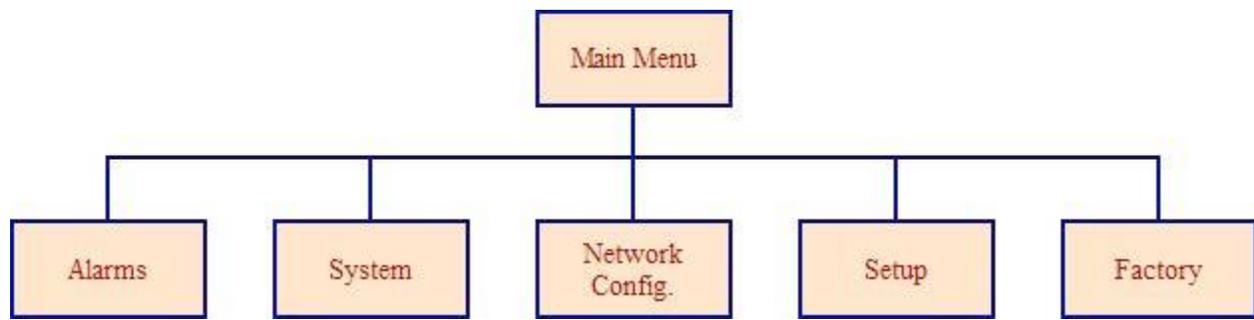
- To access the Menu, double click the CMD (Menu) button.
- To go back the previous Menu screen, press the CMD (Menu) button.
- To scroll through items on the Menu, adjust the TURN KNOB.
- To select the item on the Menu, press down the TURN KNOB (aka ENTER)
- To select the take control from the repeater (remote), long press the CMD button.

After the wiring installation, the system setup is done as follows:

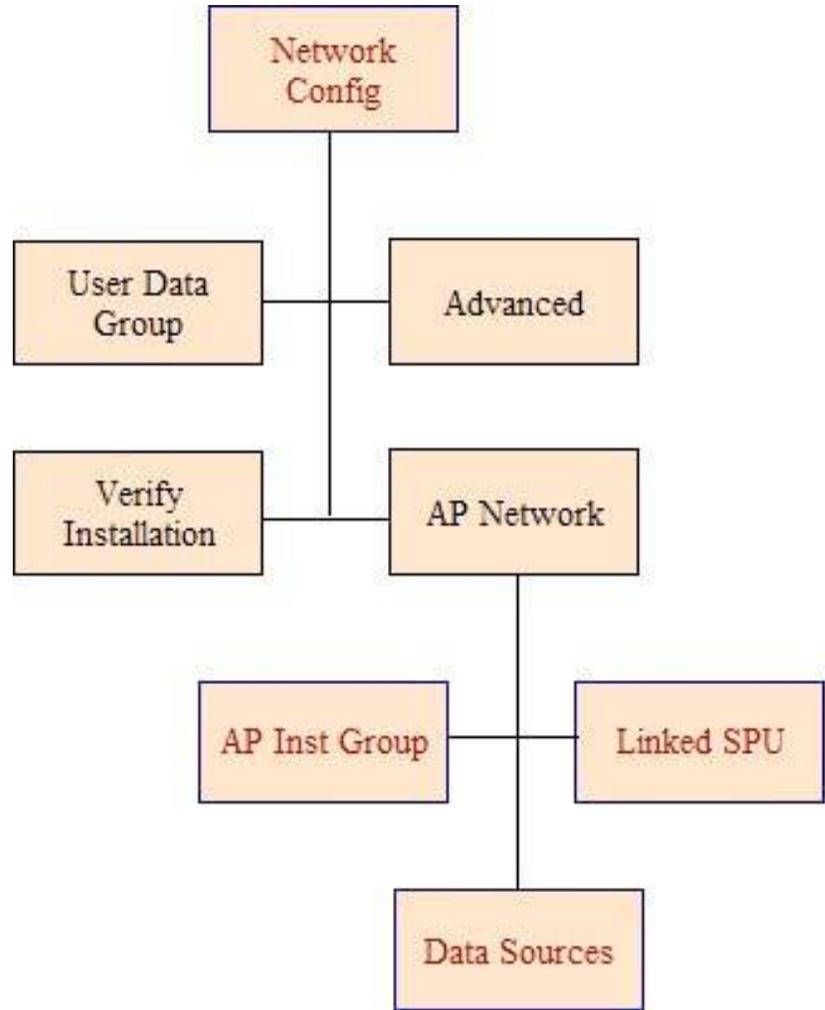
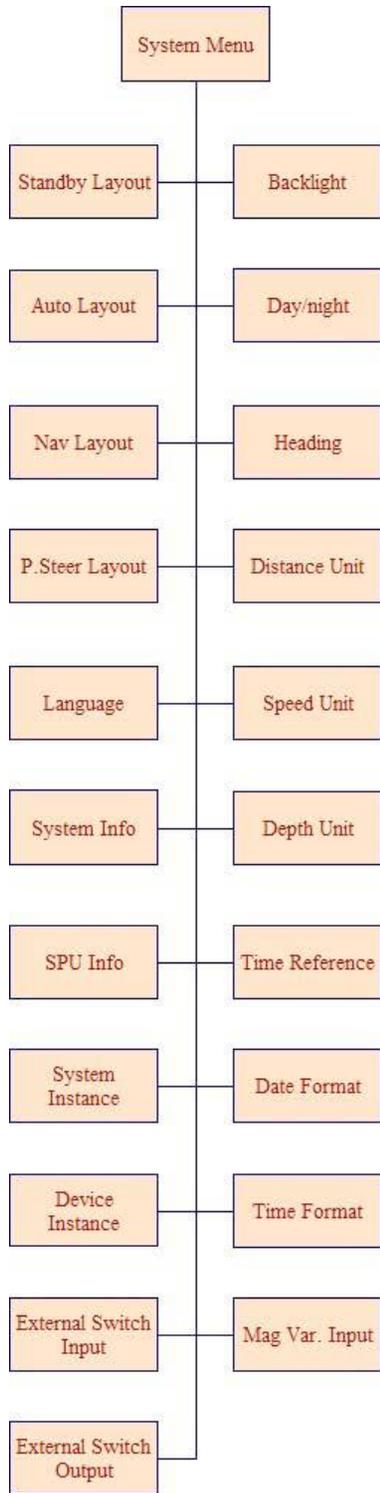
- Setting up requires getting into the Main Menu Screen by pressing the CMD (Menu) button, this will drop down four choices.

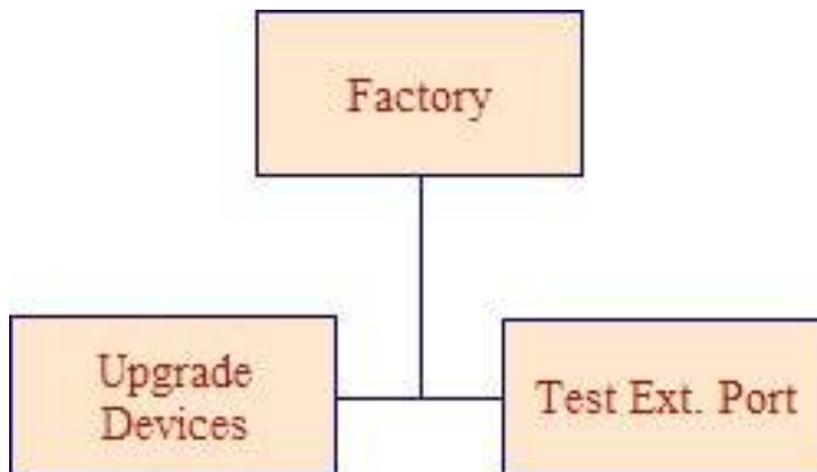
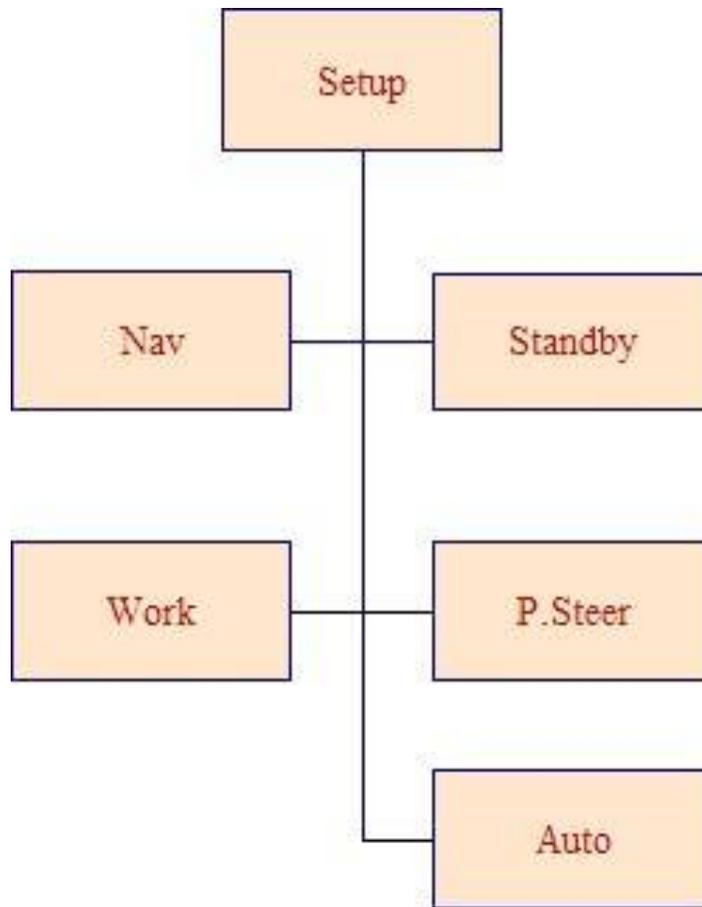
- **Alarm** – contains all alarm messages on the screen that have been acknowledged (May not show if there are no alarm messages)
- **System Menu** – defines the format and layout for Heading, speed, provides system and SPU info etc.
- **Network Config** – allows user to connect any devices (such as Heading and Navigation source) on N2K network to the P4 SPU. In order for the P4 system to work, the P4 Control Head gets configured to the P4 SPU through the N2K before any use. On the other side, the P4 Control Head can be used as the Heading Display without SPU, if configured to a valid Heading Source through this selection.
- **Factory** – allows user for Factory Testing & Upgrading units.

### Main Menu Flowchart



### System, Network Config. and Setup Flowchart (Setup devices for N2K network)





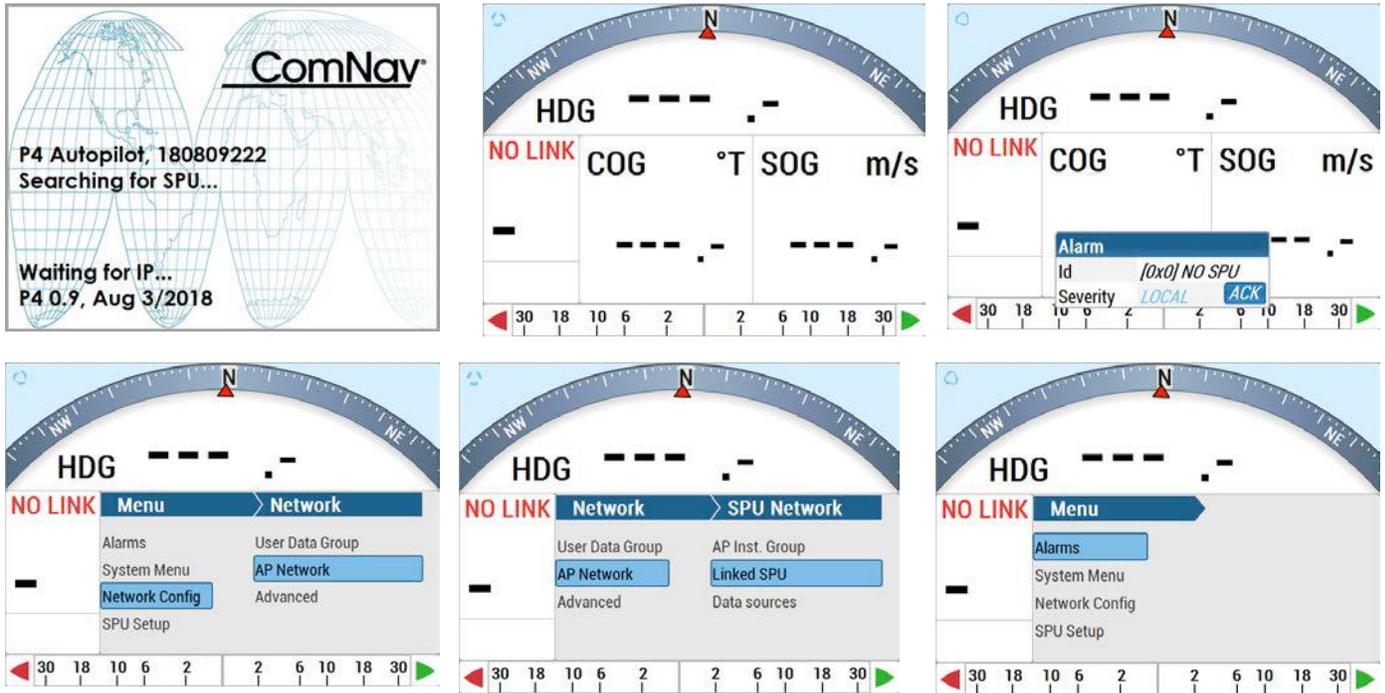
For typical ComNav P4 N2K system - P4 Head and SPU with GNSS (N2K) Compass and Rotary Feedback, do the following:

1. Install the P4 SPU as per the “Wiring the system” section for Signal Processor Unit and Power Supply.
2. Install the Rudder Follower unit, pump, drives and Navigation devices as per the “Installation” and “Wiring the system” sections for the RFU to the P4 SPU.
3. Connect the GNSS (N2K) Compass onto the N2K network with a drop cable.
4. Connect the P4 Head and SPU onto on the N2K network with drop cables

The ComNav P4 system is designed with safety messages for all situations requiring alerts, and users must acknowledge the alarm messages if and when they occur.

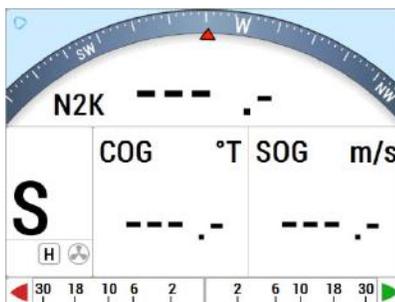
When the unit is first connected to the N2K network, there will be two possible screens with alert messages. One is “No Link” to SPU. The other is “Faulty Head.”

**For “No Link” to SPU:**

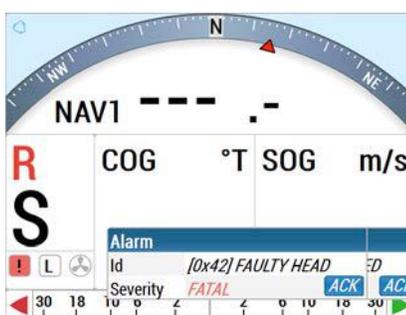


## To repair and reset:

1. Make sure the N2K wires are connected to the SPU properly.
2. Press the Enter button to acknowledge alarm
3. Press and hold the CMD button to take control
4. Press the CMD button to “Main Menu”
5. Select Network Config
6. Select AP Network
7. Press Enter (TURN KNOB) button to acknowledge the Warning Message - press ENTER to dismiss”
8. Select Linked SPU
9. Select the SPU serial number
10. Press Enter to select the SPU. Now the Control Head and the SPU are connected together and the Remote is in control.
11. Press the CMD button to go back to the previous screen.
12. Press and hold the CMD to take control of the Head.
13. Press the CMD button a few times to get back to “STANDBY” screen, “S” on the left lower corner as below.



## For “Faulty Head”

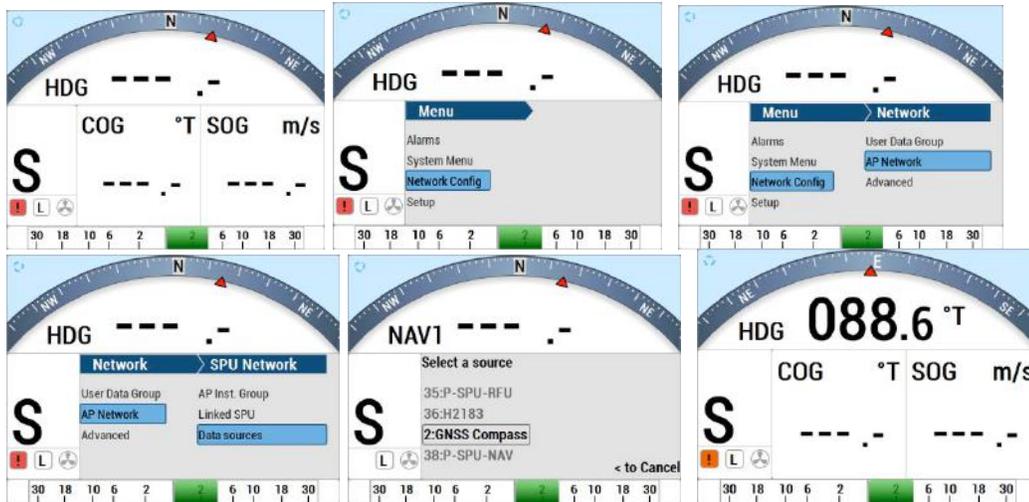


The “Faulty Head” alert identifies a connection failure to the SPU upon initial start-up. The “Compass error” alert occurs when the SPU can’t identify the Compass source. To correct either of these alerts, do the following:

1. Press “Enter” (brought up by clicking/single press the TURN knob) to acknowledge the alarm message.
2. Press and hold the “CMD” button to take control. The “Faulty Head” and “Compass Error” messages will disappear.

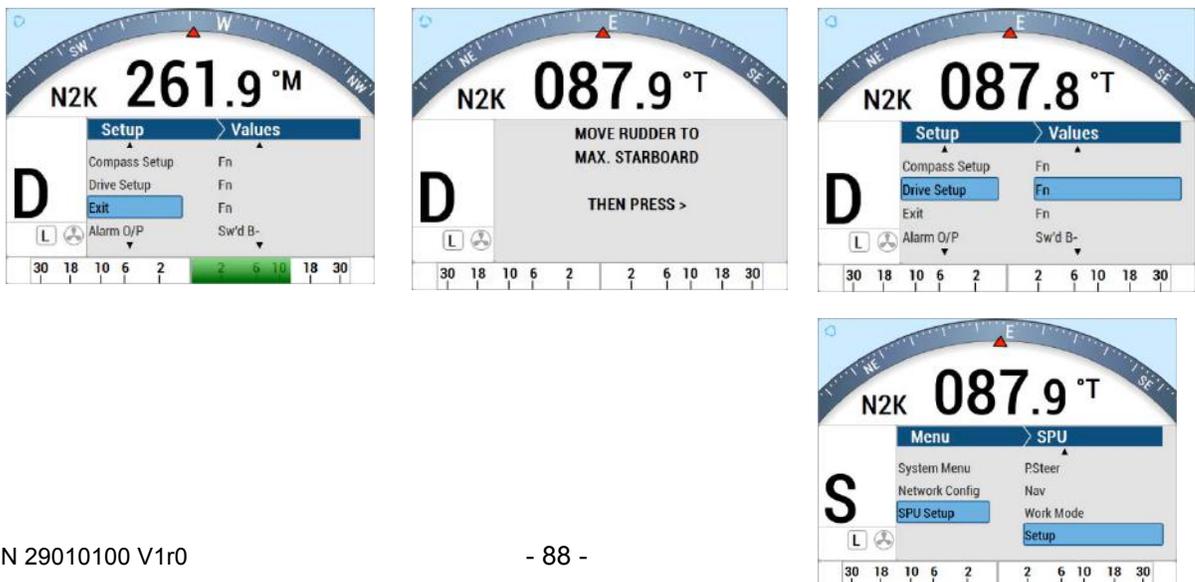
### Connect GNSS (N2K) Compass to system

By default, the P4 system links to a compass source from a N2K (NMEA 2000 device). It is first indicated by “N2K ----.” with no specified N2K device.



#### To configure GNSS (N2K) Compass as HDG (Heading Source) and/or POS (Position Source)

1. Press Enter to acknowledge the alarm
2. Press the CMD button to take control
3. Press the CMD button to bring up the menu.
4. Select Network Config
5. Select AP Network
6. Press the ENTER button to acknowledge Warning Message>Select Data Source
7. Select HDG (Heading) Source, select POS (position) Source
8. Select the GNSS serial number
9. Press ENTER to select the compass.
10. Press the Menu button to go to previous screen
11. Press the CMD button to take control of the Head
12. From the STANDBY mode screen, the compass reading should show “HDG XXX.X°T” where XXX.X is the True Heading from N2K network



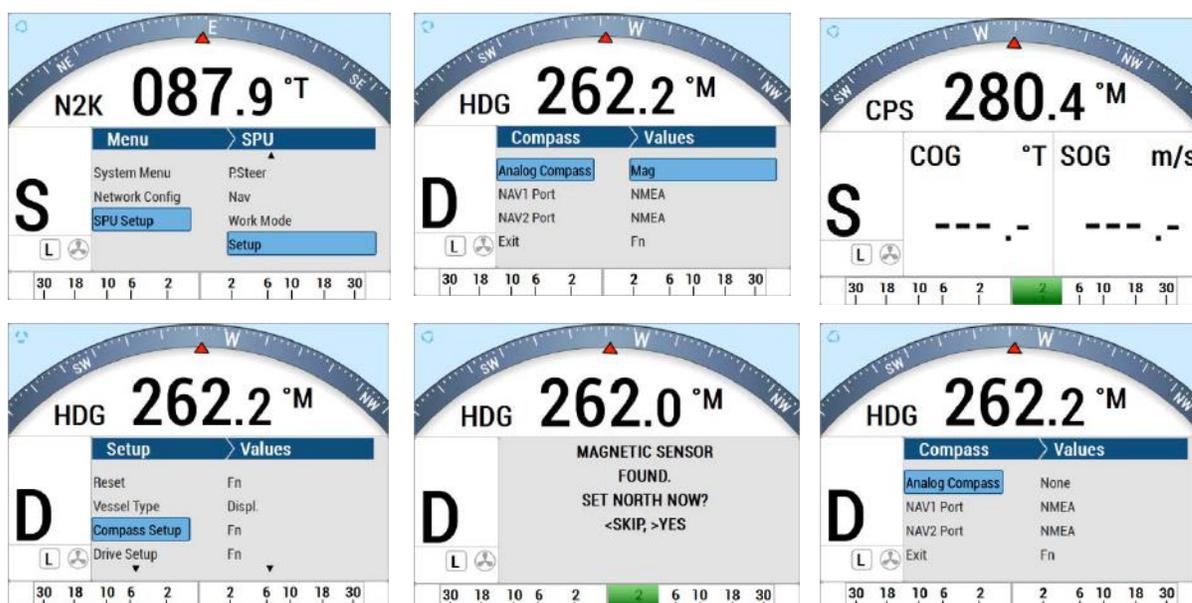
## Connect Rotary Follower unit to system

1. Press Enter to acknowledge the alarm
2. Press the CMD button to take control
3. Press the CMD button to bring up the menu.
4. Select SPU Setup
5. Select Setup (it works only when it is "S" STANDBY mode)
6. Note that the "S" changed to "D"(Dockside Setup Menu)
7. Select Drive Setup
8. Follow instructions to move rudder to finish setup.
9. After Dockside, the screen returns to "Drive Setup)
10. Select "Exit" on the Dockside Setup Menu, DO NOT use the MENU button to go to the previous screen.
11. Press the Menu button to go back to STANDBY mode
12. To verify, press P.STR button to activate the rudder, and the rudder indicator on the screen should show accordingly

## For Magnetic /Fluxgate Compass and Rotary Feedback Follower

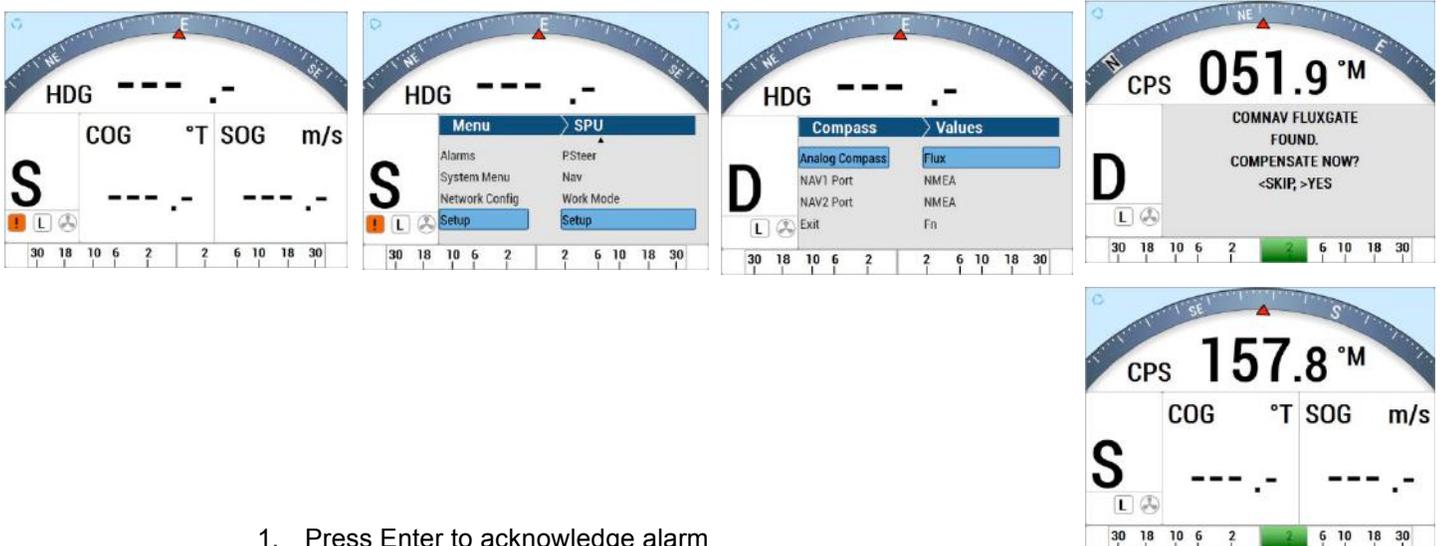
The following is how to install and connect a ComNav Magnetic/Fluxgate Compass and Rotary Feedback Follower.

1. Install the P4 SPU according to the section "Wiring the system" for Signal Processor Unit and for Power Supply.
2. Install the Rudder Follower unit, Pumps, Drive and Navigation devices under section "Installation" and "Wiring the system" for Rudder Follower Unit to the P4 SPU.
3. Connect the Magnetic /Fluxgate Compass onto J8 and /or J9 of the SPU under section "Installation" and "Wiring the system" for Magnetic/Fluxgate/NMEA0183 to the P4 SPU.
4. Connect Control Head to SPU
5. Do the same as for a N2K system
6. Connect a Magnetic compass to the SPU



7. Press Enter to acknowledge the alarm
8. Press the CMD button to take control
9. For first time compass set-up, it is not important to have a valid compass reading (it may be from N2K network)
10. Press Menu to bring up the System Menu
11. Select SPU Setup
12. Select Setup (it only works when in "S" STANDBY mode)
13. Note that the "S" has changed to "D" (Dockside Setup Menu)
14. Select Compass Setup
15. Select Analog Compass to Mag
16. It will display "Magnetic sensor found"
17. After Dockside, the screen returns to "Compass"
18. Select "Exit" on the Dockside Setup Menu, DO NOT use the MENU button to go to the previous screen.
19. Select "Exit" to go back to STANDBY mode
20. From the STANDBY mode screen, the compass reading will now show "CPS XXX.X°M" where XXX.X is the Magnetic compass reading.

### Connect Fluxgate compass to the SPU



1. Press Enter to acknowledge alarm
2. Press the CMD button to take control
3. For first time compass set-up, it is not important to have a valid compass reading (it may be from N2K network)
4. Press Menu to bring up the System Menu
5. Select SPU Setup
6. Select Setup (it only works when in "S" STANDBY mode)
7. Note that the "S" has changed to "D" (Dockside Setup Menu)
8. Select Compass Setup
9. Select Analog Compass to Flux
10. It will display "ComNav Fluxgate found"
11. After Dockside, the screen returns to "Compass"
12. Select "Exit" on the Dockside Setup Menu, DO NOT use the MENU button to go to the previous screen.
13. Select "Exit" to go back to STANDBY mode
14. From the STANDBY mode screen, the compass reading will now show "CPS XXX.X°M" where XXX.X is the Magnetic compass reading.

**For Non-ComNav devices, the devices are configured as follows:**

- N2K devices – through “Network Config” from the Main Menu and the wiring is a drop cable to the N2K network. Consult ComNav for compatibilities
- NMEA 0183 devices –through “SPU setup” from the Main Menu and the wiring is through NAV1 and NAV2 port of the P4 SPU
- For ComNav pumps, thruster and solenoids are configured through “SPU setup” from the Main Menu and the wiring is through Drive Outputs, Rudder Follower port of the P4 SPU.

Continue to “**Setting up the System.**”

**Setting Up**

This chapter describes all the steps needed to prepare your P4 Autopilot for use on your vessel, after you have installed it.

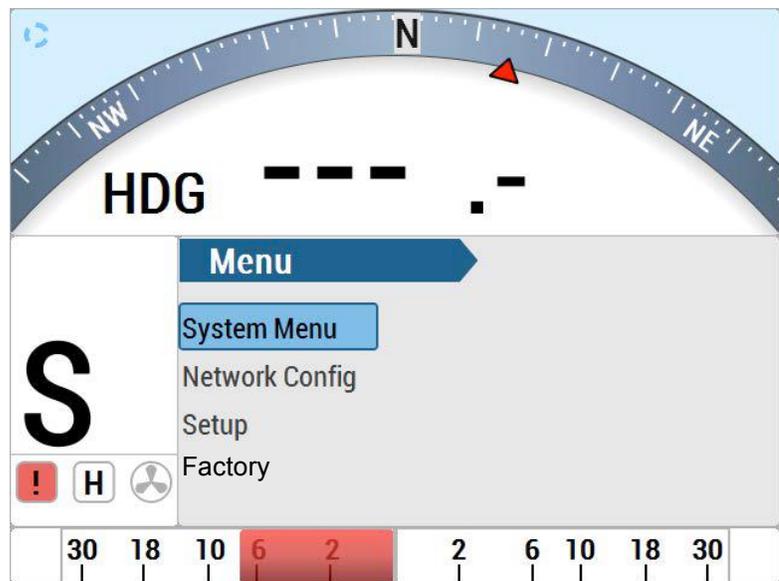
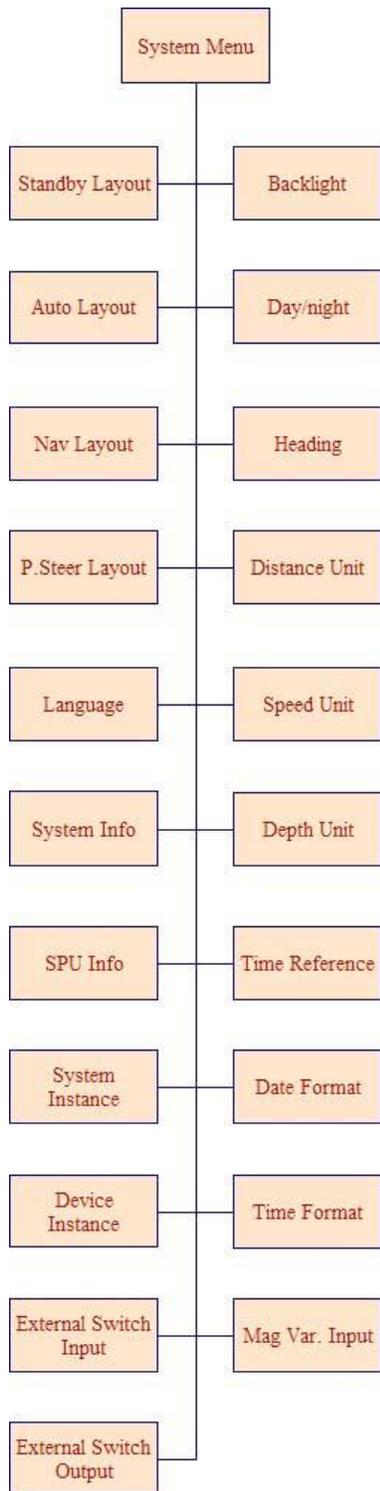
*NOTE: to correctly complete the procedures described in this chapter, you will need to be familiar with the basic concepts of using the autopilot's Control Head – modes, menus, turning the system on and off, etc.*

If you have not already done so, please read the introductory section of the Basic Operations chapter.

**System and Network Config. Set-up**

1. System Menu - Set up the layout and unit format in P4 Control Head.
2. Network Config. Menu - Configure all N2K devices (mainly the N2K Compass and N2k Navigation unit) to the P4 Autopilot.
3. When you first Power Up the P4 Autopilot, and without any configuration done, the unit will automatically pick up any valid N2K compass or Navigation Source signals available on the N2K network.
4. Bring up the Network Config. Menu to check the selected items, and to make sure you are using the correct Compass and Navigation source.

### System menu



The System menu has all of the adjustable parameters that are involved with the P4 Head Display. To access the System menu, double-press the CMD button for the MAIN Menu, and then press the TURN KNOB button to select.

## Backlight

There are two modes, DAY & NIGHT that allow you to select for the most convenient and interference free viewing of the display.

### Day

The backlight level is adjustable between 5% to 100%

### Night

The backlight level is adjustable between 2% to 20%

### Day / Night

Selects either the Day-time screen or the Night-time screen

## Heading

This line allows you to choose which type of value – Degrees Magnetic or True – from an NMEA source will be used by the autopilot for its Heading:

- “Auto” - the autopilot will automatically select whether to use Magnetic or True, depending on which NMEA 2000 (PGN) sentences are received (assuming all sentences have valid data).
- If the HDG PGN sentence is being received (regardless of whether HDM and/or HDT PGN are also being received), then the autopilot will use a Magnetic Heading (indicated on the display by an ‘M’ beside the boat’s actual Heading value on the screen), and it will be the value in the HDG sentence.
- If only HDM and HDT are being received, or just HDT, then the autopilot will use True Heading (indicated by a ‘T’), from the HDT sentence.
- If only HDM is being received, then the autopilot will use a Magnetic Heading (indicated by an ‘M’), from that sentence.
- “True” - the autopilot will use True Heading from the HDT sentence. If HDT is not being received, a Heading Error alarm will occur.
- “Mag” - the autopilot will use Magnetic Heading from the HDG sentence, if that is being received, or from HDM if only that is being received. If neither HDG nor HDM are being received, a Heading Error alarm will occur.

There are three choices: Auto, True and Mag. Once the Auto is set, the Heading on the screen will show True or Magnetic depending on the Heading Source.

**Distance Unit**

There are four Distance Unit choices: m (Meter), Km (Kilometer), mil (Miles), nm (Nautical Miles).

**Speed Unit**

There are four Speed Unit choices: m/s (meter/second), Km/s (Kilometer/second), mph (mile/second), Kn (Knots)

**Depth Unit**

There are four Depth Unit choices: m (Meter), Km (Kilometer), ft (Feet), ftm (Fathom)

**Time Reference**

To be defined.

**Date Format**

To be defined.

**Time Format**

UTC (Universal Time) and Local (Local Time).

**Mag Var. Input**

To be defined.

**Standby Layout**

There are 2 choices (0 or 1).

**Auto Layout**

There are 2 choices (0 or 1).

**Nav Layout**

There are 2 choices (0 or 1).

**P.Steer Layout**

There are 2 choices (0 or 1).

**Language**

There are five languages supported, Spanish, Italian, English, French, Norwegian.

## System Info

This provides the following information for the P4 Head on a N2K network:

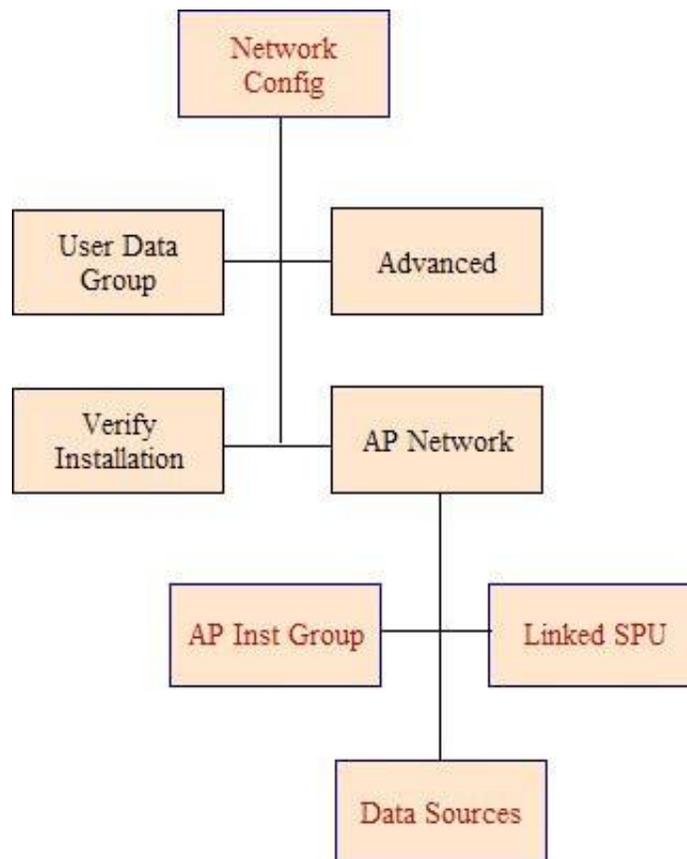
- Network addr. (Network address eg.21)
- Manufacturer (404 for ComNav devices)
- Model ID (ComNav Product Model: P4 Autopilot)
- S/W (Software Revision eg. P4 Head 2.01)

## SPU Info

This provides the following information for the P4 SPU on a N2K network:

- Network addr. (Network address eg.34)
- Manufacturer (404 for ComNav devices)
- Model ID (ComNav Product Model: P4 Autopilot)
- S/W (Software Revision eg. P4 SPU D5.01)

## Network Config menu



The Network Config menu allow users to configure the preferred Compass Source, Navigation Source, multiple P4 SPUs' and multiple P4 Heads' that are involved with a P4 Autopilot connecting to a N2K Network. To access the Network Config menu, double-press the CMD button to bring up the MAIN Menu and then press TURN KNOB button to select.

### User Data Group

- Allows the user to change the group data field for their device.
- P4 devices with the same group data field will sync to each other. For example, if you set one P4 device with a group data field from 1 to Night mode, other P4s on the network with the same value for their group data will also change to Night mode.

## AP Network

Linking all P4 (N2K) devices to a N2K network, there are three sub-menus:

### Advanced (Advanced AP Inst Group)

Allows the user to configure specific devices on the network.

For most devices the only options will be “Set PGN Update Rates” and “Device Info”

- The first option will retrieve a list of PCNs’ emitted by that device and allow a user to request changes to the rate of emittance of a given PGN through a menu.
- The second option will display some basic information on the device, such as the Model ID, Serial, and Software Version

For some proprietary ComNav devices, the options “Compass Constants”, “Cal. Compass”, “Compass Settings”, “Compass Attitude Biases”, and “0183 Port Configuration” will also appear. These allow for advanced configuration of those devices.

### Verify Installation

- Displays ComNav items available on the N2K Network.

## AP Network sub-menu

### AP Inst Group

There are four Distance Units: m (Meter), Km (Kilometer/second), mil (mile/second), nm (nautical mile/second)

### Linked SPU

Allows users to select one SPU from multiple SPUs on the N2K network. Please note that the screen will show all the devices on the N2K Network, you must then select the device with “ComNav SPU.” Selecting a device which is not SPU, will show an error message.

### Data Sources

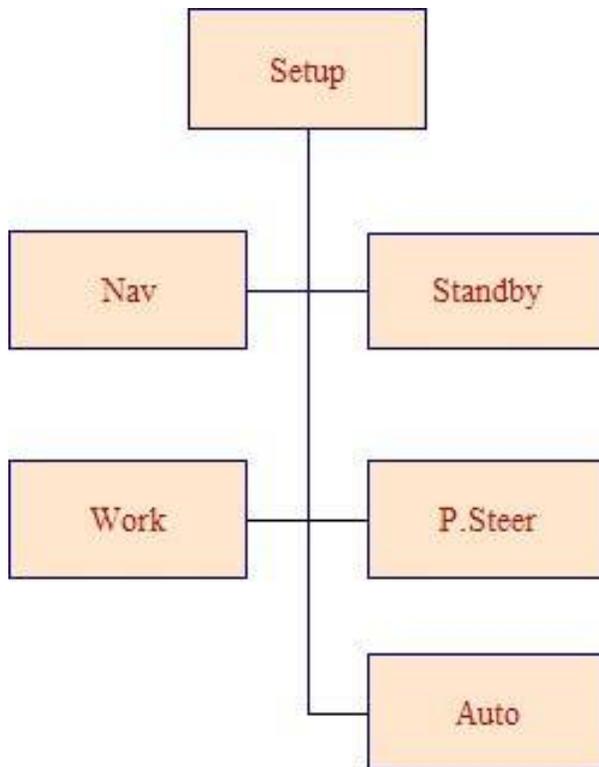
Allows users to choose Heading and Navigation Data Source that are on the N2K Network for use in AUTO and NAV mode. There are nine choices of modifiable Data Sources:

1. SPU (Signal Processor Source) Source
2. RFU (Rudder Follower Source) Source
3. HDG (Heading) Source
  - ComNav GNSS GPS Compass is under this category.
  - ComNav SSRC Compass is also under this category.
4. NAV (Navigation) Source

- 5. POS (Position) Source
  - ComNav GNSS GPS Compass is under this category.
  
- 6. COG (Course Over Ground) Source
  - ComNav GNSS GPS Compass is under this category.
  
- 7. SPD (Course Over Water) Source
  
- 8. Backup HDG (Heading) – Use for alarm only, not for a backup in case of lost heading.
  
- 9. Mag-Var Source

*NOTE: By default, the P4 Autopilot will select all of the above Data Sources automatically available on the N2K network. If there is more than one same Data Source (PGN) on the network, the P4 Autopilot will pick the first that is available. If there is none available, the P4 Autopilot will do nothing. It is up to the user to confirm they are using the correct data for navigations.*

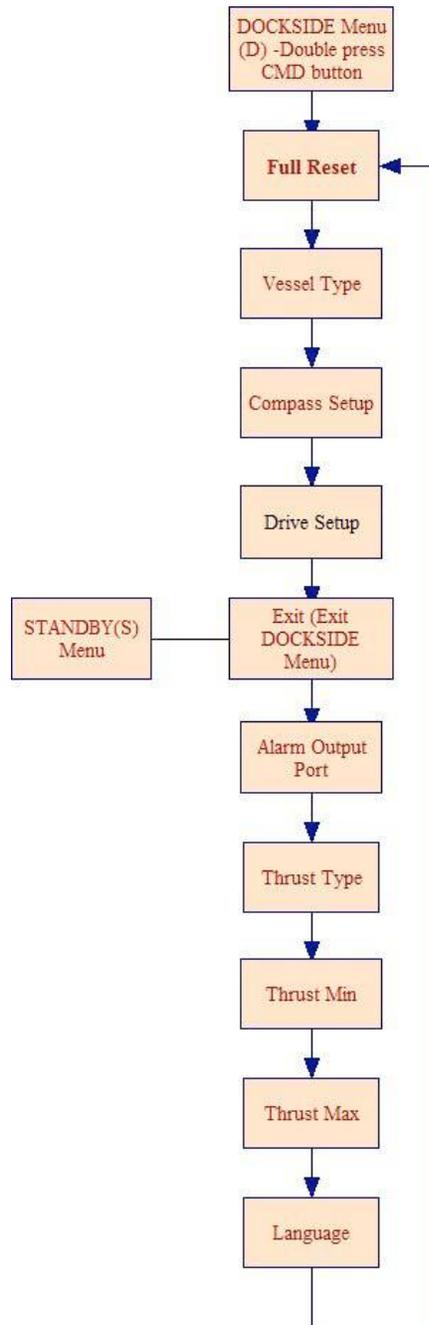
### Setup Menu



1. Set up the adjustable parameters for use in **STANDBY**, **P.STR**, **AUTO**, **WORK** and **NAV** modes which are stored in the P4 SPU.
2. Configure any non-N2K devices such as the Analog devices, NMEA0183 devices, Drives, Pumps and Rotary Followers that are directly wired to the P4 SPU. After the SPU Setup has been done, the non-N2K units (such as Analog Compasses, Rotary Feedback, P4 SPU Nav1 Port and P4 SPU Nav2 Port), will be assigned through the P4 SPU with a unique N2K address and description which will appear on the N2K network. Please note that P4 SPU Nav1 (NMEA0183) Port and P4 SPU Nav2 (NMEA0183) Port are on the N2K network all the time with configurations. Once the configuration of the Compass and Navigation Source (either through Network Config or SPU setup menu) has been done, the Compass Source can be switched simply to "Compass Source" in STANDBY mode or "Navigation Source" in NAV mode.

To access the Network Config menu, double-press the CMD button to bring up the MAIN Menu and then press the TURN KNOB button to select.

**SPU DOCKSIDE Menu: Available only** by pressing <> at the same time during the power-up. Then double press the CMD button.



## Reset

A full reset of all the P4's operating parameters will be initiated when the ENTER button is pressed and held until the word "Reset" changes to upper case "RESET." This change indicates that a full reset has been completed.

Resetting means that any configurations you have set (including Compass and Drive Setup), as well as all parameter adjustments you have made, will be lost. You should use the full-reset option only on the advice of an authorized ComNav service representative.

*Caution! A "full reset" means that ALL of the parameters in the entire autopilot system will revert back to the default settings installed at the factory. All custom information will be lost.*

## Vessel Type

Set the vessel type to match (as closely as possible), the kind of craft that the autopilot is being installed on. The system then automatically selects a specific set of equations and constants – for use in the P4's steering algorithms – which have been found to work reasonably well with typical craft of the chosen type. Also selected are the initial values of the Steering Parameters used in those equations (see the **Sea Trials** and **Auto Menu** sections for more details).

*NOTE: during Sea Trials, and later in normal operation, you can adjust any or all of the Steering Parameters' values, to better suit your own vessel, and/or the current sea conditions.*

Setting	Vessel Type	Comments
Stern	Stern Drive	Choose this for planing-hull boats with outboards or stern-drive legs.
Displ	Full Displacement	Choose this setting for full displacement boats that do not plane or rise out of the water at cruising speed.
Semi	Semi-Displacement	Choose this if your boat rises partially out of the water at cruising speed.
Large	Large, with a slow Helm response	Vessels in this category are typically over 125' LOA and/or 100 GRT (e.g., freighters, tankers, dredgers, car/truck ferries, fish processors, etc.).

**Table 4 – Vessel types**

## Compass Setup

Pressing the **ENTER** button when this line is highlighted starts the configuration menu for various compasses the autopilot can work with.

You should make sure that you have connected your compass to the correct port. Wiring diagrams are provided in the System Overview for Compasses. You should also refer to your compass manual for special requirements. See the **Compass Setup – Dockside** procedure for full details.

## Drive Setup

Pressing the **ENTER** button when this line is highlighted starts a script in which the autopilot automatically determines the orientation of the Rudder Follower Unit, measuring the physical limits of the rudder's range of motion, figures out what kind of steering system (i.e. reversing motor, solenoid, etc.) is installed, and then tests all of these to make sure everything is operating properly. See the **Drive Setup** section for more information.

## Exit

Press the **ENTER** button to exit the Dockside Setup menu and restart the autopilot in STANDBY mode. Alternatively, you can press and hold the red STANDBY button to shut off the autopilot.

## Alarm O/P (Alarm Output Port)

This parameter controls the function of the External Alarm Output. See the **Watch Alarm** and **External Alarm** sections in the **Advanced Operations** chapter for full details.

## Thrust Type

## Thrust Min

## Thrust Max

If the optional CT7 Thruster Interface is installed with your P4 system, you will need to make adjustments to these settings. Complete instructions are included with the CT7 Thruster Interface.

## Language

This parameter allows you to set the language used for the menus and messages that appear on the Control Head. However by default, a few items remain in English at all times, typically where there is no simple translation for that item. Also, the word "Language" on the menu is always shown in English.

Choices are as follows:

- English - English
- Français - French- software upgradable
- Español - Spanish- Software upgradable
- Íslenska - Icelandic- Software upgradable
- Italiano - Italian- Software upgradable
- Norsk - Norwegian- Software upgradable

*NOTE: other languages may be added in future Firmware Upgrades.*

## Setup Procedures

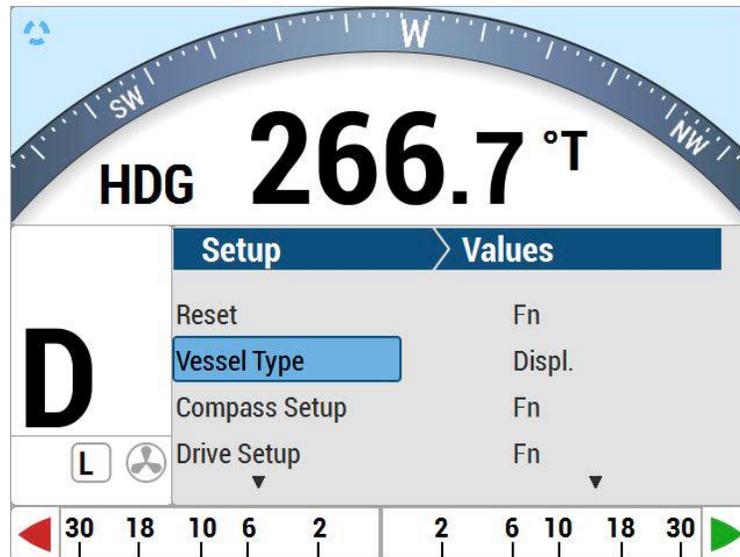
The following section describes how to set-up any or all of the devices (such as Magnetic/Fluxgate compass, Solenoid, Rotary Feedback, and/or NMEA0183 devices) wired directly into the P4 autopilot system.

- First, input your vessel type into the autopilot, and then specify the characteristics of the Rudder Drive mechanism on the craft.
- Next, input what type of Compass(es) it will be using, and have the system verify that it can use those compass(es).
- Next compensate and calibrate all of your compasses.
- Next, do the initial settings of the various operating parameters (Rudder Gain, etc.) at high and low speed.
- Finally, test how well the autopilot performs in various sea conditions, re-adjusting parameters as needed.

*NOTE: The configuration will be transparent to the N2K network.*

## Selecting Vessel Type

1. Power the system up, in the Dockside Setup menu
2. Select the Vessel Type menu line shown in [Figure 51](#), and set the type of your boat (see [Table 4](#) - Vessel Type).



**Figure 51 – Set Vessel type**

*NOTE: At this step in the setup process, all of the various Vessel Types (Displacement, Stern, Semi, etc.) can be selected, for P4 autopilot.*

## Drive Setup

The procedure for setting up the autopilot to work properly with your boat's steering system varies, depending on whether or not you have fitted a Rudder Follower Unit.

For a P4 system which has an RFU fitted, the Rudder's characteristics are automatically measured by the autopilot, during **Drive Setup P4**.

However in both cases, the purpose of the procedure is to find out:

- The type of drive system (solenoid(s) or a reversing motor) the boat has.
- The orientation of the RFU (if one is fitted).
- The direction the rudder moves in relation to the voltage polarity of the drive outputs from the SPU.
- The Hard-Over to Hard-Over time of the rudder
- The physical limits of the rudder's travel.

To begin the Drive Setup procedure, scroll through the Dockside Setup menu to "Drive Setup", then press the **ENTER** button. This will start the setup's automated script.

You will see a series of screens, prompting you for various actions or information. For example: move the rudder all the way to Port, or center it, or enter the maximum deflection of the rudder, etc. (This could be an actual rudder, an I/O leg, an outboard motor, etc. – all are referred to here as "rudders").

Some points to keep in mind while doing this procedure are:

- Use the boat's manual steering system (wheel, tiller, etc.) to move the rudder, when prompted.
- When moving the rudder to the maximum Port or Starboard position, be sure to move it all the way to the physical stops.

*NOTE: in normal operation, the autopilot always stops the rudder a few degrees away from the position of the physical stops, to avoid unnecessary, repeated impact against them.*

The speed at which you move the rudder manually is not critical, nor does it matter if you move the rudder back and forth a bit when it reaches the requested position.

Do not be concerned if the Rudder Angle Indicator shown on the screen initially goes in the wrong direction. The autopilot will correct any inconsistencies during the procedure.

If for some reason, the autopilot was not able to detect the type of drive, you will see a "Drive Detection Failed" screen. If this happens, go back to the Dockside Setup screen, re-check all the drive wiring, and then re-start the Drive Setup procedure (The word "Drive", as used on the menus, sometimes refers to the hydraulic and/or electrical system that the boat uses to control the steering mechanism (rudder, etc.), and other times to the mechanism itself).

If you continue to have problems, contact your ComNav Dealer for assistance.

## Drive Setup Continued

After detecting the drive type, a P4 with an RFU gives you the option to bleed your hydraulic steering system. If you wish to do this, please refer to the hydraulic system's manual. When all bleeding is done, press the **ENTER** button on the Control Head.

If you do not have a hydraulic system, just press the **ENTER** button on the Control Head.

When the P4 with an RFU is testing the drive system's performance, it will run the rudder from hard-over port to hard-over starboard a number of times. It will also make a series of short movements of the rudder – quick starts and stops – in order to determine a base reference for how the steering system responds to the typical small movements the autopilot uses during normal operation.

After the autopilot has determined the time span for a Hard Over to Hard Over movement of the rudder, there are several possible results:

- If the HO-HO time is too fast (less than ~5 seconds), the setup may fail. That's because if the Rudder moves too quickly, it can not be safely controlled by the autopilot.

- However the setup may also fail if the HO-HO time is too slow (more than ~22 seconds), because the autopilot will not be able to control the Heading of the boat properly.

In either case, you will need to make some changes to the drive system, to slow it down or speed it up, as determined by your specific application.

If the drive system is a reversing motor (in a hydraulic or cable drive system), and it did not test as too slow, you will see an option to have the autopilot slow down the rudder intentionally.

Slowing it down is done by using Pulse Width Modulation (PWM) on the SPU's drive output voltages. PWM in effect lowers the voltage "seen" by your drive system's motor(s), and thus slows down the rudder's HO-HO time.

On most boats, it is probably not necessary to slow down the rudder, unless the HO-HO time is less than ~10 seconds. However, every vessel is different, and so the choice is left up to you.

If you do choose to slow it down, the rudder movement will be re-tested (in the same sequence of test steps that you just did), but with it slowed down using a PWM signal that should run the motor(s) at about 65% of full speed (i.e., the HO-HO time should be ~50% longer than at full speed).

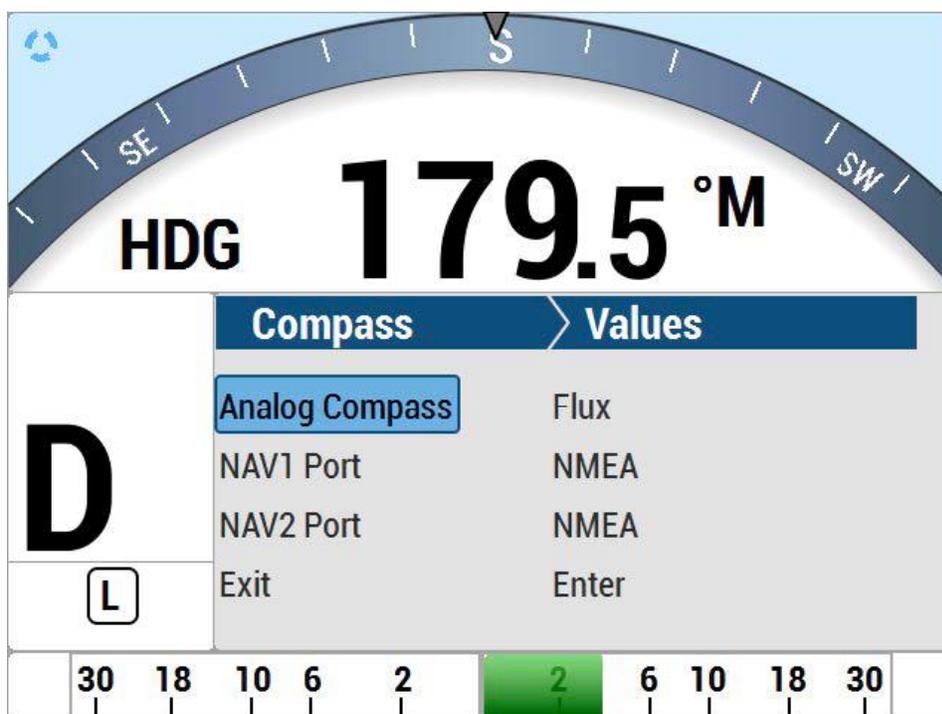
If this happens, but you still wish the autopilot to slow down the rudder, you may have to re-route the wiring, and/or use better (possibly shielded) wiring, and/or take other typical "noise reduction" steps. Contact your ComNav Dealer for assistance.

When Drive Setup is all done, record the settings and choices you made, in **Settings - Compass Setup – Dockside**

*NOTE: Slow-down is automatically selected for Stern Drive boats when operating using the "Hi" Parameter Set. Also, Pulse Width Modulation may increase the electrical "noise" emitted from the drive system's wiring, potentially causing interference with other equipment.*

## Compass Set-up

Highlight Compass Setup shown in [Figure 52](#) and press **ENTER**. The list of all four supported compass heading sources will be displayed (see [Table 5](#)).



**Figure 52** – Set Compass Type in Compass Configuration menu

The first step in setting up your compass(es) is to verify that it is (or they are) properly wired to the SPU.

After the verification, depending on which compass or compasses you are using, you must do the calibration or configuration one at a time.

All calibration or configuration should be done while tied up to the dock, in case any re-wiring needs to be done, or if it turns out that some elements of the P4 system need to be moved.

*NOTE: during these steps, the autopilot may issue an INVALID HEADING alarm. These alarms can be ignored, by hitting the **ENTER** button.*

Once a compass is “found” during this procedure, the alarms should cease.

## Analog Compass

An analog compass may be in the type of Magnetic, (ComNav) Fluxgate, Fluxgate with fixed reference, or float reference. If you don't have an analog compass, leave the Analog Compass selection to "None" and move to the next line.

If you are not already in the Compass Configuration menu as seen in [Figure 52](#), start by selecting Compass Setup with the **ENTER** button from the Dockside Setup menu (see the Dockside Setup menu as shown in [Figure 50](#)).

- Highlight "Analog Compass", and turn the knob to set the type according to what compass you have.
- Press **ENTER** to verify that the selected compass type is properly connected and can be read.
- A "Please Wait" screen will be displayed for a few seconds.
- The results of the search will now be displayed, along with an option to "Compensate Now?" or "Set North Now?" The type of Analog compass that is shown, and the "Compensate" or "Set" option, will depend on what you selected for "Analog Compass."
- Skip the compass/HRS compensation process (press the PORT button), since this can not be done while still tied up at the dock.
- If the autopilot could not find a compass that matches with the type you have selected in step 2, it will display a "not found" error message at this point.

*NOTE: Some compass types can masquerade as others, so be sure you have selected the correct type at step 2.*

Check your installation to be sure that the compass is wired correctly. Fix any problems, and re-start at step 2. Return to the Compass Configuration menu.

Contact your ComNav Dealer for help, if necessary.

## NAV 1 Port

NAV Ports are always available as a compass source for a NMEA 0183 compass and need not be installed. However, if you have a NMEA 0183 Tri-Axis Rate Gyro Compass connected to a NAV1 port, you can calibrate the compass when your boat is on the water. See **Compass Setup** – on the water for setting up Tri-Axis Rate Gyro Compass.

## NAV1 or NAV2 Port for general NMEA0183 Compass

For other NMEA compasses – such as a G2 or G2B GPS Compass – you should refer to the setup and configuration instructions that are supplied with it.

Some points to keep in mind:

- For proper performance of the autopilot, the update rate of the Heading sentences from the NMEA 0183 compass must be ~10 Hz
- Typically, you can set the sentence update rate in an NMEA compass using a generic “terminal” program, or a product-specific “control” program, on a PC (e.g., HyperTerminal, or Airmar’s WeatherCaster™)
- Be sure to make that 10 Hz rate the “power-on default” rate (More than 10 Hz is not useful, but at much less than that the autopilot will not be able to maintain good control of the vessel’s steering).
- Whenever a NMEA 0183 compass is being used as the Heading source, if valid Heading/Compass data sentences are not received for ~3 seconds, an INVALID HEADING alarm will occur.
- If you are going to be using only Magnetic Heading values, or only True Heading values, then you only need to set the NMEA0183 compass to output the corresponding sentence – HDG or HDM for Magnetic, HDT for True.
- If you wish to be able to switch between True and Magnetic (via the Heading parameter in the System menu, then HDT and either HDG or HDM should be enabled, with both HDT and HDG/HDM at 10 Hz (see the section on “Bandwidth” later in this chapter).
- To verify that an NMEA compass is connected, look at the “NMEA IN” LEDs in the Diagnostic section; the LED for the SPU’s NAV input which the compass is connected to should be flickering.

*NOTE: if the `A` and `B` wires are connected backwards, the LED will still flicker; but when NAV1 or NAV2 is later selected at the Compass Source in the Standby menu, no Heading will be displayed, and a NO HEADING alarm will occur. If this is the case, simply reverse the `A` and `B` wires.*

Be advised that some NMEA0183 compasses, even if correctly wired, will sometimes be outputting Null Heading values. For example, the G2/G2B, if it can not detect enough GPS satellites well enough to be able to compute the Heading, it will output these sentences:

- **\$GPHDM,,M\*1B**
- **\$GPHDT,,T\*1B**

In these cases, the Heading data fields (between the commas) are empty, meaning “null” or “nothing” (not “zero” – since 0 is a valid Heading value). This will result in no Heading being displayed on the Control Head, and trigger a NO HEADING alarm. To deal with this condition, please refer to the NMEA compass’ manual – and in the meantime, use one of your other on-board compasses.

### Bandwidth of an NMEA Compass Connection

You must always ensure that the maximum bytes/second capability (aka “data rate” or “bandwidth”) of the serial link between the NMEA compass and the autopilot is not exceeded by the enabled sentences.

The maximum data rate of an NMEA 0183 serial link is always 1/10th of the link’s Baud Rate. An example calculation:

- The Baud Rate of the SPU’s NAV1 input is fixed at 4800, so if the NMEA compass is connected to NAV1, it must be configured to output at 4800 Baud, and the max data rate is then 480 bytes/sec.
- HDT and HDM sentences are each 20 bytes long, and HDG is 33.

Thus, it is possible to have both HDT and HDM at 10 Hz each, connected into NAV1:

$$- \quad 20 \times 10 + 20 \times 10 = 400 \text{ bytes/sec} \dots < 480 \text{ bytes/sec}$$

But it is not possible to have both HDT (or HDM) and HDG into NAV1:

$$- \quad 20 \times 10 + 33 \times 10 = 530 \text{ bytes/sec} \dots > 480 \text{ bytes/sec}$$

However, since the Baud Rate of the SPU’s NAV2 input can be either 4800 or 9600, the max data rate is 960 bytes/sec. So both HDT (or HDM) and HDG can be used into NAV2, at 10 Hz each (NAV2’s Baud Rate is automatically set by the SPU – by looking for “correct” NMEA sentences at each rate possible). This check must include any other NMEA sentences output from the NMEA compass.

As an example: the G2/G2B can also output the boat’s Speed Over Ground (in the VTG sentence – 45 bytes), which can then be used as the autopilot’s Speed Source data input:

The factory default setting of the G2/G2B is HDT and HDM is at 10 Hz each, and VTG is at 1 Hz (on Port B). That is indeed useable on NAV1, as well as on NAV2:

$$- \quad 20 \times 10 + 20 \times 10 + 1 \times 45 = 445 \text{ bytes/sec} \dots < 480 \text{ bytes/sec}$$

The total bytes/sec of all sentences must always be less than the link’s max data rate.

Problems caused by exceeding the max data rate are usually very hard to troubleshoot. The excessive rate will cause data errors, mostly in the form of partial sentences (caused by buffer memory overflow in the sending device, and/or in the SPU). These are always invalid, so the SPU simply discards them.

However that also can cause other subtle problems. For example, if the Heading sentences are being truncated, a few will usually still get through, and so the SPU will not raise a NO HEADING alarm (the SPU's error-detection routines do not measure update rates, they only check if any valid data is being received). However, the effective Heading update rate will be less than is required for acceptable steering – so the autopilot will seem to be “steering poorly.”

A specific case: if the Heading data source device is nominally transmitting valid Heading sentences at 10 Hz, but only 2 per second are getting through, then the effective Heading update rate that the autopilot is using is 2 Hz. And that's much too low for adequate steering. Similar problems can occur with other NMEA data used by the autopilot (speed, position, waypoints, etc.), if the link max data rate is exceeded.

Compass Source	Setting	Compass Type	Comments
Analog Compass	Mag		<p>Choose this setting if you have an externally gimbaled magnetic compass fitted with a ComNav Magnetic Sensor, such as the one shown to the left.</p>
	Flux		<p>Choose this setting if you have a ComNav Fluxgate Compass like the one shown to the left.</p> <p><i>If you have a ComNav Heading Rate Stabilizer connected in series with the Fluxgate Compass, use the HRS setting (below).</i></p>
	Fixed	—	<p>The autopilot can accept a variety of Analog compasses. Consult the manufacturer's documentation, or contact the manufacturer, to determine whether the reference signal is fixed or floating, and set the An. Compass Type to match.</p>
	Float	—	
	SSRC1		<p>Choose this setting if you have a ComNav Tri-Axis Gyro Rate compass connected.</p>
NAV1 Port	NMEA		<p>Choose this setting if your autopilot system is utilizing any type of NMEA 0183 Compass (such as the ComNav G2 or G2B GPS Compasses) other than Tri-Axis Rate Gyro compass or a specific NMEA compass that ComNav may support in the future. This type of compass usually does not require specific calibration, or can be calibrated through other means.</p>

**Table 5 – Compass types**

## Compass Setup – On the Water

The final steps of compass setup should normally be performed only after all other installation and setup procedures for the autopilot system are completed, so that all net electrical and magnetic effects of the installation on the compass(es) are taken into account.

First you must compensate the compass(es) for Magnetic Deviation (in the P4 Autopilot, Magnetic Deviation compensation of Fluxgate Compasses, and only corrects for Hard-Iron effects. Soft-Iron effects are not corrected for).

Next, you may need to calibrate each compass (IE; correct for any inherent constant directional offset in each). In relatively calm conditions, you will then need to take your vessel out into open water (the sea, a lake, a river, etc.) for real world calibration and testing.

It is important for you to have sufficient on-water space to put the boat through a series of fairly slow and wide circle turns, and to run the boat for several minutes on a straight track at various headings, without encountering obstacles, other marine traffic, etc. You should also avoid areas around bridges, underwater power lines, and pipelines, as these can affect your compass(es).

**Caution!** *Be sure to maintain a proper lookout for any other vessels and hazards, while doing any of the circle turns and manoeuvres described below.*

During any of these procedures, the INVALID HEADING alarm may occur. You can cancel it by pressing the **ENTER** button, or simply leave it active.

*NOTE: some of the steps performed here require you to be familiar with the STANDBY mode and menu of the autopilot.*

## Compensation for Magnetic Deviation

The procedure you use to compensate your compass(es) depends on the type(s) of compasses that you have installed. Some procedural elements are all the same:

You can take as long as you like to start the turns required to compensate any of the compasses requiring it, but once the SPU detects that you have started the turns, you have ~6 minutes to complete enough turns, before a “Failed ...” screen appears.

You may choose to do the turns either to Port or to Starboard. It doesn't matter which way, as long as you do not reverse direction during the compensation step.

Boat speed matters only in that it should be sufficient to hold a constant rate of turn (of about 2 to 3 degrees per second), meaning that the full circle should take between 2 and 3 minutes. As well, conditions should be calm enough that you can make smooth, steady turns, without rough seas altering the results.

## Magnetic Compass Sensor

ComNav strongly recommends that a professional compass adjuster compensate Magnetic Compasses. The Sensor itself does not require compensation, only calibration.

## ComNav Fluxgate Compass (and other fluxgate compasses)

1. Power up the autopilot in the Dockside Setup menu.
2. Select “Compass Setup” and press the **ENTER** button.
3. Highlight “Analog Compass.” Make sure the parameter is set correctly for the type of Fluxgate Compass that you are using, then press the **ENTER** button.
4. After the autopilot has auto-detected the compass, you will see a prompt to do the compensation. Press the **STARBOARD** button at this time. During the compensation, you will see a “Turn at 3°/s” prompt on the screen.
5. Manually steer the boat in a circle (either port or starboard).
6. Keep turning until the display reads “Compensation OK.” Usually, it takes a bit more than one full turn, but sometimes it can take 2 or 3 turns.
7. If after several turns the display still does not read “Compensation OK,” or if it says “Compensation Failed”, check all wiring and/or relocate the compass, then begin the procedure again.
8. Press the **PORT** button to go back to the Compass Configuration menu.
9. The Fluxgate Compass is now compensated and ready for use – although it still may need to be calibrated.

If you continue to encounter difficulties, please contact your ComNav Dealer for assistance.

## Tri-Axis Rate Gyro Compass - SSR1

*NOTE: You will only be able to calibrate the gyro compass when the compass is connected to the NAV1 port, and you have followed the wiring in [Figure 30](#).*

1. If you are not already in the Compass Configuration menu, begin by selecting “Compass Setup” and then pressing the **ENTER** button from the Dockside Setup Menu (see the Dockside Setup Menu).
2. Move the highlight to “NAV1 Port”, set the parameter to “**SSRC1**”, then again press the **ENTER** button.
3. The rest of the compensation procedure is same as steps 4 through 9 in the section on compensation for Fluxgate Compasses.

## Other NMEA Compasses

Many NMEA compasses will not require compensation such as the ComNav G1/G2/G2B GPS Compass. In all cases, you should refer to the instructions that came with your compass to determine whether compensation is needed and how to do it.

## Calibrating for Compass Offset

Even after your compass(es) are compensated for Deviation, they still may not be providing an accurate reading.

Any or all of them may have an individual fixed offset, so you must define what each one's calibration value is to the P4's SPU.

Calibration is a simple matter of synchronizing each compass's directional readings, as seen by the SPU, to the actual magnetic direction values of the Earth's magnetic field.

## All Compass Types

1. Bring the vessel onto a known bearing and maintain it there by steering manually. The autopilot should be in STANDBY mode.
2. Double-press the STANDBY button to bring up the Standby menu. Select "Compass Source," and then set it to the correct value for the first of your compasses:
  - "Analog" for a Magnetic Sensor, a ComNav Fluxgate Compass (with or without HRS), or a non-ComNav Fixed or Floating Analog Compass already connected to the P4 SPU.
  - "NAV1" for an NMEA0183 compass connected to the IN-1 pins of the **J9 - NAV I/O** of the P4 SPU connector.
  - "NAV2" for an NMEA0183 compass connected to the IN-2 pins of **J9 - NAV I/O** connector of the P4 SPU.
  - "N2000" for an NMEA2000 compass already connected to the N2K network of your choice.
3. Move the highlight down one position to "Compass Cal" for compass calibration. Using the COURSE CHANGE knob, adjust the reading so that it matches the known bearing that the boat is on.
4. For any changes, simply increase or decrease the value stored in the P4's settings memory, by 1° per click of the COURSE CHANGE knob (when you first set up your compass(es), the initial calibration value for each compass is the value it was outputting at the time it was detected during Dockside Setup).
5. Move the highlight back to "Compass Source", and select the next type of compass you have. Repeat step 2, then repeat for all other compasses.
6. Double-press the STANDBY button to exit the Standby menu.
7. Verify that the compass heading shown matches the actual heading of the boat, and stays steady, by holding a number of constant-heading courses for a few minutes each.

*NOTE: NMEA0183 or NMEA2000 compasses (e.g., the ComNav G2/G2B GNSS GPS Compass) typically do not require on-the-boat calibration. You should however refer to the Installation and Operation manual that came with your NMEA compass to verify this.*

Even if your NMEA compass does require calibration, it may not be necessary to set the value in the P4 Autopilot. Many – if not most – NMEA compasses can store their own calibration value. If that is the case in your application, you should skip the steps below, and follow the instructions that came with your NMEA compass. However, if you wish to set a calibration value for an NMEA0183 compass in the autopilot, you may do so. In fact, you may set two values – one for each of NAV1 and NAV2.

## Magnetic Sensor

There is an alternative calibration procedure, for Magnetic Sensors only:

1. Power up the autopilot in the Dockside Setup menu.
2. Select Compass Setup and press the **ENTER** button.
3. Highlight “Analog Compass” and set the parameter to “Mag”; press the **ENTER** button
4. After the autopilot has auto-detected the compass, it will ask you if you want to “Set North Now?” Press the STARBOARD button.
5. Manually steer the boat so that it is pointing to Magnetic North. Hold it on that heading and push the **ENTER** button. The autopilot will store the current heading and reference it as 000° Magnetic, and then automatically return to the Compass Configuration menu.
6. Highlight “Exit” and then press the **ENTER** button to return to the Dockside Setup menu.
7. Exit the Dockside Setup menu. After a brief pause the autopilot will restart and automatically go into STANDBY mode.

## Compass Setup – Final Steps

At this point, the entire Compass Setup procedure should be complete.

All of the compass settings and compensation/calibration values will be retained when the autopilot is turned off. As a backup, you should manually record all compass selections and settings, in the Settings chapter at the back of this manual.

It should not be necessary to re-compensate or re-calibrate any of your compasses again, unless the electrical/magnetic environment on your boat changes substantially. For example if you add any new electronic equipment, etc. You should also redo the initial compass setup if you travel with the vessel further than approximately 10° of Latitude away from the initial setup location– or to an area where the local Magnetic Deviation is known to be different (for example where there are a lot of submerged/wrecked vessels).

It is always a good idea to check all the compasses on your boat, for accuracy in all directions, on a regular basis - approximately once or twice a year - and before setting off on any long voyage. A good way to do a quick check is with any of the traditional “box the compass” methods, which every professional mariner should have learned as a novice. Simply find some convenient ranges which have good cuts between them, and steer back and forth along them.

Steer various straight tracks, in as many directions as possible, between pairs of charted objects. Determine the Coastal and Marine Geology (CMG) between various plotted positions (with GPS, or with two or three-bearing LOP fixes with a good Pelorus or hand-bearing compass, etc.) on your paper charts.

You might even want to do a box-the-compass confirmation right now, simply as a final “double check” of the compass setup you just completed.

## Sea Trials

Sea Trials allow you to test out the basic functions of your P4 autopilot while underway, and to fine-tune the steering parameters for the best performance. The goal is to achieve accurate course-keeping, and smooth, rapid changes of heading, without excessive movements of the boat’s rudder.

*NOTE: before you begin Sea Trials, it’s a good idea to review how you steer your vessel manually, and how that compares to how the P4 performs when steering the boat under autopilot conditions. Please re-read the chapter on “How Autopilots Work.”*

During Sea Trials, you will test the default Steering Parameters of the P4 on your specific vessel, and make adjustments if necessary. When the Steering Parameters are properly adjusted and fine-tuned for your boat, the autopilot will do the same as you would manually; which is to allow the boat to adapt to the body of water, yet still maintain as straight a track as possible in the current conditions, on the desired heading or course.

*NOTE: To accurately and successfully complete Sea Trials, you must be familiar with the operation of the autopilot in AUTO mode and with the specifics of the Auto menu.*

## Sea Trial Procedure

The initial Sea Trials should be done in relatively calm conditions.

### Adjust Rudder Gain and Counter Rudder for Hi Speed

1. Bring the boat up to a speed where the boat’s rudder (or steerable-thrust system, such as an outboard or I/O leg), provides sufficient steerageway that it has accurate, firm control of the boat’s direction of travel. Typically, this will be less than your normal “cruising speed,” perhaps by quite a margin. For many boats, this will be around 7 Knots.
2. Bring up the Auto menu, highlight “Parameter Set” and select “Hi”.
3. If ALC is set to “On”, highlight it and set it to “Off”.
4. Start with “Rudder Gain” and “Counter Rudder” set to the factory defaults (for Hi): 5 and 3.

5. Highlight “Seastate” and set it to 1.
6. Highlight “Turn Rate.” Select a setting that is approximately  $\frac{3}{4}$  of your boat’s comfortable turning rate at a normal cruising speed (to find your “Comfortable turning rate,” simply time a complete 360° circle while the vessel is performing a safe yet tight turn, at the normal cruising speed. A “Comfortable turning rate” is 360° divided by the number of seconds it took to complete the circle).
7. Exit the Auto menu.
8. Switch to AUTO mode (before switching into POWER STEER, AUTO or NAV modes, the rudder must be at the dead-ahead position). The autopilot will then automatically take your current heading and use that as the Course to Steer.
9. Run for about 5 minutes. If the boat “esses” back and forth more than about 3 degrees, bring up the Auto menu and reduce the Rudder Gain setting by 1 step, then test again.

### **On a P4, or P4VS with a Rudder Follower**

Make a medium Heading change, say 15°– 20°, with the COURSE CHANGE knob.

Observe how the boat responds, as it turns and settles into the new heading:

- If the boat stops turning before the new heading is reached and then approaches it slowly, either increase the Rudder Gain by 1, or decrease the Counter Rudder by 1.
- If the boat overshoots the new heading, and then makes several turns back and forth across the new heading before settling down (known as “essing” or “overshooting”), either decrease Rudder Gain, or increase Counter Rudder by 1.
- If the boat approaches the new heading, shies away, then approaches and shies away again, decrease Counter Rudder by 1.

Continue making those medium heading changes, adjusting Rudder Gain and Counter Rudder as needed, until the boat settles smoothly onto the new heading without excessive overshoot.

## On a P4VS without a Rudder Follower

In this application it is necessary to start by testing how well the boat does small turns, before testing how well it settles onto a new heading. Also, the optimum Rudder Gain setting must be found first, before adjusting the Counter Rudder setting.

1. Make a small Heading change ( $\sim 5^\circ$ ), and observe the turn:
  - If it makes an abrupt turn, reduce the Rudder Gain one step.
  - If it takes too long to turn, increase the Rudder Gain by one step.
2. Repeat the small change of heading in the same direction, observe the response, and adjust the Rudder Gain as needed, until the turn is at a safe, comfortable rate.
3. Repeat the sequence in the other direction. Then repeat in both directions a couple of times, until you are satisfied.
4. Now make a larger heading change ( $\sim 10^\circ$ ). Observe how the boat settles in on each new heading:
  - If it approaches the new heading too slowly, increase the Rudder Gain.
  - If it keeps “essing” back and forth across the new heading, reduce Rudder Gain.
5. Keep doing turns, and adjusting the Rudder Gain as needed, until the boat settles in on the new heading, with no more than two overshoots.
6. Now make some  $30^\circ$  heading changes, in both directions.
7. Adjust the Rudder Gain up or down a bit as needed, until the boat settles on the new heading with no more than two “esses”.
8. Now increase Counter Rudder by 1, and make some  $10^\circ$  heading changes.
9. Repeat this until the boat settles in on the new heading with little or no “essing”.
10. Repeat the steps for a P4VS with an RFU, using gradually larger Course changes, up to  $40^\circ - 50^\circ$ .
11. Repeat the above adjustments on several different headings until you get consistently satisfactory results.
12. Reduce the Rudder Gain by 1, then increase speed to your normal cruising speed, and repeat steps for both P4/P4VS with and without an RFU. If the rudder is moving by large amounts – more than approximately  $5^\circ$  side to side – during any of the steps, you should reduce the Rudder Gain even more. You should also do so if the boat steps up onto plane when you increase speed, because the rudder’s steering effect is typically much stronger once a boat is planing.

You can leave the higher speed tests for later, if it is not safe to run at that speed where you are doing your Sea Trials.

## Adjust Turn Rate for Hi Speed

1. Adjust the Turn Rate setting to the full comfortable rate (per the previous step 6).
2. In AUTO mode, make a few course changes of  $20^\circ$  or more, to ensure that the rate of turn is indeed comfortable at normal cruising speed; if it is not, reduce the Turn Rate setting until it is.

## Adjust Seastate for Hi Speed

1. To set Seastate, switch to AUTO mode, and then watch the Port and Starboard rudder movement arrows at the ends of the screen's RAI bar. In normal conditions, there should be rudder movement about 15% to 20% of the time.
2. If the autopilot is over-active, increase the Seastate until the arrows blink less often. If the autopilot is under-active, decrease the Seastate.

## Adjust Rudder Gain, Counter Rudder, Turn Rate and Seastate for Lo Speed

1. Adjust boat speed to what will be your lowest normal "low speed" – that is, the lowest speed at which you will ever choose to use the autopilot (for most vessels, a good speed to do the "low speed" adjustments is at or below the maximum speed in a Speed Control Zone or "no wash" area – usually 5 Knots).
2. Bring up the Auto menu, highlight "Parameter Set" and select "Lo".
3. Repeat the steps in the Hi speed Rudder Gain and Counter Rudder adjustment process discussed previously (the starting value to use for Lo speed Rudder Gain is the factory-default of 8).
4. Adjust the Lo speed Turn Rate setting to suit your preference. Make a few Course changes of 40° or more to ensure that the rate of turn is comfortable.
5. Adjust the Lo speed Seastate setting to suit your preference.

## Adjust Speed Trip Point

1. Bring up the Auto menu, and set the Trip Point speed to something mid-way between the speeds used for setting the Hi and Lo speed parameters in the steps discussed previously. This should be a speed you will never travel at for any length of time – for example, in a planing-hull boat, it would be a speed just a little bit less than where the hull starts to get up on the step.
2. Bring up the Auto menu, highlight "Parameter Set" and select "Auto".
3. In AUTO mode, change the boat speed back and forth between the Lo and Hi speeds you will normally use. The vessel should continue to maintain a straight Track along the heading you are on, and you should see that the display's Parameter Set indicator changes back and forth between "L Auto" and "H Auto" as you change speeds.

## Adjusting for Rougher Sea Conditions

The primary desire of any autopilot user is that the system steers the boat safely and accurately, across all sea conditions.

Adjusting the steering parameters in calm conditions – as you did during the initial part of the Sea Trials, above – gives a base reference for all other conditions. After doing those adjustments, you can then venture into rougher sea conditions.

Take all the time necessary to ensure that you are getting the best performance from your autopilot!

**Some suggestions and points to keep in mind:**

- Typically, you will find that you will only need to make small changes to the “calm condition” steering parameters already set, to handle a wide variety of sea conditions.
- Observe the wake of the boat while maintaining a straight Course in AUTO mode. This is one of the best indications of how well the autopilot is steering.
- The vessel should come on to each new Course Heading smoothly. Any undershoot or overshoot can usually be observed in the wake. Adjustments to Rudder Gain and Counter Rudder, as in the tests mentioned previously, are how you achieve “smooth.”
- Generally speaking, the Rudder Gain and Counter Rudder settings for Hi speed will be less than those for Lo speed.
- As the seas get rougher, you will probably need to increase the Rudder Gain 1 or 2 steps.
- In very rough conditions, you may want to reduce the Counter Rudder setting, as well as increasing the Rudder Gain.
- In quartering seas, you may wish to increase Rudder Gain and the Seastate settings. This will allow the boat to yaw a bit more as it comes off of the waves, but typically the boat will come back onto course with minimal rudder movement.
- In the tests above, you will have determined the Turn Rate value which corresponds to the full “comfortable turn rate” of your boat.
- You do not need to leave the Turn Rate always set to that value, however. You can, and should, change the Turn Rate as required, to have safe, comfortable turning rates for the current sea conditions. You may also want to lower the Turn Rate for other reasons.

Once the autopilot system is steering satisfactorily, make a note of all your steering parameter settings, and manually record them in the Settings chapter, at the back of this manual.

# Basic Operations

## Basic Operations

This chapter describes the basic modes of operation and features of a P-Series system, and instructions on how to use them.

### Control Head LCD Screen and Buttons

All of your interaction with your autopilot system will be done using the Control Head:

- Selecting an operating mode
- Setting up the parameters you wish to use in each mode
- Monitoring your boat's heading
- Setting a desired heading to be followed, etc.



**Figure 52 – Using the Control Head**

The elements of the Control Head (with reference to the identifiers in [Figure 52](#)) are:

#### 1) LCD Screen

- While the system is powered, the LCD screen is normally displaying the compass heading, rudder angle, and mode of operation.
- It can also be displaying desired heading, system status, other information, or various menus.

#### 2) STANDBY (and On/Off) button

- To power on the system, press and hold this button until the LCD screen lights up, and then release it.
- To power off, press and hold this button approximately 3 seconds.
- The autopilot always powers up in STANDBY mode, and it can always be put into STANDBY mode, by pressing and holding this button for approximately 1 second.
- Double-pressing this button brings up (or exits) the Standby menu.

### 3) PORT button

- Pressing and holding this button while in POWER STEER mode moves the rudder to Port, and it keeps moving for as long as the button is held.
- Pressing and holding this button while in AUTO, NAV, WORK or modes allows you to avoid obstacles in the boat's path, by turning to Port.
- This button is also used in menu operations, to move the highlight to the previous line.

### 4) TURN button

- Pressing this button once while in AUTO or WORK modes queues the default pre-programmed turn. Subsequent presses of the TURN button scroll through all of the available turn-types.
- The pre-programmed turn sequence is then initiated by pressing either the PORT or STARBOARD button to indicate the direction of the turn.
- See the **Default Turn** section for more details on setting the default turn from the Special Turns available.

### 5) STARBOARD button

- Pressing and holding this button while in POWER STEER mode moves the rudder to Starboard, and it keeps moving for as long as the button is held.
- Pressing and holding this button while in AUTO, NAV, WORK or modes allows you to avoid obstacles in the boat's path, by turning to Starboard.
- This button is also used in menu operations, to move the highlight to the next line.

### 6) ENTER button (knob push)

- This is a multi-function button. On all boats except sailboats, this button invokes WORK mode while in AUTO or NAV modes; double-pressing the button will bring up (or exit) the Work mode menu.
- Pressing this button when an alarm occurs will cancel the alarm.
- This button is also used during Dockside Setup, and in operating modes and menus.

### 7) COURSE CHANGE knob

- This is a multi-function control. In POWER STEER mode, it changes the rudder angle in the same direction as the knob is turned.
- In AUTO mode, it changes the Commanded Heading in the same direction as the knob is turned (Note: Heading can not be changed during any HEADING Alarm).
- The knob is also used to change parameters in the various menus.

### 8) POWER STEER (P.STR) button

- Pressing and holding this button places the autopilot into POWER STEER mode.
- A double-press of this button brings up (or exits) the Power Steer mode menu.

### 9) AUTO button

- Pressing and holding this button places the autopilot into AUTO mode.
- A double-press of this button brings up (or exits) the Auto mode menu.

### 10) NAVIGATION (NAV) button

- Pressing and holding this button places the autopilot into NAV mode.

- A double-press of this button brings up (or exits) the Nav mode menu.

## Operating the System

### Operating Modes – Overview

Your P-Series autopilot system has four basic operating modes, known as **STANDBY**, **POWER STEER**, **AUTO**, and **NAV** mode.

A fifth operating mode, known as **WORK**, is a sub-mode of **AUTO** and **NAV** modes.

*NOTE: P4VS systems only support **WORK** mode, and only when an RFU is fitted.*

Changing modes is done by pressing and holding the button on the Control Head which is associated with the mode you want to enter:

- for **STANDBY** mode press the **STANDBY** button
- for **POWER STEER** mode press the **POWER STEER** button
- for **AUTO** mode press the **AUTO** button
- for **NAV** mode press the **NAV** button
- for **WORK** mode press the **ENTER** button

*NOTE: You must press and hold the new mode's button down for ~1 second. While you're holding it down, the current mode's indicator letter (in the upper-left corner of the screen) will flash. After the time delay, the mode change occurs, and the previous mode's letter is replaced by the new mode's letter (not flashing). This time delay is deliberately designed, as a safety feature, into the system's response to the mode-change (and some other buttons), to prevent accidental activation of those buttons' functions.*

Descriptions of the operating modes (and associated menus) can be found as follows:

- **STANDBY**, **POWER STEER**, **AUTO**, and **NAV** modes are in this chapter.
- **WORK** mode is in the **Advanced Operations** chapter.

## Mode Menus

Each of the operating modes has its own set of parameters that you can adjust, to configure and fine-tune how your autopilot system behaves in the respective mode. These parameters are stored in the system's non-volatile memory; you can view and change them with the Control Head, via sets of menus that appear on the LCD screen.

*NOTE: there is an additional menu – Dockside Setup – for parameters unique to the boat (e.g., compass type). It is described in the **Setting Up** chapter.*

The menus of the four main operating modes (**STANDBY**, **POWER STEER**, **AUTO**, and **NAV**) are accessed by using the respective mode buttons: the **STANDBY** button, the **POWER STEER** button, the **AUTO** button, and the **NAV** button. The **WORK** button is used to access the **WORK**.

To access a particular operating mode menu, double-press the button associated with that mode (e.g., the **NAV** button for the **NAV** mode's menu).

To exit a particular operating mode menu, double-press the associated button again, or wait about 10 seconds. The display will then revert to the active display of whatever mode the autopilot is operating in.

You can access any mode's menu whether or not the autopilot is currently operating in that mode.



**Figure 53 – A Typical Menu**

All menus are arranged with parameter names on the left side of the screen, and the current value for each parameter on the right side.

In each menu, one line is always highlighted in a contrasting colour – it indicates which parameter is currently selected (for example, see the “Network Config” - “SPU Linked” lines in [Figure 53](#)).

You can move the highlight to other lines on the menu by pressing the **PORT** button (moves the highlight up) or **STARBOARD** button (moves it down).

Some menus have more lines than can be shown on a single screen. In this case, when the highlight has been moved to the last line on a screen, each subsequent press of the **STARBOARD** button will cause the menu to scroll up by one line, revealing a new highlighted line.

Similarly, when the highlight has been moved to the first line on a screen, each subsequent press of the **PORT** button will scroll the menu down one line. These long menus are arranged in a circular fashion, so that the scrolling action can be carried on indefinitely.

Use the **COURSE CHANGE** knob to change the value of the currently highlighted parameter. For parameters with numbered values, a clockwise turn of the knob will increase the value; counter-clockwise movements will decrease the value. Non-numerical values are generally arranged in a circular list for ease of use. In general, changes made with the knob are effective immediately.

**Caution!** For safety reasons, a few items do not take effect until the highlight is moved to the next or previous line, or the menu is exited.

When a menu is being displayed, there is an icon at the top of the screen which looks like the **COURSE CHANGE** knob, but with a line drawn through it. This is a reminder that the knob is not available for its normal function of changing the boat's course – because the knob is now being used to change parameter values.

The autopilot's mode indicator letter continues to be displayed in menus. The current mode may not be the same as the menu (since all menus can be accessed in any mode). For example, in **Figure 53** both the mode ('S') and the menu are **STANDBY** – but the mode could be any of the others: 'P' (**POWER STEER**), 'A' (**AUTO**), etc.

All menus – except Dockside Setup – have a time-out feature. This time-out triggers after about 10 seconds if no button presses, or movements of the **COURSE CHANGE** knob, are detected during that time-out interval.

When a menu times out, the display reverts to the previously active display, just as though you had double-pressed the mode button again.

## Rudder Angle Indicator (RAI)

At the bottom of the screen in all operating modes is the Rudder Angle Indicator (**Figure 53**)

- On a P4 system (or a P4VS with an installed RFU), the RAI shows the current position of the boat's rudder, as measured by the Rudder Follower Unit.
- On a P4VS without an RFU, the RAI shows the estimated position of the rudder.

### Call Factory for availability of this option.

A "V" in a small box is shown at the right end of the RAI, to indicate that the autopilot is using the Virtual Rudder Feedback feature.

**Caution:** *The estimated rudder position on a P4VS may not always be accurate. Please refer to the Cautions section for more information.*

The current or estimated rudder position is shown by a solid bar extending from the centre to the right for Starboard rudder, or to the left for Port (rudder Dead Ahead, i.e., at 0°). The numerical scale above the bar (in degrees) is expanded around the centre, and compressed at the ends.

Starboard is always indicated by a green arrow, and Port by a red arrow.

The maximum length of the rudder position bar is defined by the rudder travel limit values detected or entered during setup. In this same bar, the rudder travel limits are displayed numerically. **Figure 53** shows both Port and Starboard limits as 30°.

**Caution:** *On a P4VS without an RFU, the position bar does not appear in **STANDBY** mode. The rudder travel limits bar is shown, but is always the default full length (40° to either side), no matter the limits entered during setup.*

Whenever the autopilot is moving the boat's rudder to Port or Starboard, a small "rudder movement" arrow symbol will be shown at the corresponding end of the RAI.

## Alarm Clear

Whenever an alarm or error message occurs on the P4, an audible alarm will sound, both at the SPU and at the Control Head, and a message will be displayed on the LCD.

The alarm will remain activated until the condition that caused it is remedied, or the alarm is cleared manually by the operator.

To clear the alarm manually, press the **ENTER** button once.

If the condition that caused the alarm remains, the alarm will reappear after approximately 20 seconds.



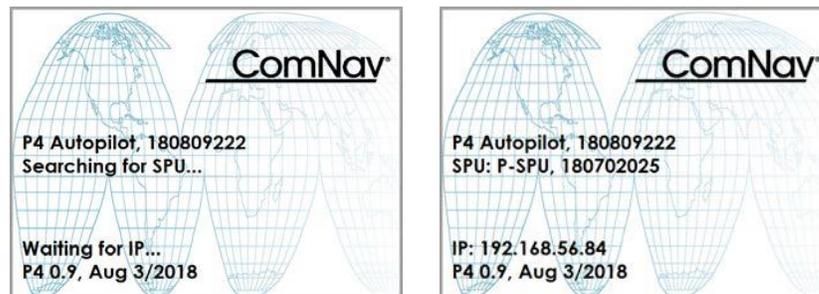
**Figure 54** – Standby Button

## Power On

The first step in using your P4 system is to *turn it on* ...

Press the Control Head's **STANDBY** button (**Figure 54**)

Press and hold until the introductory display appears on the LCD screen (**Figure 55**), then release the button.



**Figure 55** – Power On Sequence

On the SPU, the **BATT PWR**, **DRV PWR** and **VCC** diagnostic LEDs should all light up.

After a few seconds, the firmware versions of both the Control Head and the SPU are listed on the display. You should record those version numbers in the **Notes** section at the back of the manual, to reference should your autopilot ever require servicing.

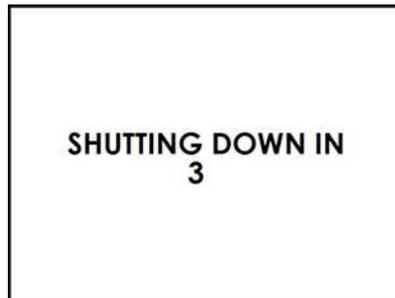
The autopilot then goes into STANDBY mode.

## Power Off

You can manually turn off the autopilot at any time:

- Press and hold the **STANDBY** button.
- The autopilot will switch first to **STANDBY** mode, if it was not already there.
- Then, if you keep pressing the button, the autopilot will start a 3 second power-down sequence.

Once the countdown has expired, the display will prompt you to release the **STANDBY** button ... and once you do, the whole autopilot system will immediately shut off.

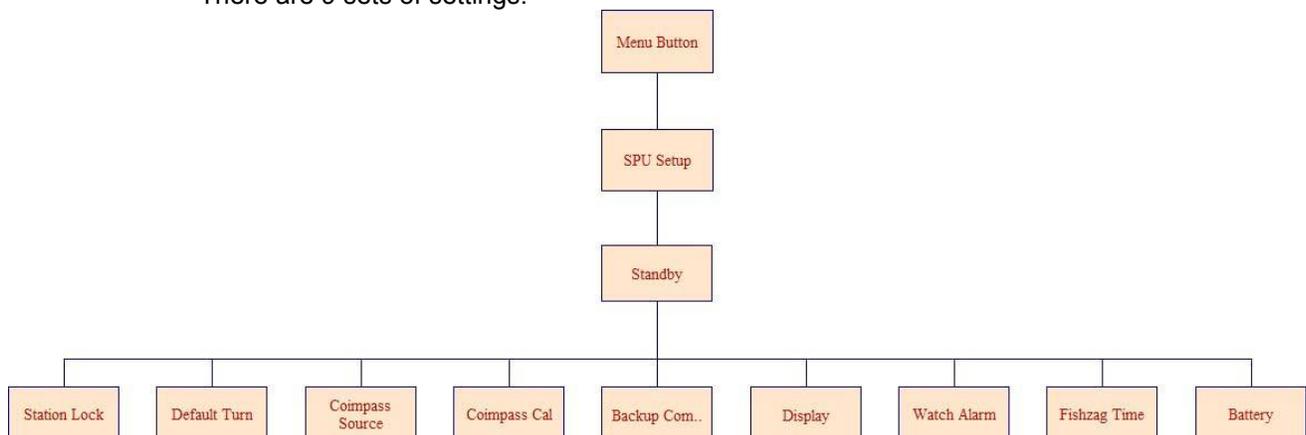


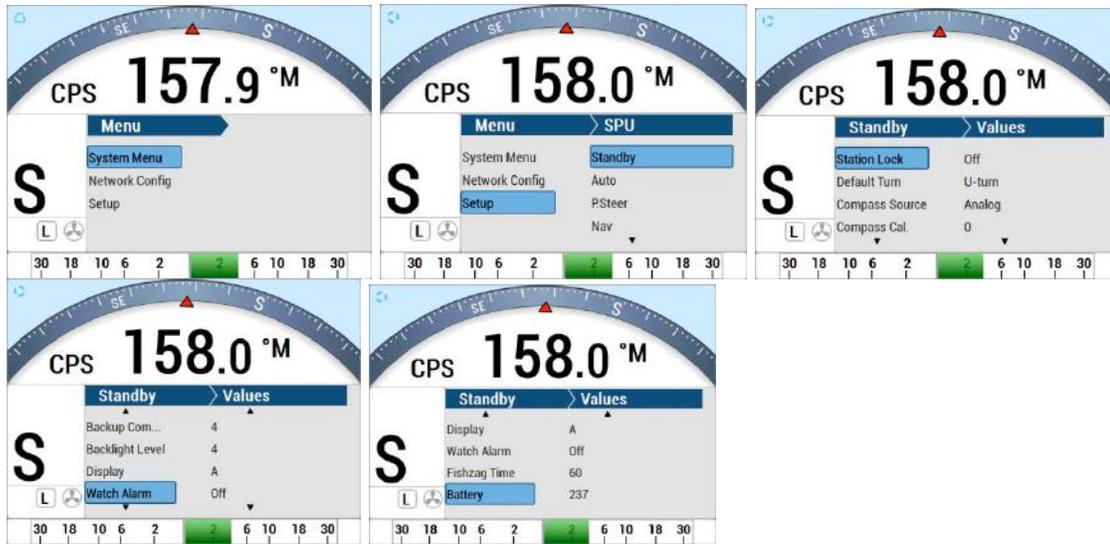
If you release the **STANDBY** button before the 3-second countdown has finished, the autopilot will abort the countdown, and remain in **STANDBY** mode.

## Standby menu

To access the STANDBY menu, press the Menu button and select "Setup."

There are 9 sets of settings.





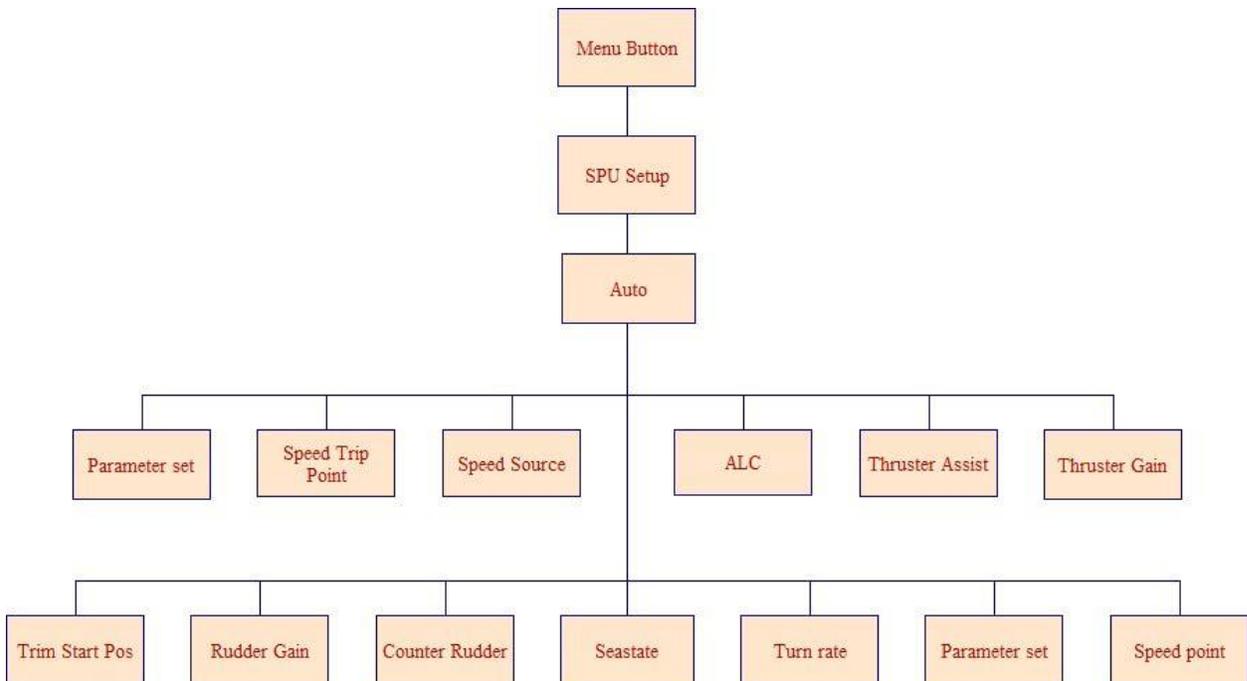
**Access to “Standby Menu”**

1. Select Setup
2. Select Standby

See a detailed explanation for each setting in the “Station Lock...” section.

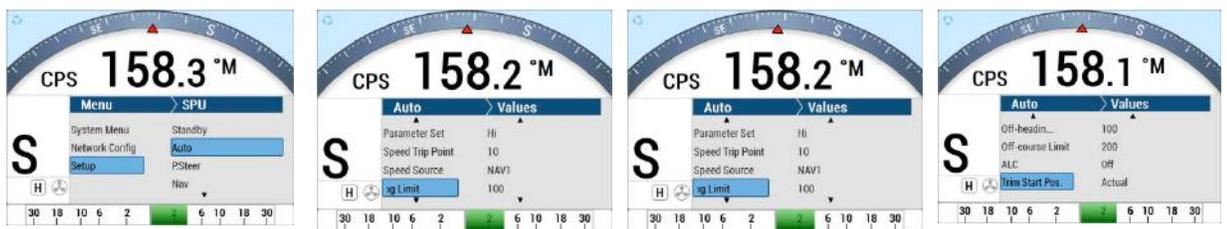
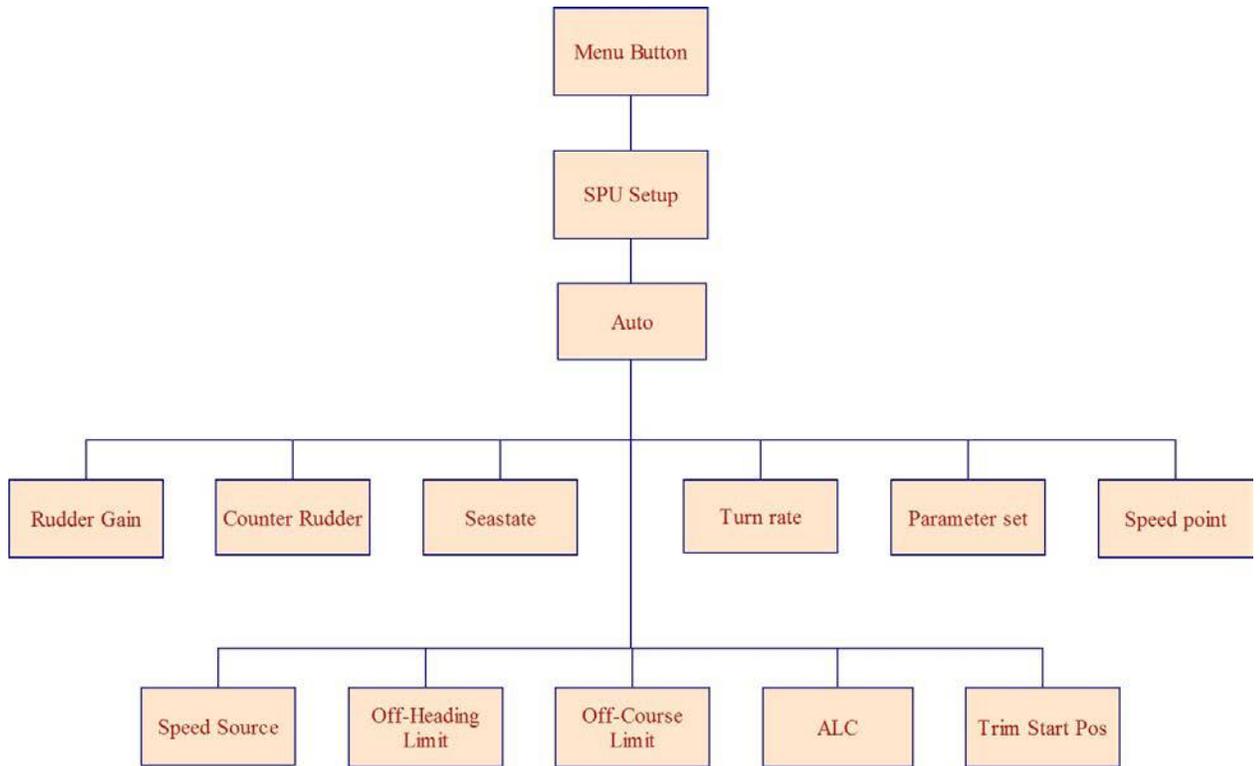
**Power Steer Menu:**

To access the AUTO menu, press Menu button and select “Setup.” There are 13 sets of settings.



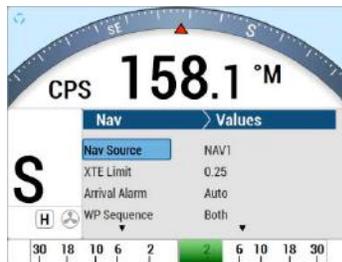
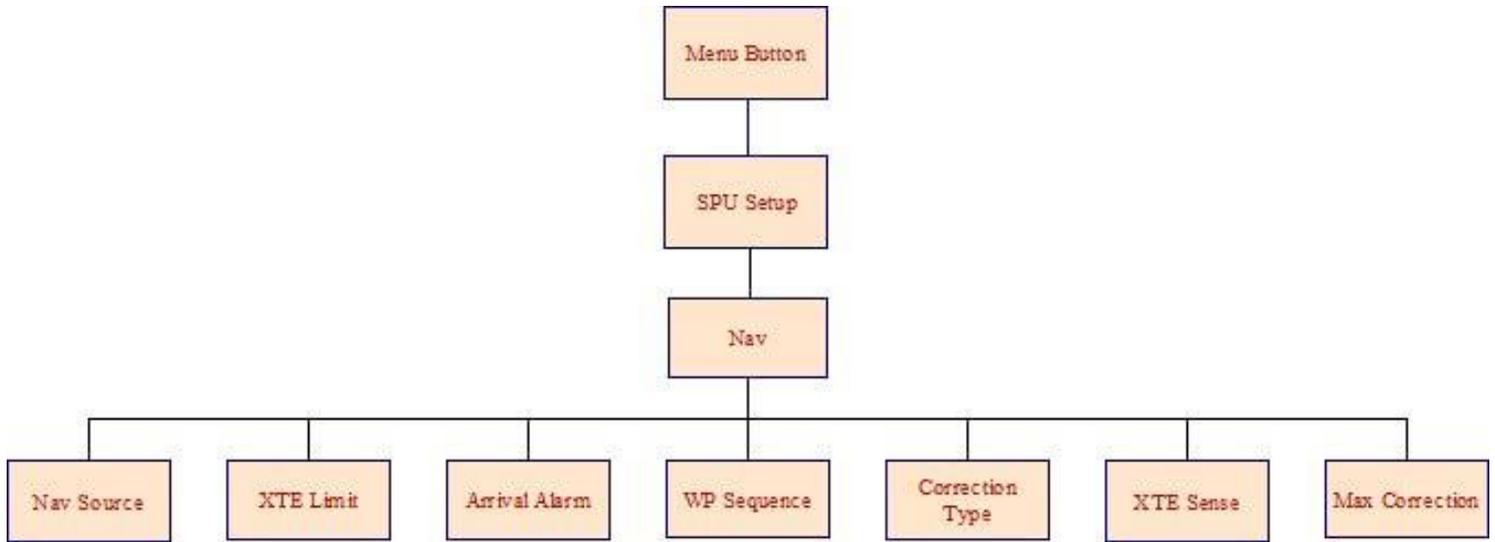
### Access to “Auto Menu”

1. Select Setup
2. Select Auto



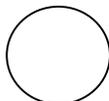
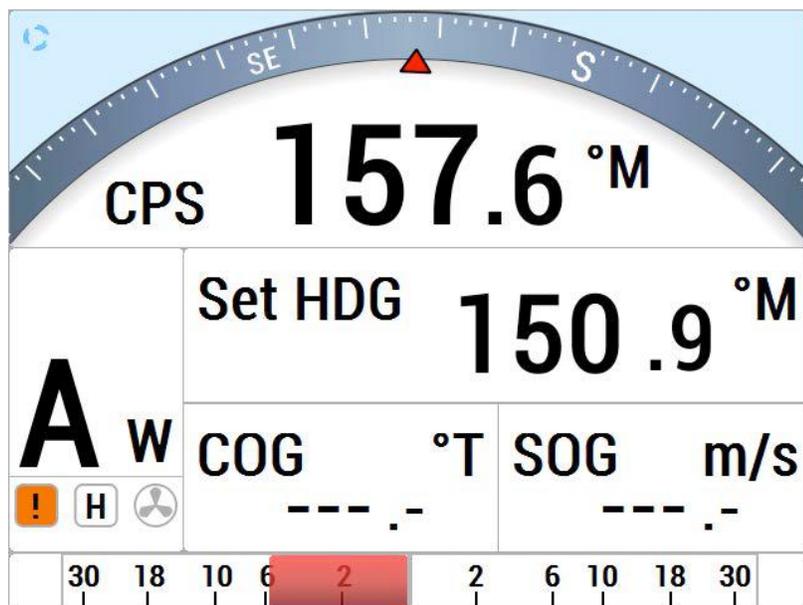
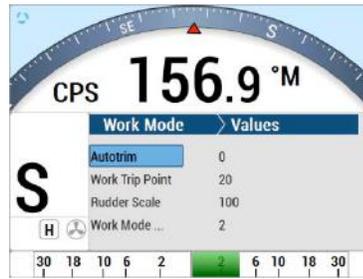
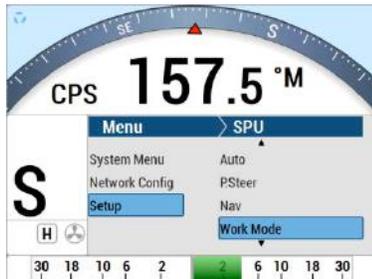
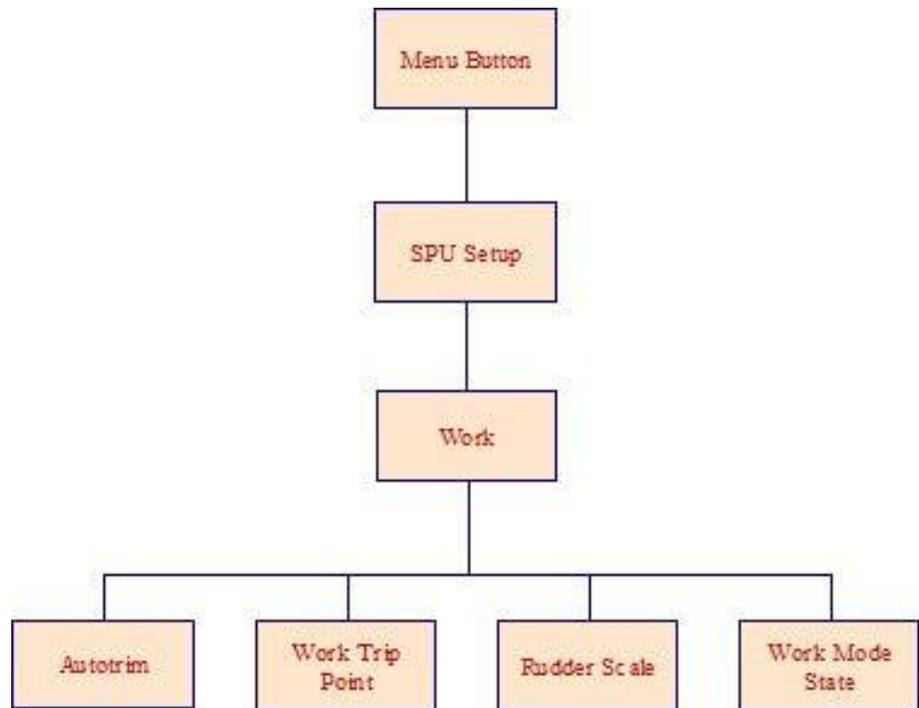
### Access to “NAV Menu”

1. Select Setup
2. Select Nav



### Access to “Work Menu”

1. Select Setup
2. Select Work



## Standby Menu

The Standby menu consists of a number of items that have a general bearing on how the autopilot operates. To access the Standby menu, double-press the red STANDBY/ON/OFF button.

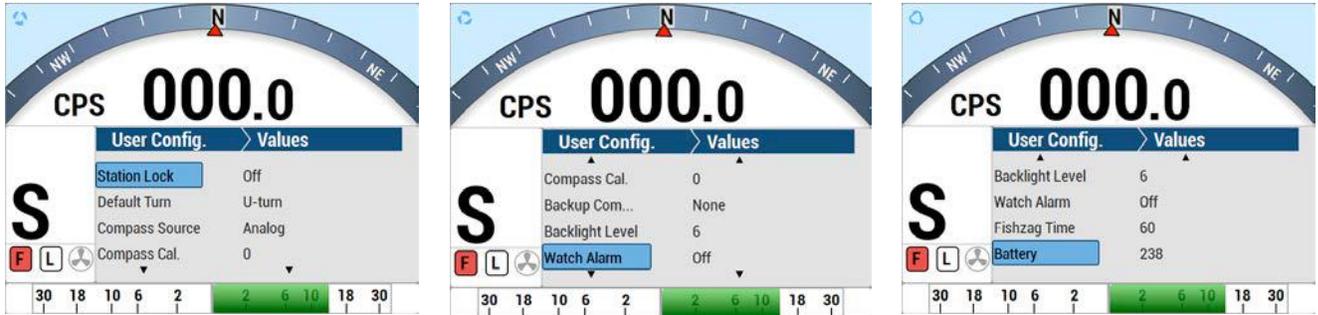


Figure 56 – Standby Menu (pages 1, 2, and 3)

## Station Lock

The P4 system can accommodate up to three Control Stations; one main Control Head, and any combination of Control Heads and Remotes on the two AUX ports.

One of these Control Stations is always the main control, and the others are simply repeater stations. You can take command with any of the repeater stations by simultaneously pressing the PORT and STARBOARD ARROW buttons on the repeater.

However, to prevent an unauthorized person from doing this, the main Control Head can lock out all of the others. Station Lock must be changed to Unlock before the repeater stations can take command. For more detail, refer to **Station Lock/Unlock** section of this manual.

## Default Turn

The P4 System has a number of Special Turns pre-programmed into it. The variety of turns available depends somewhat on the system configuration and what mode you are operating in.

Set the Default Turn parameter to the type that you are likely to use most often. Then, when you press the TURN button to initiate a Special Turn, the default turn will be the first one offered.

## Compass Source

There are a number of separate inputs for the many different types of compasses that may be used with the P4 (N2000, Analog, Nav1 and Nav2) system. You may choose to have more than one type connected at any given time. This menu item allows you to switch from one to another whenever the operator chooses.

The selected input can be the same one used for the Navigation data source and/or the Speed source.

## Compass Cal - Compass Calibration

This feature allows you to synchronize the compass on the autopilot with an external source. Simply turn the COURSE CHANGE knob until the Compass Cal value reads the same as your reference source.

*NOTE: For safety reasons, Compass Cal may not be adjusted in **AUTO** or **NAV** modes, so it does not appear if the Standby menu is entered in one of those modes.*

## Backlight Level

There is a Night mode and a Day mode that have different levels of Backlight adjustment settings.

For Daylight mode, the level can be adjusted between 5% to 100% while Night mode is adjustable between 2% to 20%.

## Watch Alarm

The P4 has a built-in Watch Alarm. This menu item allows you to turn on the Watch Alarm and set how much time is allowed to elapse before the alarm goes off. This menu item is password protected to prevent a unauthorized person from changing the Watch Alarm parameters. See the

**Watch Alarm** section of this manual for complete details on setting the Watch Alarm, and the password.

## Fishzag Time

This sets the time interval between course changes while executing the special Fishzag turn. The units displayed are seconds, and each click of the COURSE CHANGE knob will change the interval by thirty seconds. See the **Fishzag** section of this manual for more information.

## Battery

This is a read-only display that cannot be changed. The number shown is the battery voltage as measured at the Signal Processor Unit.

## Power Steer Mode

To enter POWER STEER mode, press and hold the **P.STR** button for approximately half a second, until the large “P” mode indicator appears in the upper left corner of the display (see [Figure 57](#)).

In this mode, the display shows the actual compass heading and the rudder angle. The PORT and STARBOARD ARROW buttons are used to control the rudder. Press one or the other to move the rudder in that direction. The rudder will keep moving for as long as the button is pressed until it gets to the physical rudder limits.

You can limit the maximum amount of rudder travel in POWER STEER mode by turning on the Power Steer limits. Turning on these limits, and adjusting them to suit, is done in the Power Steer menu. The COURSE CHANGE knob can also be used to move the rudder in POWER STEER mode. Each “click” of the knob will move the rudder a finite yet equal amount.

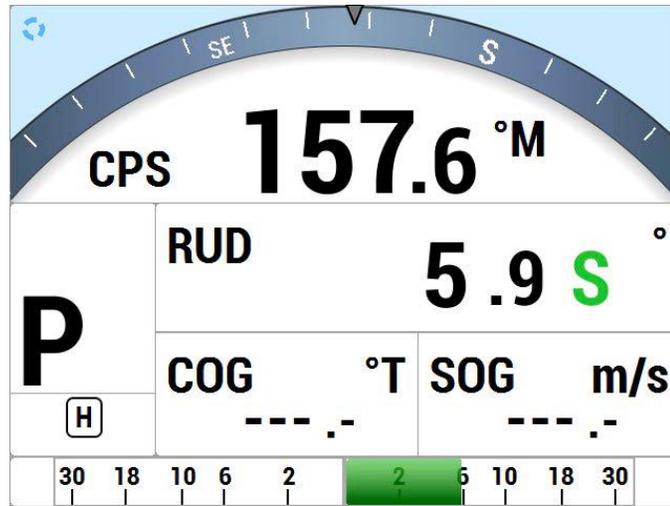


Figure 57 – Typical Power Steer Mode Screen

### Power Steer Menu

The Power Steer menu contains the mechanical steering parameters (which are common to all modes). To access the Power Steer menu, double-press the **P.STR** button.

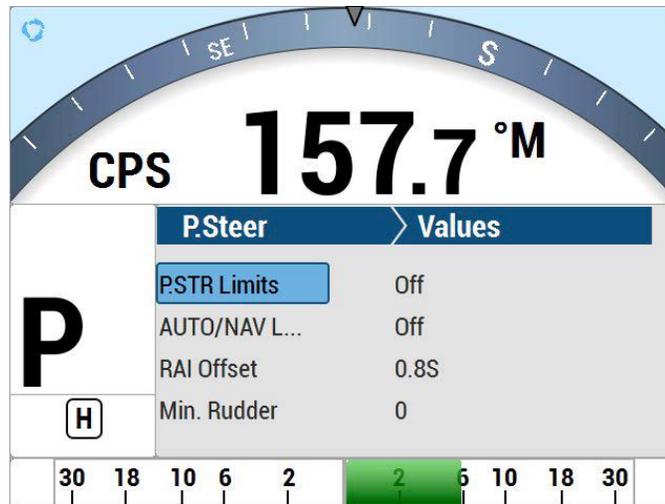


Figure 58 – Power Steer Menu

### Stdby/P.Str Limits - Power Steer Rudder Limits

When you initially set up the P4 system, you will move the rudder from hard over port to hard over starboard so that the autopilot can measure these positions. These mechanical hard

over positions are known as the “physical limits”, beyond which the rudder simply cannot be turned. However, you can artificially limit the rudder travel through the autopilot software.

To do so, set the Power Steer Limits to the number of degrees port and starboard that you would like to limit the rudder movement to. These rudder limits will be in effect whenever the autopilot is in POWER STEER mode, and during all Dodge and Jog Lever turns. The minimum setting is 5°; the maximum is the same as the physical limits measured in Dockside Setup. Setting the limits to “Off” means that the full range – up to the physical limits – will be allowed. The range beyond the selected limits will be shown on the bottom bar of the Rudder Angle Indicator display during normal operation.

*NOTE: SPU firmware versions before 3.05 allowed the rudder to be moved in Standby mode with a Jog Lever. However, this feature was disabled in that version and onwards, for safety reasons. The parameter name in the menu was not changed, however.*

## Auto/Nav Limits

The Auto/Nav Limits are essentially the same as the Power Steer Limits detailed above, but they are in effect only when the autopilot is in **AUTO** or **NAV** modes.

## RAI Offset

The Rudder Angle Indicator (RAI) display at the bottom of the autopilot display may require a slight offset adjustment in order to read zero degrees when the vessel is moving in a straight line. This is a fairly common scenario and may be due to vessel loading or design, rudder design or function, or the installation of the Rudder Feedback Unit. For example, if the vessel is traveling in a straight line, but the RAI reads 2° to starboard, adjust the RAI Offset to port so that the RAI display reads zero.

## Auto Mode

In AUTO mode, the autopilot will steer the vessel on your desired Heading. To enter AUTO mode, press and hold the AUTO button for about 1 second, until the large letter ‘A’ appears in the upper left portion of the display (see [Figure 59](#)).

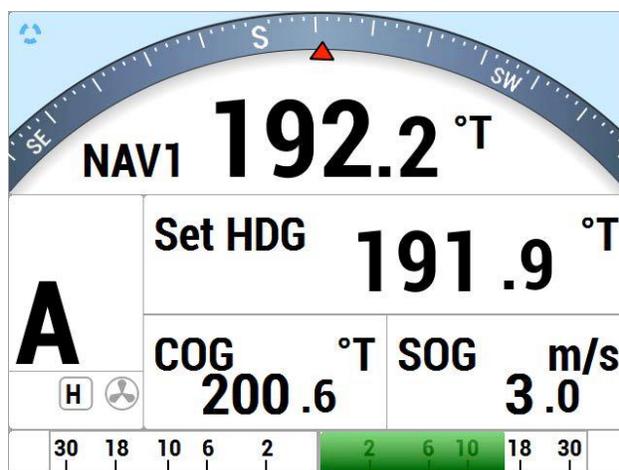


Figure 59 – Typical AUTO Mode Screen

The vessel's current actual heading is shown in large letters in the middle of the LCD screen, with the source and type. Your Desired Heading – also known as the “Commanded Heading” – is shown in smaller digits at the top-centre of the screen.

When you first enter AUTO mode, the autopilot will use the heading that the boat was on at the moment the mode was entered as the initial Commanded Heading. To change the Commanded Heading, use the COURSE CHANGE knob:

- A clockwise turn will result in an increase of the Heading.
- A counter-clockwise turn will decrease the Heading.
- One 'click' will change the Heading by 1 degree.
- A quick spin of the knob changes the Heading by 10 degrees.

The autopilot will then bring the boat around to the new Commanded Heading at no more than the rate of turn specified for Turn Rate in the Auto menu. The actual Heading shown in the display will gradually change to match the Commanded Heading.

### Notes on AUTO Mode

If you need to, you can quickly “dodge” around obstacles, and automatically return to your original Commanded Heading when the boat is clear of the obstacle, without having to turn the COURSE CHANGE knob. See the **Dodge and Jog Steering Turns** section for more information.

You can limit the maximum amount of rudder travel in AUTO mode by turning on the Auto/Nav rudder limits. Turning them on, and adjusting them to suit, is done in the **Power Steer** menu.

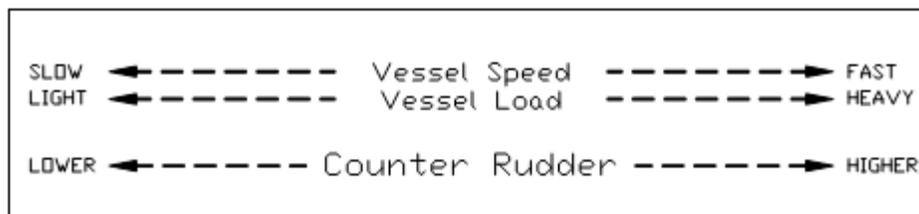
The autopilot has an automatic Off-Course Alarm that will be activated should the boat fall off the Commanded Heading by more than 20°. There is a 32 second delay on this alarm.

***Caution:** On a P4VS without an RFU, you should always manually steer a steady, straight Heading, in STANDBY mode, for at least 10 seconds – or longer, if necessary - until you don't have to continue to move the wheel/tiller to maintain a straight Track – before switching into POWER STEER, AUTO or NAV modes. The rudder must be in the dead-ahead position when you switch modes.*

### Hi & Lo Speed Rudder Gain

Counter Rudder is a measure of how much rudder is applied for a given rate of change in course error. If the course error is increasing, the counter rudder adds to the rudder correction, and if the course error is decreasing, the counter rudder subtracts from the rudder correction applied.

Like Rudder Gain, there are two numbers shown; one for LO speed, and one for HI speed. The parameter values do not have any units. The following diagram provides a general guide to setting Counter Rudder:



**Figure 60 – Guidelines for setting Counter Rudder**

## Seastate

The Seastate control tells the autopilot how much deviation from the set course allow before taking corrective action. This deviation is also called “Yaw.”

Seastate should be set according to sea conditions. As conditions worsen, the Seastate setting can be increased. This can result in slightly decreased steering performance, but will improve and reduce the amount of rudder movement and strain on the steering system.

This parameter’s units are in total degrees on either side of the set course, so a value of 1 will allow the vessel to change up to 0.5° of heading on either side of the set course before bringing it back on course. The maximum value is 10°.

There is also an Automatic Seastate Control feature that will monitor and adjust the Seastate setting for you. To activate this, highlight “Seastate” in the menu and turn the COURSE CHANGE knob counter-clockwise until the value reads “A.”

There are two Seastate settings; one is for low speed operations (LO) and one is for high speed operations (HI).

## Turn Rate

Varying the Turn Rate parameter controls the maximum rate at which the vessel may make a course change (in AUTO or NAV modes), return to its original heading after a dodge manoeuvre, or execute a Special Turn. Factors such as speed, load, hull characteristics and weather conditions may limit the maximum achievable turn rate.

This parameter’s units are in degrees per second. Up to 1.5 °/sec, the value increments by 0.1° per click of the COURSE CHANGE knob; between 2.0 °/sec to the maximum of 20.0 °/sec, it changes by 1° per click.

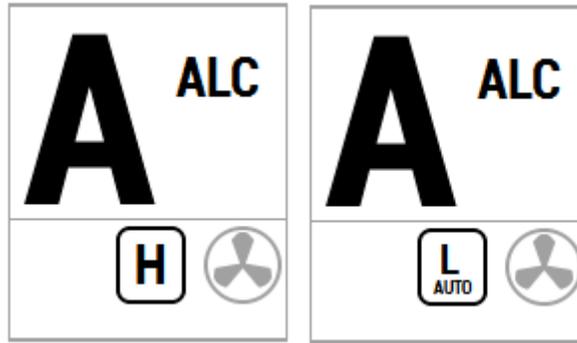
There are two Turn Rate settings; one is for low speed operations (LO) and one is for high speed operations (HI).

## Parameter Set

The P4 gives you the ability to store two sets of steering parameters, labelled “Hi” (high) and “Lo” (low). This allows for best performance under varying vessel speeds and/or loading conditions.

The autopilot can be set manually to use either the Lo or the Hi settings. There is also a selection for “Auto”. If Auto is chosen, the autopilot will automatically switch from Hi to Lo, or vice-versa, depending on the vessel’s speed. For Auto to work, the autopilot must be connected to an NMEA 0183 Navigation System that outputs speed information. The Speed Trip Point discussed later, governs the point at which the switch is made.

When the P4 is in AUTO or NAV mode, it always indicates which steering parameter set is in effect. This is shown just to the left of the Rudder Angle Indicator, and consists of a small box shape with either H for Hi or L for Lo in it. If the parameter is set to Auto, then the word “AUTO” also appears in the box ([Figure 61](#)).



**Figure 61** – HI and LO Speed Icons (Left of Rudder Angle Indicator)

### Speed Trip Pt – Speed Trip Point

The Speed Trip Point governs the point at which the autopilot automatically transitions from the Lo steering parameters to Hi. For an automatic transition to take place, the Parameter Set must be set to “Auto.”

### Speed Source

The P4 can obtain information about the vessel’s speed from a variety of sources that provide NMEA 0183 data outputs, at either the NAV1 or NAV2 inputs on connector **J9**. This menu item is used to select which of the two inputs the autopilot will use.

The selected input can be the same one used for the Compass source, and/or the Navigation data source.

### ALC - Automatic Leeway Correction

The P4’s Automatic Leeway Correction (ALC) feature is turned on or off with this parameter. It is active only in AUTO mode. See the **Following a Track** section for more information.

### Thruster Assist / Thruster Gain

These two functions are only available when the parameter is not set to “None.” Complete instructions are included with the CT7 Thruster Interface.

### NAV Mode

In NAV mode, the P4 Advanced Autopilot system can use steering information from an external NMEA 0183 Navigation System, to steer to a destination, or along a route of waypoints leading to a final destination.

In NAV mode, the P4 uses its own compass (or the Navigation System) as its primary source of heading for course keeping, while the steering data received from the Navigation System is used to calculate the commanded heading to the destination or next waypoint.

#### To activate NAV mode:

- Turn on your Navigation System and activate a waypoint.
- Press the NAV button on the Control Head until the letter “N” appears in the upper left portion of the display, indicating NAV mode has been initiated (**Figure 62**).

- The Waypoint ID, Range, Bearing, and cross-track error (XTE), as provided by the Navigation System will be shown on the Control Head display.

*NOTE: some Navigation Systems do not provide all of this information. In such cases, the display will show dashes ( - - - ) or "NONE" in place of any missing data.*



**Figure 62 – Typical NAV Mode Screen (Normal Display)**

In NAV mode, you can quickly “dodge” around obstacles, and automatically return to your original Track. See the **Dodge** and **Jog Lever Turns** sections for more information.

You can limit the maximum amount of rudder travel in NAV mode by turning on the Auto/Nav rudder limits. Turning them on, and adjusting them to suit, is done in the Power Steer menu.

The P4 has an automatic Off-Course Alarm that will be activated should the vessel fall off the commanded course in NAV mode, by more than 20°. There is a 32 second delay on this alarm.

## Nav Menu

The Nav menu contains a number of parameters used when operating the autopilot in NAV mode. To access the Nav menu, double-press the NAV button.

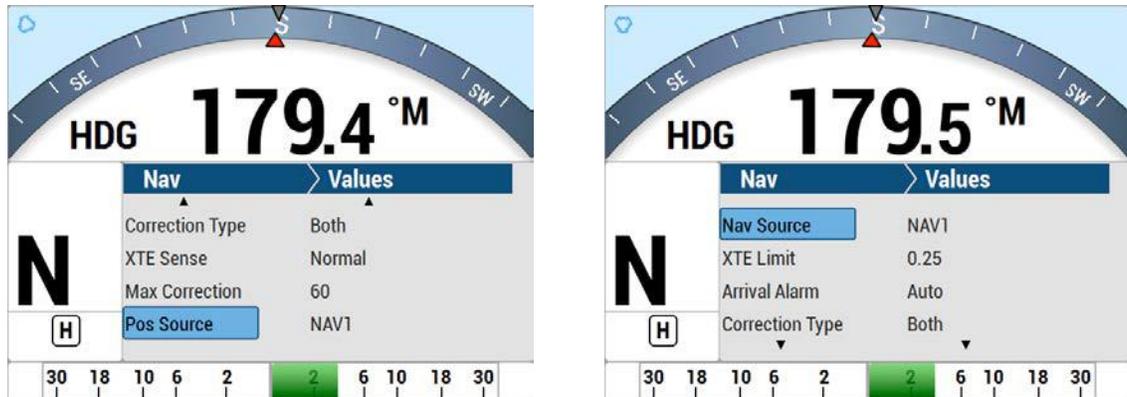


Figure 63 – Nav Menu, pages 1 and 2

## Nav Source

Set the Nav Source to the SPU's input connection (NAV1 or NAV2) that the external Navigation System is connected to. The autopilot will then look at that input when in NAV mode to obtain the bearing and course-to-steer information.

The selected input can be the same one used for the Compass source, and/or the Speed source.

## XTE Limit - Cross-Track Error Limit

The autopilot will raise an alarm while in NAV mode if the vessel's cross-track error exceeds the limit set here.

## WayPt. Arrival - Waypoint Arrival

When the vessel arrives at a waypoint or the end of a route, a special "arrival" message is sent to the autopilot from the Navigation System. This menu item tells the P4 how you want to deal with the arrival message.

**Manual** (manual sequencing):

- Displays "Waypoint Arrival" on the Control Head screen, accompanied by an audible alarm. The autopilot will maintain its present course and NOT automatically turn the vessel to the next waypoint in a route until the alarm has been acknowledged by pressing the **ENTER** button.

**Auto** (automatic sequencing):

- Displays "Waypoint Arrival" on the Control Head screen, accompanied by an audible alarm. However, the autopilot will automatically turn the vessel to the next waypoint in a route even if the alarm is not acknowledged by pressing the **ENTER** button.

**Silent** (silent sequencing):

- Automatically turns the vessel to the next waypoint in a route. **Caution! No waypoint arrival alarm will be displayed. Choose this option if your Navigation System has its own waypoint arrival alarm that cannot be turned off, and you do not wish to acknowledge the same alarm on multiple devices.**

## Correction

If the vessel is not directly on track when in NAV mode, there are three ways it can arrive at the waypoint:

Setting	Description	Comments
CTS	Course-To-Steer	The autopilot picks out the Course-To-Steer information from the Navigation System. This results in a straight-line course to the destination waypoint. Cross-track error, while displayed, is not used by the autopilot.
XTE	Cross-Track Error	The autopilot steers from its current heading so as to minimize Cross-Track Error. No Course-To-Steer information from the Navigation System is used.
Both	Course-To-Steer plus Cross-Track Error	The autopilot steers a modified course taken from the Navigation System's Course-To-Steer. The amount of modification is proportional to the amount of Cross-Track Error. This method is generally best for normal usage.

**Table 6 – NAV Mode Correction**

## XTE Sense - Cross-Track Error Sense

Cross track error (XTE) contains two pieces of information. First, it contains the *amount* of the error. Secondly, it gives information about the 'sense' of the error (i.e. whether the vessel is to the left or the right of the line between the beginning and ending waypoints).

The NMEA (National Marine Electronics Association) has specified how a cross track error should be identified; a left indicator (L) in the data sentence means the vessel should steer to the left and a right indicator (R) means the vessel should steer to the right.

However, some manufacturers of GPS, chart-plotters, and other navigation devices and systems have used the left indicator to mean that the vessel is to the left of the line, so the vessel should steer to the right, and the right indicator to mean that the vessel is to the right of the line, so the vessel should steer to the left,

Because of this confusion, the P4's handling of XTE can be switched from "Norm" (normal) to "Rev" (reverse). In "Norm", the autopilot will respond normally to the sense of the cross-track error. In "Rev", the autopilot will respond in the opposite way in response to the same information.

## Max Correction

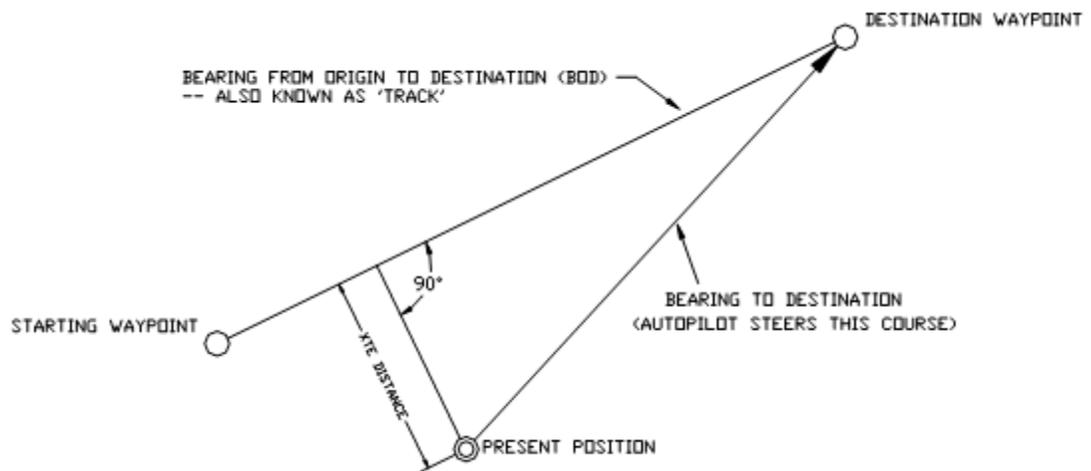
When activating pre-stored routes with a large amount of initial cross track error, the autopilot will steer the boat at almost 90° to the track, in order to get back on track as fast as possible. In certain circumstances, this can appear as though the vessel is moving away from the desired waypoint. Setting Max Correction to something less than 90° can minimize this phenomenon, yet will get you back on track less quickly.

## Commanded Heading Displayed

The commanded heading shown on the display in NAV mode may not be the same as the bearing given by the Navigation System. This is because there are three different methods that the P4 can use to process and react to the navigation data from the Navigation System. You select which method you want the P4 to use by specifying “XTE”, “CTS”, or “Both” for the “Correction” parameter in the Nav menu.

## Correction set to CTS – Steering a Direct Bearing

In this method, Cross-Track Error is not factored into the calculation that the P4 uses to determine the heading to steer. The autopilot therefore steers directly to the destination waypoint, as depicted in [Figure 64](#):



**Figure 64 – Steering with Correction set to CTS**

**Test this out to be familiar with it, by performing the following steps:**

- 1) Change “Correction” in the Nav menu to “CTS”
- 2) Make sure the Navigation System is turned on and that a waypoint is programmed in.
- 3) Switch the autopilot to **STANDBY** mode and manually steer the vessel away from the waypoint track by a few hundred meters or more.
- 4) Place the P4 into **NAV** mode by pressing and holding the NAV button until the unit beeps and the letter “N” appears in the upper left portion of the display.
- 5) Observe the commanded heading on the P4 display. It should match the bearing reported by the Navigation System.

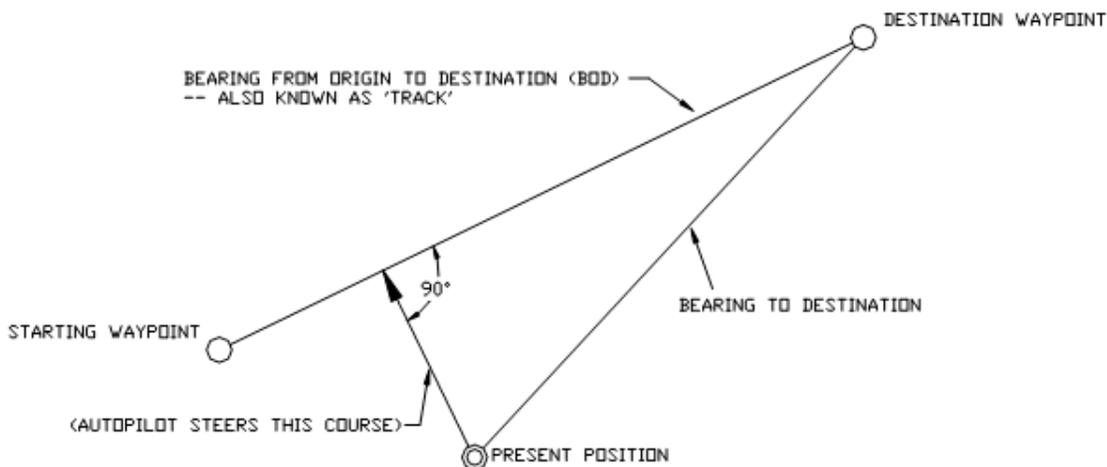
**Caution!** *Be sure to maintain a sharp lookout to ensure that there are no obstacles between the vessel and the destination when steering directly to a waypoint.*

## Correction set to XTE – Cross-Track Error Steering

Cross-track error is the perpendicular distance from the track to the vessel's position.

When using Cross-Track Error Steering, the autopilot initially steers on its present heading, and monitors the Cross-Track Error reported by the Navigation System. The autopilot changes the heading so as to minimize the cross-track error.

If the initial cross-track error is large, the autopilot will steer a course almost perpendicular to the original track, so as to get back on the track as quickly as possible.



**Figure 65 – Steering with Correction set to XTE**

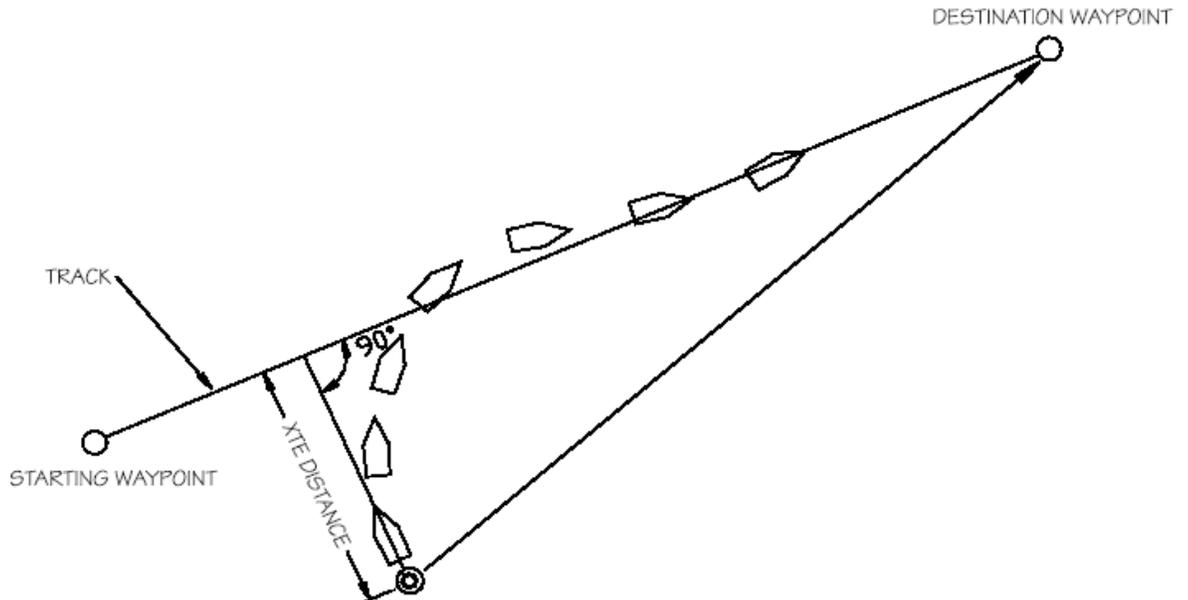
**Test this out so as to be familiar with it by performing the following steps:**

- 1) Change “Correction” in the Nav menu to “XTE”
- 2) Make sure the Navigation System is turned on and that a waypoint is programmed in.
- 3) Switch the autopilot to **STANDBY** mode and manually steer the vessel onto the track.
- 4) Place the P4 into NAV mode by pressing and holding the NAV button until the unit beeps and the letter “N” appears in the upper left portion of the display.
- 5) Observe the vessel’s heading and the cross-track error. The autopilot should be steering so as to minimize cross-track error.

The course steered when Correction is set to “XTE” may not be the most efficient in terms of overall distance traveled.

*NOTE: If the vessel seems to be continually falling off course away from the track, change the “XTE Sense” (cross-track error sense) in the Nav menu from “Norm” (normal) to “Rev” (reverse) and observe any performance differences.*

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 position updates received from the Navigation System. For best performance, it is always best to minimize any cross-track error before putting the autopilot into NAV mode.



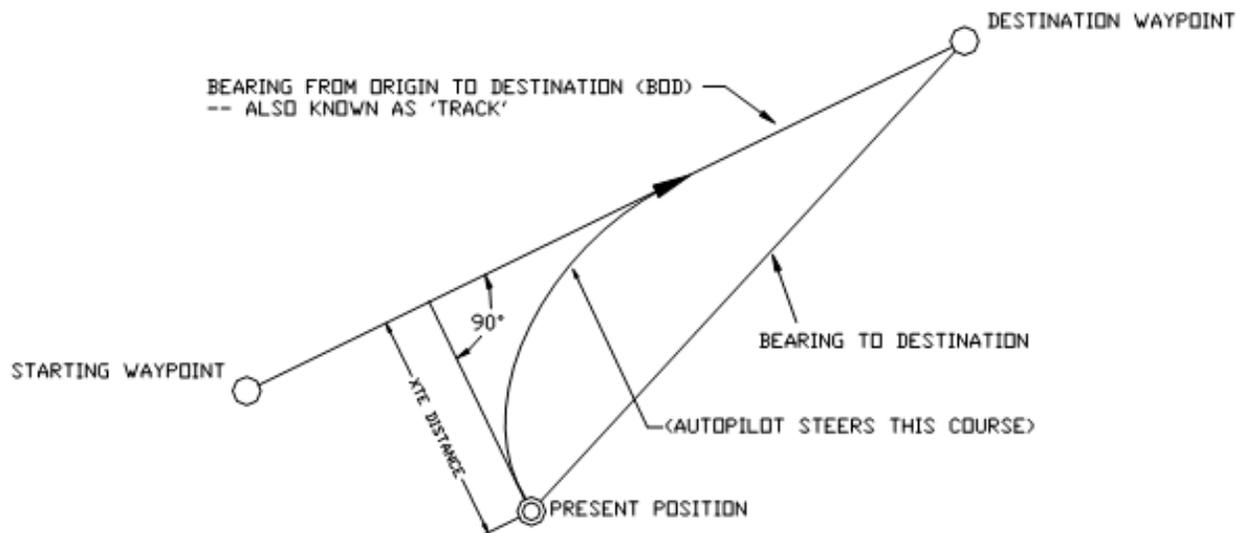
**Figure 66 – Response of Vessel to a Large Cross-Track Error**

The total number of degrees that the autopilot will correct the heading received from the Navigation System as it tries to bring the vessel back on track is limited to the value set for “XTE Limit” in the Nav menu.

**Caution!** *Be sure to maintain a sharp lookout to ensure that there are no obstacles between the vessel and the original track.*

### Correction set to Both – Steering To/Along a Track

In this method shown in **Figure 67**, the P4 will bring the vessel onto the track as smoothly and efficiently as possible. It does this by combining aspects of steering, using cross-track error, bearing from original to destination, and bearing directly to the waypoint.



**Figure 67 – Steering with Correction set to Both**

When steering along a track, the P4 tries to minimize cross-track error by steering to a heading that lies between the perpendicular to the track and the destination waypoint. The farther you are off track, the closer to the perpendicular the heading will be. As you come closer to the track, the heading of the vessel will change closer to the heading of the track. When you are on-track, the vessel's heading and the track heading will be identical.

The total number of degrees that the autopilot will correct the heading received from the Navigation System as it tries to bring the vessel back on track is limited to the value set for "Max Correction" in the Nav menu.

**You can test out how well the P4 steers along a track by following these steps:**

- 1) Make sure the Navigation System is turned on and that a waypoint is programmed in. Usually this means selecting a waypoint from a list and pressing the "GOTO" button.
- 2) Steer the boat close to the waypoint track.
- 3) Put the P4 in NAV mode by pressing and holding the NAV button until the unit beeps, and the letter "N" appears in the upper left portion of the display.
- 4) Observe the vessel's response for several minutes (if the vessel seems to be continually falling off course away from the track, change "XTE Sense" (cross-track error sense) in the Nav menu from "NORM" (normal) to "REV" (reverse) and observe any performance differences).
- 5) Verify correct operation by steering back to the original track and then putting the autopilot into NAV mode again.
- 6) 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 System, the most common cause is poor signal quality in the sensor or antenna wiring of the Navigation System.

This may be due to:

- Improper grounding
- Electrical noise generated in the vessel (alternators, power packs, etc.)
- Poor antenna location

Refer to the Navigation System's manual for signal quality measurements, and ideas on making improvements.

## Alternate Navigation Display

An alternative display is available for NAV mode. To access this display, enter NAV mode by pressing the NAV button until the letter “N” appears in the upper left portion of the display. Release the button, and then press the NAV button again. The display will change to a “highway” representation as shown below:



Figure 68 – Typical NAV Mode Screen (Alternate Display)

To change back to the normal display, press the NAV button again.

In the alternate NAV display, cross-track error is shown graphically by the boat icon being located to the left or right of the centerline. The position is proportional to the amount of cross-track error. Note the small numbers in the lower corners of the highway display. These indicate the scale of the display. There are four scales that can be shown on the highway display: 0.2, 0.5, 1.5, and 3.0 nautical miles. The scale changes automatically to give the best resolution.

## Dodge

When in AUTO, NAV, WORK or modes, you can use the PORT and/or STARBOARD ARROW buttons to avoid (“dodge around”) an obstacle in the water.

Pressing and maintaining either the PORT ARROW button or STARBOARD ARROW button will cause the P4 to turn the vessel in that direction.

As long as one of the buttons is pressed, the rudder will keep moving in the corresponding direction.

- If one or both of the Power Steer Rudder Limits and/or the Auto/NAV Limits are set, then the autopilot will stop moving the rudder when it gets to the lesser of the limits.
- If neither of the Rudder Limits are set, then the autopilot will stop moving the rudder when it gets within a few degrees of the physical limits of rudder travel.

Once the button is released, the Autopilot will turn the vessel back to the commanded course (i.e., Heading, Track, or Angle, depending on which operating mode is in effect).

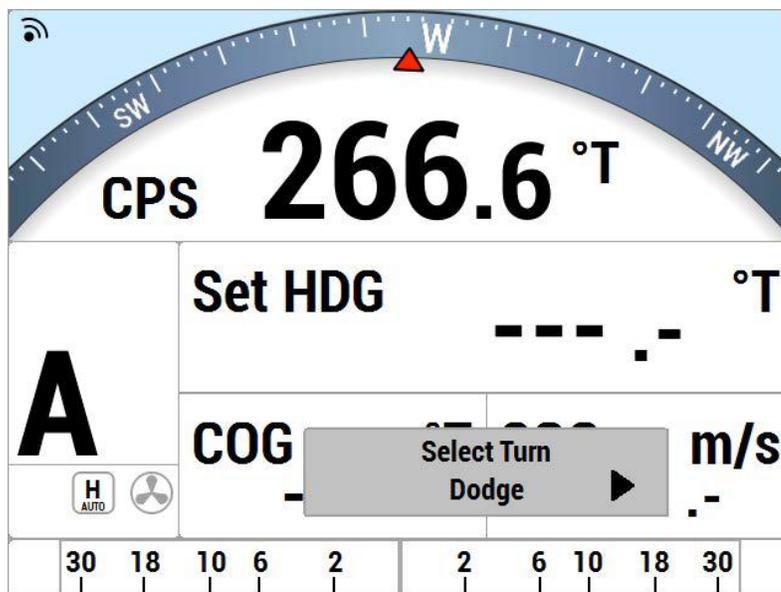


Figure 69 – A Dodge in Progress (in AUTO Mode)

**Caution!** During a Dodge turn (for example, while one of the ARROW buttons is maintained), the Autopilot will not limit the rate of turn of the vessel. Once an ARROW button is released, the autopilot will begin to turn the vessel back to the Commanded Course, but this time the turn will occur at no greater than the maximum turn rate that is set in the Steering Parameters.

**NOTE:** If you dodge the vessel in AUTO or WORK modes, when you release the PORT or STARBOARD ARROW 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 manoeuvre. This is illustrated in Figure 70.

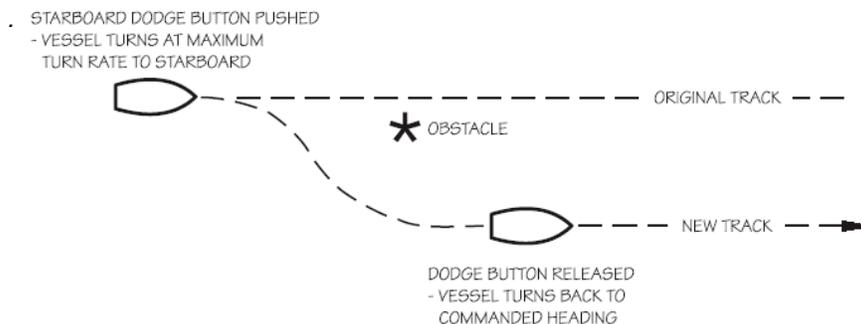


Figure 70 – Vessel Track During a Dodge Manoeuvre in AUTO Mode

By contrast, when you execute a Dodge in NAV mode, the autopilot will return the vessel to the original Track, once you release the PORT and/or STARBOARD button.

If desired, you can also bring the rudder back to centre (Dead Ahead) part-way through a Dodge. For example, you might want to center the rudder in order to maintain a temporary but specific Heading that the vessel has reached during the dodge.

- Press the other ARROW button (PORT if you are dodging to Starboard, and vice-versa), without releasing the button already being pressed.
- Maintain both the ARROW buttons simultaneously for as long as you wish to keep the rudder centred.

The course that the vessel follows while both buttons are pressed will typically be a straight Track, at approximately the Heading that was current at the time the second button was pressed.

However, this can be affected by weather and waves, by the vessel’s rudder speed and steering response time, and any directional offset that the vessel exhibits when the rudder is centred.

- Releasing one button will re-start a Dodge in the other direction.
- Releasing both buttons will end the dodge completely, with the same mode-dependant behaviour with respect to “Resuming the Track” as noted previously.

### Jog Lever Turns

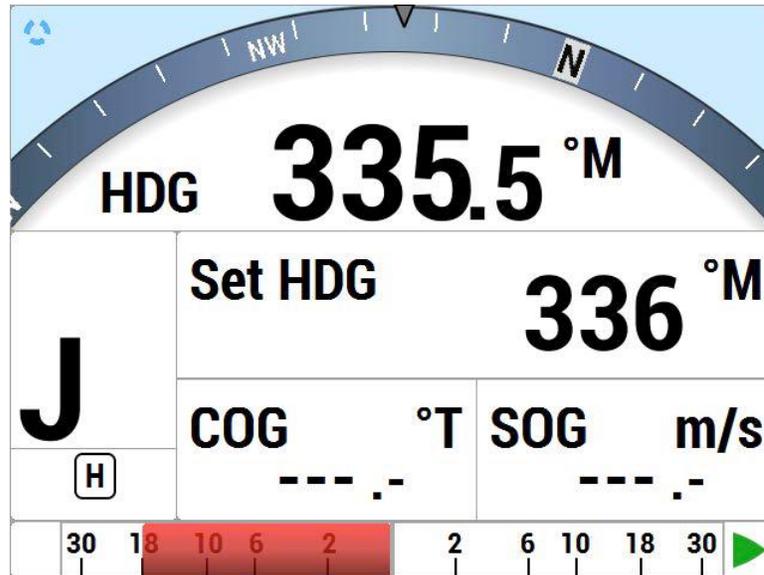


Figure 71 – Typical Jog Lever Activated Screen

If a Jog Lever is connected to SPU terminal block **J3**, you can directly change the vessel’s heading with that Lever, while the P4 is in POWER STEER, AUTO, NAV, or WORK modes.

This is identical to a Dodge, except that you use a Jog Lever to start and control it, and also you can do it while in POWER STEER mode.

When a Jog Lever is activated, the rudder will move immediately in the requested direction, to Port or Starboard (the autopilot system allows connecting any desired number of Jog Levers).

As long as the Jog Lever is held activated, the rudder will keep moving in the corresponding direction.

- If one or both of the Power Steer Rudder Limits and/or the Auto/NAV Limits are set, then the autopilot will stop moving the rudder when it gets to the smaller of the limits.
- If neither of the Rudder Limits are set, then the autopilot will stop moving the rudder when it gets within a few degrees of the physical limits of rudder travel.

When you release the Jog Lever, the autopilot will return the vessel to the current commanded Heading if in AUTO or WORK modes, or to the current track to the next waypoint if in NAV mode.

Whenever a Jog Lever is activated, a large “J” is displayed in the upper left corner of the Control Head’s screen (see [Figure 71](#)) – temporarily replacing the current mode’s indicator letter.

The jog Levers are ignored when the autopilot is in STANDBY mode, or in DOCKSIDE SETUP mode.

**Caution!** *You should always be prepared for a change in the vessel’s direction when you release the Jog Lever.*

# Advanced Operations

## Advanced Operations

This chapter describes the advanced modes of operation and features of a P-Series system, and shows you how to use them.

### WORK Mode

WORK mode is a special mode, for use in conditions that are different than normal autopilot operation. Some prime examples are dragging, trawling, and pair trawling. It is also useful for towing or when traveling at very slow speeds. WORK mode can be activated in either AUTO or NAV mode. You can even switch from AUTO to NAV mode or vice-versa, while WORK mode is active.

*NOTE: WORK mode is not available on a P4VS without an RFU.*

Initial set up of WORK mode is easily accomplished. Only two parameters need to be adjusted: a Work Trip Point and the Rudder Scaling Factor. Some other parameters can be used to monitor and fine-tune the operation of WORK mode.

The autopilot has an automatic Off-Course Alarm that will be activated should the boat fall off the Commanded Heading by more than 20°. There is a 32 second delay on this alarm.

### Automatic WORK Mode

Although WORK mode can be used manually, it works best if a valid NMEA source for the boat's speed is also interfaced to the autopilot. The speed source must also be properly configured (in the Auto menu, see page 127). With a valid NMEA speed source, WORK mode can be engaged automatically when the boat's speed falls below the Work Trip Point, and disengaged when the boat's speed increases beyond the Work Trip Point.

To use Automatic WORK mode, first go into either AUTO or NAV mode. Then press and hold the WORK button for approximately 1 second, until a confirming beep is heard. A small letter 'W' will appear beside the bigger mode-indicator letter ('A' or 'N') in the upper left portion of the LCD screen, to indicate that the WORK mode feature is enabled.

If the boat's speed is above the Work Trip Point, the 'W' will flash slowly, about once per second, indicating that WORK mode is enabled – but not yet engaged. If the 'W' appears continuously (not flashing), the boat speed is below the Work Trip Point, and WORK mode is actually engaged.

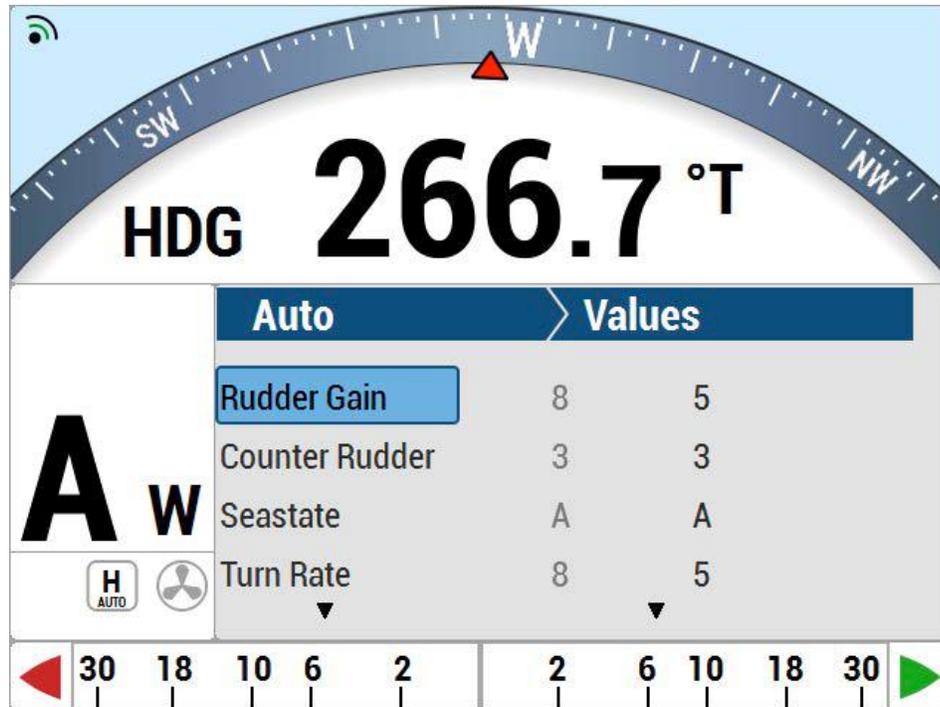


Figure 72 – Typical WORK Mode Screen (Engaged)

To disable WORK mode, press the WORK button again, for approximately 1 second, until a confirming beep is heard and the letter 'W' disappears from the display. WORK mode can also be cancelled by switching to either STANDBY or POWER STEER mode.

When WORK mode is engaged, the Rudder Scale Factor changes the amount of corrective rudder movement which the steering algorithms calculate using the Rudder Gain setting. In WORK mode, that calculated amount (i.e., proportional to the course error) will also be multiplied by the Scale Factor, resulting in larger rudder movements for a given course error. The Rudder Scale Factor is entered on the Work menu.

**Other effects take place in WORK mode too.**

- The corrective rudder movement calculated for Counter Rudder is reduced to the minimum possible for the vessel type (i.e., as if the Counter Rudder parameter was set to 0), which enhances the effect of the Rudder Gain and Rudder Scale Factor.
- Turn Rate is limited to 10° per second while WORK is active, for all changes of Heading controlled by the autopilot, and for Special Turns.
- Particularly useful for pair trawling, the autopilot also disables the automatic course trim unless Autotrim (in the Work menu) is specifically turned on.
- Finally, the built-in off-course alarm will be disabled the entire time WORK mode is engaged.

If the user is not satisfied with the fixed helm bias determined by the Autopilot at the onset of WORK mode, manual adjustments can be made “on-the-fly” while WORK mode is engaged. A double-press of the WORK button will bring up the regular Work menu, but with an additional line.

Rudder Bias will be the first line on the list, and will show the current helm bias. You can change this value to suit, using the COURSE CHANGE knob. This feature is useful in order to accommodate changing load or sea conditions.

As mentioned earlier, WORK mode will automatically be disengaged if the boat's speed rises above the Work Trip Point set by the user. While it is disengaged, all normal features such as automatic trim and off-course alarm will be operational.

## Manual WORK Mode

Even if no NMEA source of speed data is available, WORK mode can still be used, by manually initiating it.

To do so, switch to AUTO or NAV mode, and then press the WORK button for ~1 second until the letter `A` or `N` in the upper left portion of the display stops flashing, and a small letter `W` appears beside it.

Then, double-press the WORK button to bring up the Work menu. Highlight "Work Mode State". Then use the COURSE CHANGE knob to change the selection to "**M\_On**" (Manual On). WORK mode is now engaged.

**Caution!** *When Manual WORK mode is engaged, large rudder movements may occur. If your boat is traveling too fast, these rudder movements may affect the stability of the boat. Do not engage Manual WORK mode without first ensuring that it is safe to do so and that the boat speed is appropriate for using WORK mode.*

To disengage WORK mode, again select "Work Mode State" in the Work menu and change it to "**A\_Rdy**" (Automatic Ready).

To cancel WORK mode completely, press and hold the WORK button for 1 second, or switch to STANDBY or POWER STEER mode.

You can also manually disengage WORK mode, if it has been engaged in the automatic mode. Double-press the WORK button to bring up the Work menu. If WORK mode is engaged, the "Work Mode State" will show "**A\_On**" beside it. Highlight "Work Mode State", then use the COURSE CHANGE knob to change it to "**M\_Rdy**" (Manual Ready).

### Work Menu

The Work menu has all of the adjustable parameters that are involved with WORK mode. To access the Work menu, double-press the WORK button.

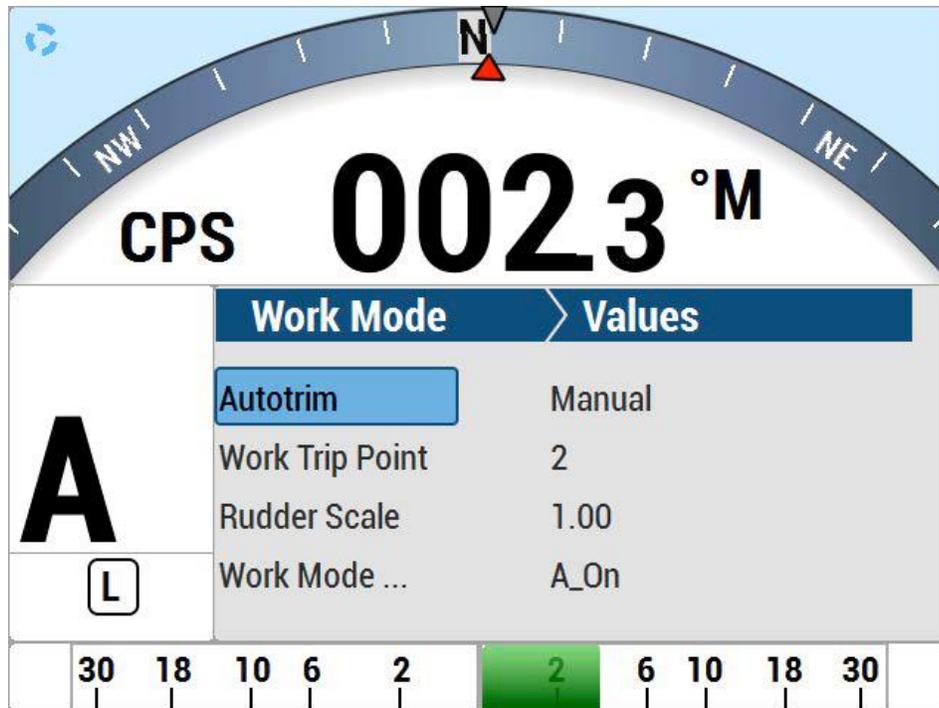


Figure 73 – WORK Mode Menu

### Rudder Bias

This menu line only appears when WORK mode is active. It shows the current rudder bias, which can be adjusted if desired.

### Autotrim

The autopilot’s WORK mode can be configured to use manual or automatic rudder bias trim when in WORK mode (the default is to use automatic bias).

Manual rudder bias is fixed by the position of the rudder when the autopilot first enters WORK mode, but can be adjusted by the user if desired.

Automatic rudder bias is initially set to the position of the rudder when the autopilot first enters WORK mode, but is automatically adjusted on a continual basis thereafter to ensure that the vessel remains on-course.

### Work Trip Pt. - Work Trip Point

This is the speed below which WORK mode can be engaged, and above which WORK mode will be disengaged automatically. The value can be 1 to 10, and these units refer to the information the Speed Source (see the **Auto** menu) is providing.

## Rudder Scale - Rudder Scale Factor

When WORK mode is engaged, the “Rudder Scale Factor” will multiply the Rudder Gain setting in the Auto menu. Normally, the rudder is moved an amount proportional to the course error detected (for example, the error times the Rudder Gain, and using some constants which depend on vessel type), but in WORK mode that amount will also be multiplied by the Scale Factor. This will always result in larger rudder movements for a given course error.

## Work Mode State

This parameter shows the current status of WORK mode. It is also a means to force WORK mode to be active or not. Normally, WORK mode is engaged or disengaged depending on the speed of the boat as given by a Navigation System. In cases where this information is not available, WORK mode can still be made to function by forcing it on.

The states shown are “Off”, “A\_On” and “A\_Rdy” (abbreviations for Automatic On and Automatic Ready, respectively), or “M\_On” and “M\_Rdy” (Manual On and Manual Ready).

## Special Turns

There are a number of Special Turns pre-programmed into the P4 system. Special Turns can be executed only in AUTO, WORK and modes.

**To execute a Special Turn (with the autopilot in the appropriate mode):**

- 1) Press the TURN button. The default special turn will be displayed, along with a query for a direction.
- 2) If a different special turn other than the default shown is desired, press the TURN button again. The next special turn in the available list will be shown. Press the TURN button again and again until the desired special turn is shown.
- 3) Press either the PORT or STARBOARD ARROW button to select the direction in which to execute the Special Turn.

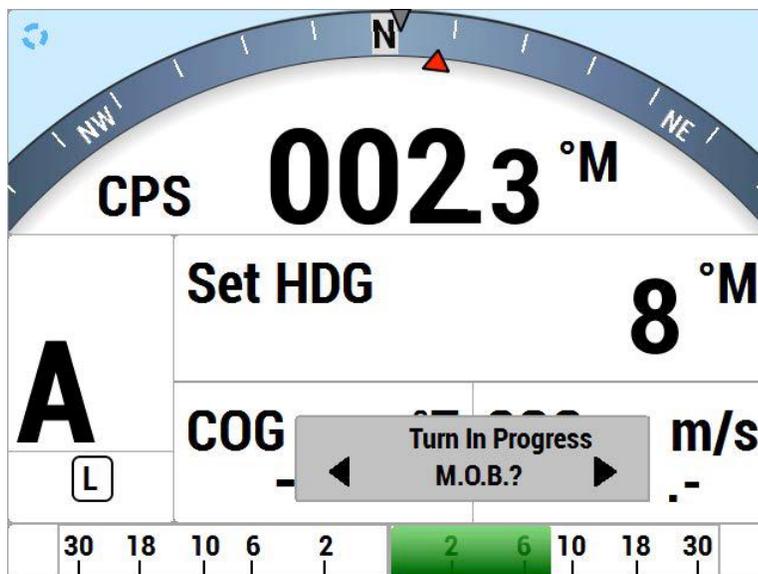


Figure 74 – Typical Special Turn Query\]

The default Special Turn can be changed as desired by adjusting the “Default Turn” in the STANDBY menu.

Special Turns can be aborted by pressing the TURN button again while the Special Turn is executing, or by changing modes.

### U-Turn

For a U-Turn, the autopilot calculates a reciprocal course to the vessel's heading, and then turns the vessel to that heading, in the appropriate direction, once the PORT or STARBOARD ARROW button is pressed.

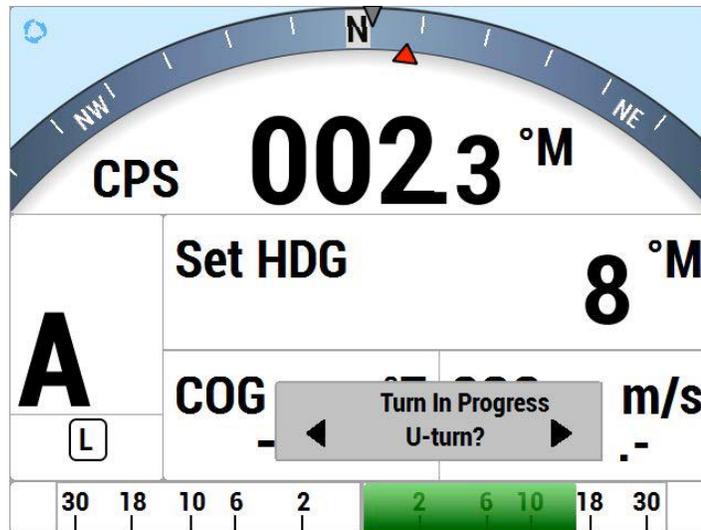


Figure 75 – U-Turn Query

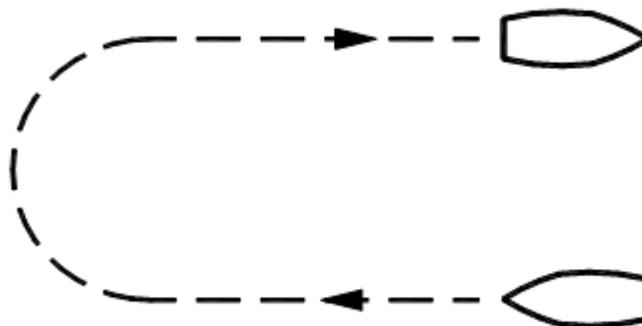


Figure 76 – U-Turn Vessel Path

## Circle Turn

For a circle turn, the autopilot steers a never-ending circle in the appropriate direction once the PORT or STARBOARD ARROW button is pressed. The Turn Rate setting in the Auto menu governs the rate of turn. To stop the circle, press the TURN button again, or switch modes.

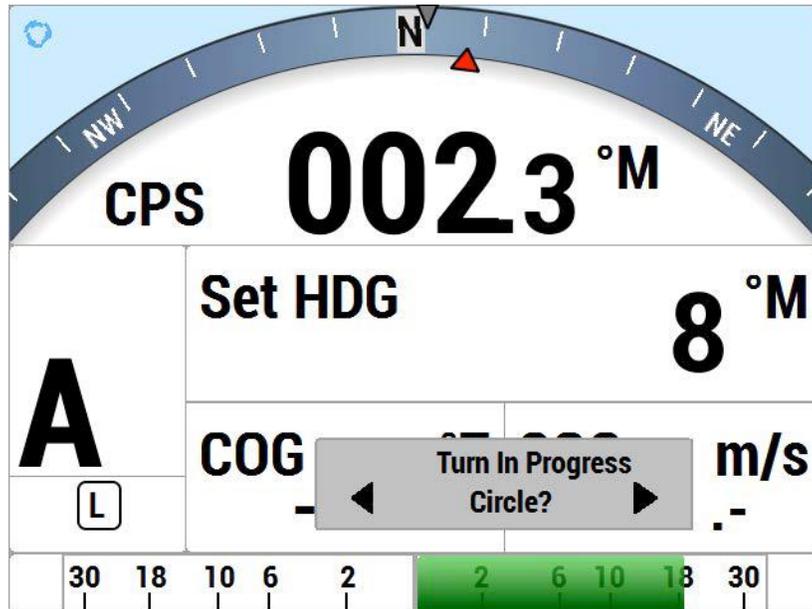


Figure 77 – Circle Turn Query

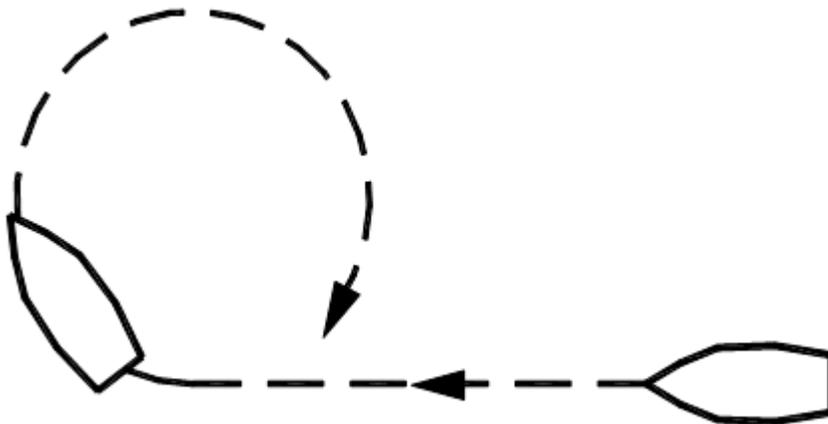


Figure 78 – Circle Turn Vessel Path

### M.O.B. – Man Over-Board

The autopilot can perform a Williamson / Man Overboard turn, sometimes known as an Emergency or E-turn. This will bring the vessel onto a reciprocal heading; typically right down the vessel's own wake. The PORT or STARBOARD ARROW buttons are used to determine the initial turning direction. For best accuracy, do not adjust the vessel speed once this turn has been initiated.

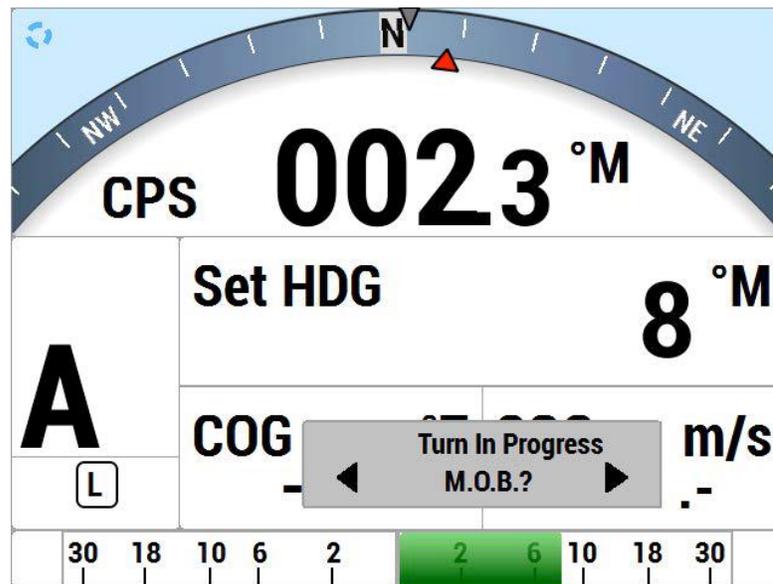


Figure 79 – Man Overboard (MOB) Turn Query

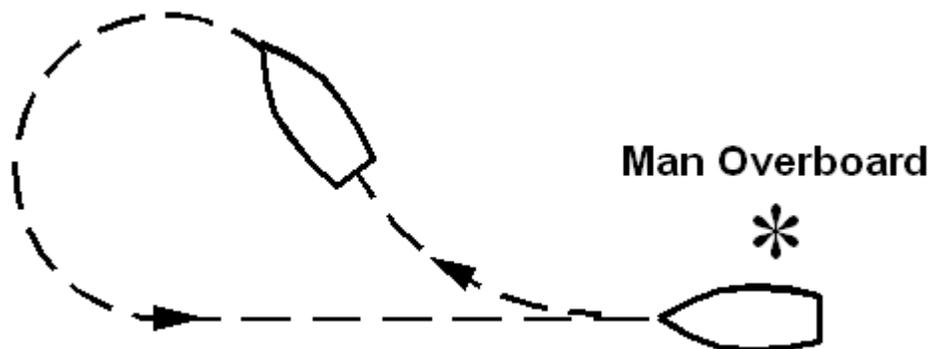


Figure 80 – Man Overboard (MOB) Turn Vessel Path

### Fishzag

As its name implies, the Fishzag turn was developed specifically for fishing.

When this Special Turn is executed, the autopilot maintains the present course for the time interval specified by the Fishzag Timer in the Standby menu. Once the timer has expired, the autopilot will make a 60° course change in the direction specified when you pressed the PORT or STARBOARD ARROW button.

After 30 seconds, the autopilot will return to the original course, and start the timer over again. This time, when the timer goes off, the autopilot will make a 60° course change in the opposite direction. Again, after 30 seconds, the autopilot will return to the original course where the cycle repeats itself.

The Fishzag turn has the effect of dropping the fishing gear behind one side of the boat, and raising the gear slightly on the other side while the boat is turning. This has been shown to be an effective means of luring fish to strike.

To cancel the Fishzag turn, press the TURN button again, or switch modes.

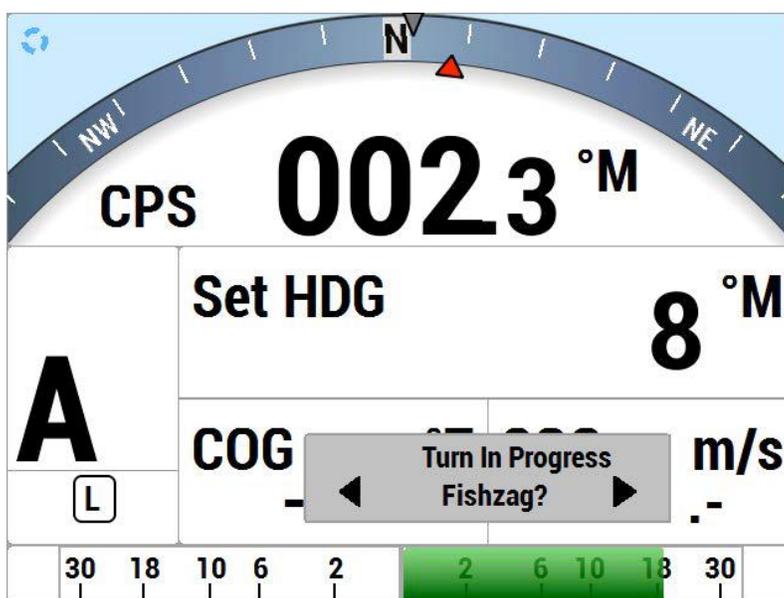


Figure 81 – Fishzag Turn Query

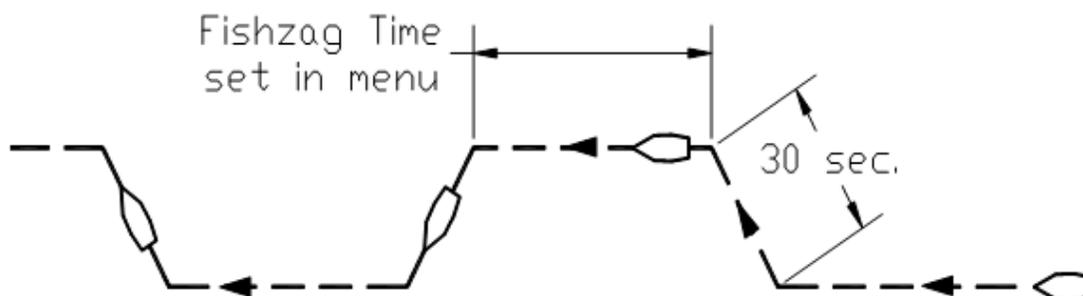


Figure 82 – Fishzag Turn

Multiple Control Heads and Auxiliary Controllers

Two additional Control Heads or Auxiliary Controllers may be added to the standard P4 system. These may be any combination of Control Heads, CR-203 Handheld Remotes, or TS-203 Fixed Remotes.

Only one Control Head or Auxiliary Controller may be In-command at any given time. When the autopilot system is first powered on, the main Control Head, connected to J11 of the SPU, will always be In-command.

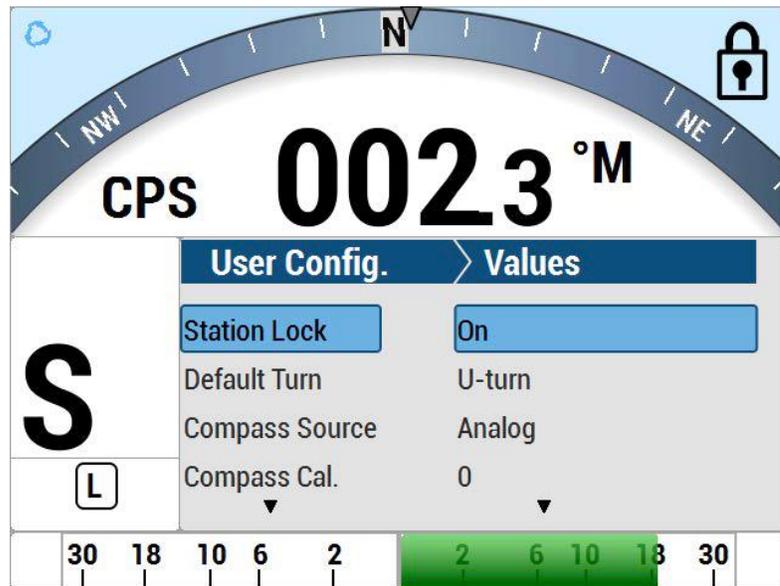
The other Control Heads and/or Auxiliary Controllers are said to be Repeaters. As a Repeater, the unit simply repeats the display information from the In-command unit, but does not affect the operation of the autopilot. You can always tell whether a particular controller is a Repeater because it will display a large letter “R” in the upper right corner of the display.

Command can be transferred from an In-command controller to a Repeater. To do so, press and hold the PORT and STARBOARD ARROW buttons on the repeater until the audible alarm beeps and the letter R disappears. The Repeater now becomes the In-command controller, while the previous controller becomes a Repeater.

**Station Lock/Unlock**

Setting the Station Lock parameter in the Standby menu to Lock prevents any of the Repeaters from being able to take command. When station lock is set to Lock, the image of a key will be shown in the upper right corner of the display, next to the repeater R.

The key image will either be outlined or filled-in, depending on whether the station lock is for the main Control Head or an Auxiliary.



**Figure 83 – Station Lock Icons on Main (left) and Aux. Control Head, when In-command (right)**

The controller In-command shows an outline key icon. The outline key signifies that all stations, except for the main Control Head and the controller which is currently In-command, are locked out.

Controllers that are Repeaters, except for the main Control head, will show the solid key icon, indicating that they are locked out and cannot take command.

The main Control Head always shows the outline key icon, because you can always take command back with the main Control head. This unconditional return of command is an important safety feature.

**Caution!** *If your P4 system is equipped with Jog Levers, you must be aware that they can be activated any time the autopilot is turned on. They can not be turned off or locked out. It is your responsibility to see that appropriate measures are taken to ensure that they cannot be activated by accident.*

## Watch Alarm

The Watch Alarm is a special timer built into the P4 autopilot. It measures how long it has been since any of the buttons on the Control Head have been pressed. If the time exceeds the amount set for the Watch Alarm parameter in the Standby menu, an alarm is activated to alert the operator.

**There are two ways that the Watch Alarm feature can be configured:**

- 1) The Watch Alarm can be set to bring up an alarm message and sound the audible alarm on the Control Head. At the same time, the audible alarm on the SPU will sound. Once the alarm is set off it can only be reset by pressing the **ENTER** button.
- 2) The Watch Alarm can be set up to operate exactly in the same manner as above, but in addition, if the alarm is not reset within 30 seconds (by pressing the **ENTER** button), an external alarm connected to the SPU will be activated. The external alarm can be used to alert ship's personnel that the helm may be unattended.

To use the Watch Alarm as per option 1, the Alarm O/P parameter in the Dockside Setup menu must be set to "none", **Sw'd B+** and "all", or **Sw'd B-** and "all".

To use the Watch Alarm as per option 2, the Alarm O/P parameter in the Dockside Setup menu must be set to **Sw'd B+** and "watch", or **Sw'd B-** and "watch". You must also have a compatible external alarm connected. See

**External Alarm Output** for more details.

The Watch Alarm timer is controlled by the Watch Alarm parameter in the Standby menu. The value may be adjusted from "OFF" (Watch Alarm completely inactive) to 30 minutes in 1-minute increments.

The Watch Alarm parameter is password protected. The autopilot will not allow you to change the Watch Alarm timer without first correctly entering a password.

**There are a few key points to remember about passwords:**

- 1) For safety reasons, only authorized persons should be allowed to know or change the Watch Alarm password.
- 2) The password consists of a button sequence entered on the Control Head, consisting of 0 to 10 button presses. For the best security, we recommend choosing a password with a minimum of a 5-button sequence.

- 3) All of the buttons, except the STANDBY/ON/OFF button, may be used for the password sequence, and a button may be used more than once in the sequence.
- 4) The STANDBY/ON/OFF button is reserved to signify the end of the sequence (like the ENTER key on a computer).
- 5) The P4 autopilot is shipped from the factory with an empty password – just press the STANDBY/ON/OFF button when prompted for the password.



# Care and Maintenance

## Care and Maintenance

The P4 Advanced Autopilot System has been designed to provide many years of reliable service. The following periodic care and maintenance tips will help to ensure the longevity of your autopilot.

## Cleaning and Appearance

Both the Control Head and SPU should be regularly and carefully cleaned with a damp cloth and mild soap. This is particularly important for the LCD screen overlay.

***Caution! Do not use abrasive cleaners or chemicals.***

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

Environments exceeding a maximum temperature of 140° F (60° C) or below a minimum temperature of 5° F (-15° C) MUST BE AVOIDED.

Exposure to prolonged direct sunlight should be avoided in order to prevent damage to the electronics and housing, and UV-induced fading of the LCD.

## Protection of Wires and Cabling

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

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

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

## Periodic Checks

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

An annual inspection should be undertaken thereafter.

## Fuse Replacement

There are two fuses used on the SPU.

Replace fuses only with the same type and rating, as per the table below.

Should a fuse blow, determine the cause before replacing.

To inspect and/or replace a fuse, the clear plastic cover over the SPU's Diagnostic section must be removed. To do so, gently pry up the center portion of the plastic rivets which fasten the cover to the SPU's case; be careful not to lose any of the plastic pieces.

After the fuse(s) are replaced, the cover must be re-installed, and remain in place during normal operation.

Designator	ComNav Part Number	Generic Description <i>Manufacturer(s) and Part Number(s)</i>
F1	60810009	20A, Non-Time Delay, 125V, 1/4"x 1-1/4" Bussman ABC -20
F2	60810012	<i>3.15A Medium Time Delay, 125V or better, 5 x20mm(DIN41571,IEC127, Bussman GMC 3.15A</i>

**Table 7 – Fuse Replacement Guide**



# Appendices

## Appendix 1

### NMEA 2000 PGN numbers Accepted and Transmitted by the Autopilot

#### Transmitting PGNS

PGN\_59392,  
 PGN\_59904,  
 PGN\_60928,  
 PGN\_126996,  
 PGN\_61184,  
 PGN\_126720,  
 PGN\_126464,  
 PGN\_126208,  
 PGN\_130826,  
 PGN\_130827,  
 PGN\_65341  
 PGN\_127250,  
 PGN\_127251,  
 PGN\_127245,  
 PGN\_127237,  
 PGN\_128259,  
 PGN\_129025,  
 PGN\_129026,  
 PGN\_129283,  
 PGN\_129284,  
 PGN\_65342,  
 PGN\_129283\_  
 PGN\_126993,  
 PGN\_NUMOF

#### Receiving PGNS

PGN\_60928  
 PGN\_59904  
 PGN\_59392,  
 PGN\_126208,  
 PGN\_127250  
 PGN\_128259,  
 PGN\_129025,  
 PGN\_129026,  
 PGN\_129029,  
 PGN\_129283,  
 PGN\_129284,

### NMEA 0183 Sentences Accepted and Transmitted by the Autopilot

The P4 Advanced Autopilot system receives and transmits serial data in NMEA 0183 format.

#### Messages Accepted

The P4 accepts the following NMEA 0183 sentences (the \* in front of the sentences indicates that the TALKER Identifier is always ignored):

Sentence	Description	Data Used
*APA	Autopilot Sentence "A"	Cross-Track Error, Arrival Status, Bearing from Origin to Destination, Waypoint ID
*APB	Autopilot Sentence "B"	Cross-Track Error, Bearing from Origin to Destination, Waypoint ID, Course to Steer
*BOD	Bearing – Origin to Destination	Bearing from Origin to Destination, Waypoint ID
*BWC	Bearing and Distance to Waypoint	Range to Destination
*GLL	Geographic Position (Latitude and Longitude)	Latitude, Longitude
*HDG	Heading, Deviation and Variation	Magnetic Heading, Magnetic Variation
*HDM	Heading, Magnetic	Magnetic Heading
*HDT	Heading, True	True Heading
*HSC	Heading Steering Command	Course to Steer
*MWV	Speed and Angle	Angle, Speed
*RMA	Recommended Minimum Specific Loran-C Data	Speed
*RMB	Recommended Minimum Navigation Information	Cross-Track Error, Waypoint ID, Range to Destination, Bearing from Origin to Destination, Arrival Status
*RMC	Recommended Minimum Specific GNSS Data	Speed, Magnetic Variation
*VBW	Dual Ground / Water Speed	Speed
*VHW	Water Speed and Heading	Speed
*VTG	Course Over Ground and Speed	Speed
*VWR	Apparent Speed and Angle	Angle, Speed
*VWT	True Speed and Angle	Angle, Speed
*XTE	Cross-Track Error	Cross-Track Error

**Table 8 – NMEA 0183 Sentences Accepted by the P4**

All sentences received must have valid checksums. Sentences which do not have any checksums, or have invalid checksums, will be ignored. In some cases, if the missing/invalid condition persists long enough, an INVALID CRS DATA, SPEED DATA, and/or HEADING error will occur.

A number of the various data values used by the autopilot can be received in one or more different sentences (for example, Speed can be received in VTG, VHW, VBW, RMA or RMC). If a particular data value is received in more than one sentence, then the value in the highest-priority sentence – per [Table 8](#) – will be the one used by the autopilot.

<b>Data Used</b>	<b>Sentence</b>	<b>Sentence Priority</b> <i>(larger number is higher priority)</i>
Magnetic heading	*HDM	1
True heading	*HDT	2
Magnetic heading, Magnetic variation	*HDG	3
Range to waypoint	*BWC	4
Vessel speed	*VTG	5
Vessel speed	*VHW	6
Vessel speed	*VBW	7
Bearing origin to destination magnetic and true, Waypoint ID	*BOD	8
Cross track error	*XTE	9
Cross track error, Arrival circle entered Bearing origin to destination magnetic or true, Waypoint ID	*APA	10
Course to steer magnetic and true	*HSC	11
Cross track error, Waypoint ID, Range, Bearing present to destination true, Arrival circle entered	*RMB	12
Cross track error, Arrival circle entered, Bearing origin to destination magnetic or true, Waypoint ID, Bearing present to destination magnetic or true, Course to steer magnetic or true	*APB	13
Vessel speed	*RMA	14
Vessel speed, Magnetic variation	*RMC	15
Latitude and longitude	*GLL	16
True angle and speed	*VWT	17
Apparent angle and speed	*VWR	18
True or Apparent angle and speed	*MWV	19

**Table 9 - NMEA Sentence Priority**

*NOTE: the Heading value used by the P4 may be in Degrees Magnetic or True, depending on which sentences are received (assuming all sentences have valid data):*

- *If all of HDM, HDT and HDG are being received, or just HDT and HDG, or just HDM and HDG, then the autopilot will use Magnetic Heading (indicated on the display by an 'M' beside the Heading value – and will use the data value in the HDG sentence.*
- *If only HDM and HDT are received, or just HDT, then the autopilot will use True Heading (indicated by a 'T'), from the HDT sentence.*

- *If only HDM is received, then the autopilot will use Magnetic Heading (indicated by an 'M'), from that sentence.*

## Messages Transmitted

The P4 outputs NMEA 0183 compliant data (at 4800 Baud, on the OUT A/B pins of the **J9 – NAV I/O** connector), which may be used by NMEA 0183 compliant LISTENERS, or may be used to observe and/or record various P4 parameters, for diagnostic purposes, while the system is running.

The P4 outputs 3 sentences:

- \***HDG** Heading, Deviation and Variation
- \***HDT** Heading, True
- \***PCMNS** (ComNav Proprietary Sentence)

HDG and HDT are output at 9 times per second.

The TALKER Identifier is AP, in all cases. All messages have valid checksums.

The PCMS sentence is output, once per second, if the Vessel Type in the Dockside Setup menu is set to Sail.

Example:

```
$PCMNS,PS,340.0,339.6,M,0.1,0.4,,,*2C
```

- 1) \$ ⇒ the symbol that starts all NMEA 0183 sentences
- 2) P ⇒ identifies a proprietary sentence
- 3) CMN ⇒ the identifier assigned to ComNav Marine Ltd. by NMEA
- 4) S ⇒ status type sentence
- 5) Mode: SB ⇒ **STANDBY** mode, PS ⇒ **POWER STEER** mode, AP = **AUTO** mode, NA = **NAV** mode
- 6) Commanded Heading, degrees
- 7) Actual heading, degrees
- 8) Units of heading: M ⇒ Degrees Magnetic, T ⇒ Degrees True
- 9) Commanded Rudder Angle
- 10) Actual Rudder Angle
- 11) ALC corrected heading
- 12) W ⇒ mode active (field is blank if not)
- 13) L ⇒ ALC active
- 14) Checksum, as per NMEA 0183 standard

## Appendix 2

### Error Messages

There are a number of different error messages that display for varying reasons and at different times in the P4 autopilot system. These messages are displayed on the Control Head screen, and are usually accompanied by an audible alarm.

The following errors are classified as warnings. Operation of the autopilot continues normally. The error messages may be temporarily suppressed by pressing the **ENTER** button. They are automatically cancelled should the condition that caused them be removed.

Message	Description
COURSE ERROR	The vessel is in AUTO, WORK or NAV modes, and has been off the commanded course by more than 20° for more than 32 seconds.  The vessel is in mode, and the angle of the has been more than 20° different than the commanded angle, for more than 32 seconds.  Adjust steering parameters to prevent this.
EEPROM ERROR	The system has detected a non-fatal error in one of the memory devices on the SPU. Contact your ComNav Dealer for repair service at your earliest convenience.
NO AUX #1	The system previously detected an auxiliary Control Head connected to <b>J12- Aux 1</b> ( but cannot detect it now. Check all wiring.
TURN RATE HIGH	The measured rate of turn of the vessel has exceeded the Turn Rate set in the Auto menu.
TURN RATE LOW	The measured rate of turn of the vessel is much lower than the Turn Rate set in the Auto menu.
WAYPOINT ARRIVED	The Navigation System used in <b>NAV</b> mode has sent a message to the P4 indicating that the vessel has entered the arrival circle around the active waypoint.
SHIFTED	The P4 has detected that the has shifted by more than the “Shift” value in the menu, for a period of time exceeding the “Shift Delay” set in the menu.
SPEED TOO LOW	The Speed is less than about 6 Knots.
XTE OVER LIMIT	The Cross-Track Error limit set in the Nav menu has been exceeded. Adjust steering parameters to prevent this. Also, ensure “XTE Sense” in the Nav menu is set correctly.

**Table 10 – Warning Messages**

The following messages are classified as “severe” errors. Typically, these messages describe a condition that prevents normal operation in the current mode, but operation in other modes may still be possible. The error messages may be temporarily suppressed by pressing the **ENTER** button. They are automatically cancelled should the condition that caused them be removed.

Message	Description
COMPASS ERROR	The P4 cannot read the Analog compass specified in the Standby menu under Compass Source. Check compass wiring.
FAULTY AUX #1	The P4 SPU has detected a problem in communicating with the Control Head connected to <b>J12 – Aux1</b> . Check all wiring.
HIGH TEMPERATURE	The SPU circuitry has become too hot, typically due to excessive current demands. Check all wiring and verify that all output loads (solenoids, pump motors, etc) are within the specifications given for the SPU. Also, ensure that the SPU has adequate ventilation.
INVALID CRS DATA	Valid NMEA 0183 Course data has not been received at NAV1 or NAV2 for ~28 seconds.
INVALID SPEED DATA	Valid NMEA 0183 Speed data has not been received at NAV1 or NAV2 for ~28 seconds.
	Check that the Navigation System sending the data is turned on and functioning properly. Check the wiring between the system and the SPU.
INVALID HEADING	If an Analog Compass is selected as the Compass Source in the Standby menu, this message indicates that the signals from the compass are faulty. Check the wiring between the Compass and the SPU.
	If an NMEA 0183 Compass or other source of Heading data (NAV1 or NAV2 in the Standby menu) is selected as the Compass Source, this message indicates that no valid Heading sentences have been received for ~28 seconds. Check that the device is turned on and functioning properly. Check the wiring between the device and the SPU.
NO NAV DATA	The SPU has not been able to detect, for ~32 seconds, at the Nav Source specified in the Nav menu, the NMEA 0183 navigation information it needs to operate in <b>NAV</b> mode.
NO SPEED DATA	The SPU has not been able to detect, for ~32 seconds, at the Speed Source specified in the Auto menu, the NMEA 0183 Speed data it needs to operate in <b>AUTO</b> or <b>WORK</b> mode .
	Check that the device sending the data is turned on and functioning properly. Check the wiring between the device and the SPU.
WATCH ALARM	The watch alarm timer has timed out. Press the <b>ENTER( Course Knob)</b> to reset the timer.

**Table 11 – Error Messages**

The following messages indicate a serious problem. Operation of the autopilot cannot continue until the problem is resolved.

Message	Description
AUX.STATION ERROR	The auxiliary Control Head or Handheld Remote connected to the SPU are not compatible with the autopilot system. Typically, this is caused by using Heads or Remotes with firmware versions that are incompatible with that of the SPU. Contact your ComNav Dealer for a Firmware Upgrade.
BATTERY TOO HIGH	Battery voltage has risen above ~40 VDC. Check all wiring and charger systems.
FAULTY HEAD	The main Control Head is not responding to the SPU. Check all wiring.
FUSE F2 FAULTY	Fuse F2 on the SPU has blown. This fuse supplies current to the drive outputs. Check all wiring and verify that all output loads (solenoids, pump motors, etc) are within the specifications given for the SPU. Replace the fuse with the same type only.
LOW BATTERY	The P4 has detected that the battery supply voltage is less than ~10 VDC, which is too low to continue safe operation. Check all wiring as well as the battery/batteries.
ROM ERROR	The P4 has detected a problem in its program memory. Return the unit to your ComNav Dealer for repair.
RFU NOT FOUND	The P4 cannot detect the presence of a Rudder Follower Unit. Check all RFU wiring. If no faults are found, the RFU may be defective. Contact your ComNav Dealer for repair advice or replacement.

**Table 12 – Critical Error Messages**

## Appendix 3

### Diagnostic LEDs

The Signal Processor Unit is equipped with a number of Light-Emitting Diode (LED) lamps that can assist in trouble-shooting should a problem arise with the autopilot system. To observe the LEDs, remove the metal cover on the Diagnostic section.

LED	Description
ALARM	On whenever there is an alarm condition on the SPU. Lights in conjunction with the audible alarm.
BATT PWR	A general indication of the Battery Power supplied to the SPU. Should be on whenever the autopilot is turned on.
DRV PWR	An indication of the power available for the output Drive. Drive Power should be brightly lit whenever the autopilot is on. If it is off, check fuse F2.
VCC	VCC is the voltage supplying the logic circuits on the SPU. The voltage is nominally 5.25 VDC, and can be measured at testpoint TP3 with respect to ground (GND).
SW'D B+	This indicator will be on whenever the Switched B+ output is turned on.
SW'D GND	This indicator will be on whenever the Switched Ground output is turned on.
M1/PORT	For systems that utilize Solenoid steering valves, this LED will be lit whenever the solenoid is activated. For Reversing Motor systems, this LED will be shut off whenever the motor is activated in one direction (which direction depends on how the reversing motor was plumbed in and wired).
M2/STBD	For systems that utilize Solenoid steering valves, this LED will be lit whenever the solenoid is activated. For Reversing Motor systems, this LED will be shut off whenever the motor is activated in the opposite direction to the M1 output.
NMEA 0183 IN #1	This LED will be lit whenever the autopilot receives serial data on the NAV1 input. Note that this indicator only shows that data was received. It does not mean that the data received is valid. Typically, this LED will flash at a rate of about once per second for regular data from a GPS or Chartplotter; it will flash at a rate of about 10 times per second when connected to a heading source such as an NMEA compass. If the LED does not flash and you are sure the sending device is sending data, try reversing the wires from the device connected to <b>J9 – NAV I/O</b> .
NMEA 0183 IN #2	This LED operates identically to the NMEA 0183 IN #1, but shows the reception of data for the NAV2 input.
NMEA 0183 OUT	This LED flashes whenever NMEA 0183 serial data is sent out of the SPU. During normal operation, this LED will flash at a rate of about ten times per second.
ComNav Network RX	This LED is reserved for possible future use.
ComNav Network TX	This LED is reserved for possible future use.

**Table 13 – Diagnostic LEDs**

## Appendix 4

### Upgrading Firmware

The P4 Advanced Autopilot System is the result of extensive development and testing programs.

ComNav is constantly doing research and development related to our Autopilot Systems. From time to time, this can result in new features and benefits that can be incorporated into an existing system installation, in the field – by a ComNav Dealer, or even by the vessel operator.

For the P4 system, this is done with a Firmware. The Firmware link is available from your authorised dealer. The Link will provide intuitive instructions on how to download latest firmware to install the Upgrade. Contact your ComNav Dealer for more information.

***Caution!*** *Be sure to read all of the documentation accompanying the Firmware Upgrade instructions, so you understand all of the operational and performance changes that may occur as a result of the Upgrade.*

## Appendix 5

### General Specifications

Parameter	Specification
Dimensions	
SPU	218x 152 x 62 mm (10.6" x 5.6" x 2.4")
Bracket Mount Head	157 x 118 x 73 mm (6.2 x 4.6 x 2.9") @ 20° max tilt – add 28 mm (1.1") in width for bracket knobs
Flush-Mount Head	165 x 122 x 12 mm (6.5 x 4.8 x .47") – add 11 mm (.43") for Control Knob and 41 mm (1.6") behind surface to clear rear of Head (not incl. cable)
Display	214mmx 145mm 35mm (8.4"x5.7"x1.9")
Colour Head	Sunlight viewable LED backlit, 640 x 480 VGA
Operating Voltage	12/24 VDC
Power Consumption	
SPU	400 mADC
Control Head	350 mADC
Drive Output	20 Amps (max)
Navigational Interface	NMEA 2000 compliant - Network
NAV1 input	NMEA 0183 compliant, optically isolated, 4800 Baud
NAV2 input	NMEA 0183 compliant, optically isolated, auto-baud detecting (4800, 9600, 19.2K and 38.4K Baud)
NMEA 0183 output	Heading (10x per second) and Autopilot status (1x per second), NMEA 0183 compliant, RS-422 compliant, RS-485 compliant, 4800 Baud, 8 data bits, no parity, one stop bit
Course Detection	0.1°
Course Resolution	
<b>AUTO</b> mode	1°
<b>NAV</b> mode	0.1°
External Rudder Angle Indicator	Supports up to five 500µA instruments
Jog Lever Input	Yes
Rudder Follower Input	1.0 – 4.0 VDC centered at 2.5 VDC.
Control Head cable length	6 metres Drop cable standard

**Table 14 – General Specifications**

## Compass Safe Distances

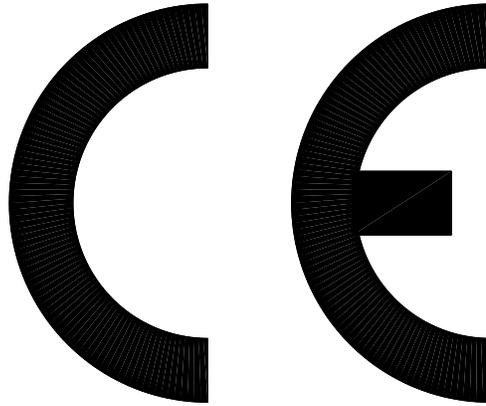
The following Compass Safe Distances were determined using a UKAS calibrated 23 Axis Magnetometer, for both standard compasses and steering/emergency compasses.

<b>ComNav PN</b>	<b>Description</b>	<b>Standard Compass Limit 5.4°/H</b>	<b>Steering Compass Limit 18°/H</b>
20140002	Signal Processing Unit (SPU)	28 cm	16.5 cm
30140001	Control Head	32 cm	21 cm
20310033	TS4 Tiller steering Remote	31 cm	18 cm
20310034	NF4 Jog Lever	13 cm	8 cm
20330008	Medium Duty Rotary Rudder Follower	20 cm	8 cm
20330012	Heavy Duty Rotary Rudder Follower	62 cm	40 cm

*H = horizontal flux density in*

**Table 15 – Compass Safe Distances**

## CE Compliance (European Conformity)



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 Head Office.

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

# 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 2G1 ("ComNav").

### LIMITED ONE YEAR WARRANTY

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

### EXTENDED THREE YEAR LIMITED WARRANTY

If;

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

and

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

then;

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

### NO OTHER WARRANTIES

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

**NO LIABILITY FOR CONSEQUENTIAL DAMAGES**

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

**REMEDIES NOT TRANSFERABLE**

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

**NOTICE OF DEFECT**

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

**WARRANTY LIMITATIONS**

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

**IMPLIED WARRANTIES**

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

## CUSTOMER REMEDIES

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

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

## **CHOICE OF LAW AND JURISDICTION**

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

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

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

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

## **WARNING**

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

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

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# User Notes and Settings

## User Notes and Settings

### User Settings

Once your P4 system has been installed and set up correctly, make a record of all the settings for future reference, in the table below.

Parameter	Range	Default Value	User Settings 1	User Settings 2
<b>Dockside Setup menu</b>				
Reset	<i>press ENTER Knob to do</i>	<i>n/a</i>		
Vessel type	Displ, Semi, Plane, Stern, Sail	Displ		
An. Compass type	None, Mag, Flux, Fixed, Float,	None		
Compass setup	<i>press ENTER Knob button to do</i>	<i>n/a</i>		
Drive setup	<i>press ENTER Knob to do</i>	<i>n/a</i>		
Exit	<i>press Enter Knob to do</i>	<i>n/a</i>		
Alarm O/P	None, SW'D B-, SW'D B+	None		
External Alarm Type	All, Watch	All		
Thrust Type (CT7)	None, On/Off, Prop.	None		
Thrust MIN (CT7)	0 – 70%	0		
Thrust MAX (CT7)	Thrust min to 100%	0		
Language	English, Français, Español, Íslenska, Italiano			
<b>Standby Menu</b>				
Station Lock	Lock, Unlock	Unlock		
Default Turn	U-Turn, Circle, M.O.B., Fishzag,	U-Turn		
Compass Source	Analog, NAV1,NAV2, N2K	NAV1		
Compass Cal	0 – 359°	<i>Set at Runtime</i>		
Watch Alarm	Off, 1 – 30	Off		
Fishzag time	30 – 300	60		
Battery	<i>Read only value</i>	<i>n/a</i>		

Parameter	Range	Default Value	User Settings 1	User Settings 2
<b>Power Steer Menu</b>				
Stdbby/P.Str Rudder Limits	Off, or 5° up to physical limits from Dockside Setup	Off		
Auto/Nav Rudder Limits	Off, or 5° up to physical limits from Dockside Setup	Off		
RAI Offset	0° – 15°	0		
<b>Auto Menu</b>				
Rudder Gain	1 – 10	8, 5		
Counter Rudder	0 – 10	3, 3		
Seastate	Auto, 1 – 10	A, A		
Turn Rate	0.1 – 20	8, 5		
Parameter Set	Lo, Hi, Auto	Auto		
Speed Trip Pt.	1 – 20	10		
Speed Source	NAV1, NAV2	NAV1		
ALC	On, Off	Off		
Thruster Assist <i>(only if Thrust Type is not None)</i>	Off, or 1 – 7 in 0.5 steps	Off		
Thruster Gain <i>(only if Thrust Type is not None)</i>	Low, Med. High	Low		
<b>Nav Menu</b>				
Nav Source	NAV1, NAV2, N2K	NAV1		
XTE Limit	0.01 – 3.0, step 0.01	0.25		
Waypoint Arrival	Silent, Manual, Auto	Auto		
Correction	XTE, CTS, Both	Both		
XTE Sense	Norm, Rev	Norm		
Max Correction	30° – 90°	60°		

Parameter	Range	Default Value	User Settings 1	User Settings 2
<b>Work Menu</b>				
Rudder Bias	Auto/Nav rudder limit or physical limit	<i>Set at Runtime</i>		
Autotrim	Off, On	Off		
Work Trip Pt.	1 – 10	2		
Rudder Scale	0.25 – 3.00, step 0.25	1.00		
Work Mode State	A_Rdy, A_On, M_Rdy, M_On	<i>Set at Runtime</i>		



# ComNav<sup>®</sup>

# marine ltd

ADDENDUM # 260416 Rev. 2

**RE: ComNav P4 Autopilot Installation and Operation Manual**

## Installation

### Safety Precautions

**⚠ Warning: An autopilot is a useful navigation device intended to assist navigators in determining their position and safe course. Under no circumstances it shall replace the guidance of human navigation.**

Do not use the automatic steering in the following circumstances:

- In the event of poor weather conditions such as poor visibility and extreme weather conditions
- In the event of heavy traffic or in narrow waters
- In places when the use of autopilot is prohibited by law

When using an autopilot follow the guidelines below:

- Do not leave the helm unattended
- Do not place any magnetic materials near all types of compasses used by the autopilot
- Verify the position and course of the vessel periodically
- BE ALERT, always switch to Standby mode and reduce speed in sufficient time to avoid hazardous situations

## Connect the System

A basic P4 system includes these components (excluding external steering system):

1. The Signal Processor Unit (SPU)
2. A P4 Head as the main controller
3. The Rudder Feedback Unit (RFU)
4. A heading input device. This can be any NMEA 2000 or NMEA 0183 heading sensor such as a rate compass or GNSS based compass that is capable of providing a heading update rate of 10Hz, or a magnetic or fluxgate compass.

A P4 system can be expanded to include multiple control stations such as a second P4 Head and/or NF4, TS4.

5. Optional additional P4 Head
6. Optional remote controllers
7. Optional navigation devices to use NAV mode

PN 29030083

While the P4 system communicate through the CAN bus, and certain devices (such as NF4 and TS4) are powered by the network power, the SPU and the P4 Head require local power supply.

### **Power Supply to SPU**

The Figure A.1 shows the power supply connection to the SPU. J1 of the SPU box is the local power supply port for the SPU. Fuses are built into the SPU unit. However, a remote disconnect switch or a circuit breaker **must** still be installed in line with the power input to the SPU. Make sure it is rated at a greater than or equal value to 25 Amps. **This breaker will serve as your autopilot ultimate safety “OFF” switch** in case the network-based controllers have lost communication to the SPU.

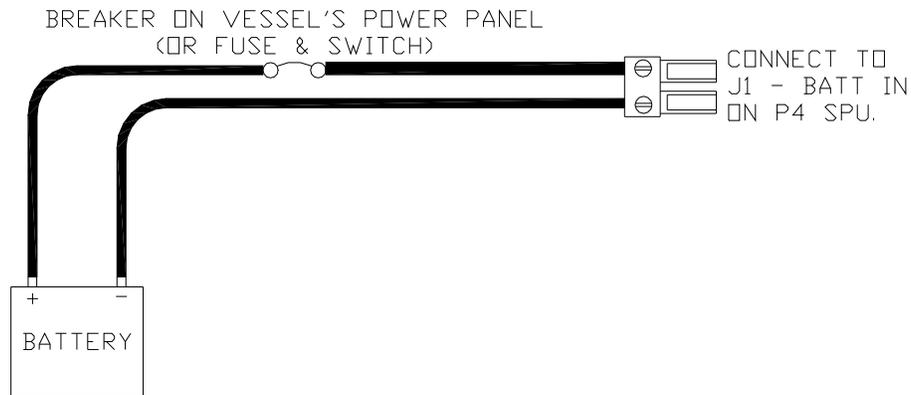


Figure A.1 – Power Supply connection to the SPU. A circuit breaker must be installed.

The location of the SPU unit it should be placed to minimize length of wiring. It is most important to minimize the runs of power and motor leads since voltage drop in these cables will reduce steering power.

### **Power Supply to P4 Head**

The Figure 24 in the manual shows the typical battery connection to a P4 head. A P4 Head wired like that is one control Station. When a station turns on, it starts from the “repeater” status, meaning it monitors all data from the SPU but cannot operate the SPU. The user has to switch the Head to the “command” status before it can be used to control the SPU.

A **Master** station is the one that will automatically place itself to the “command” status after the device is turned on. To wire a P4 Head to a Master station, connect the brown terminal of the P4 head power cable to the negative battery terminal as shown in Figure A.2 below. If you have more than one P4 Heads, only one of them should be wired as a Master station.

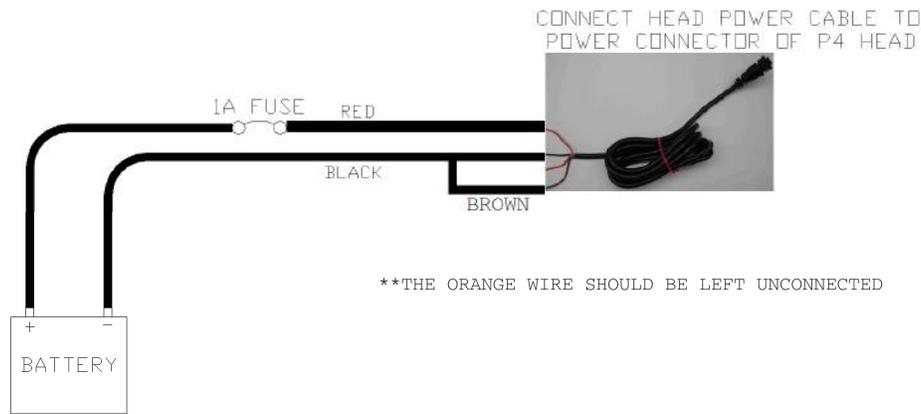


Figure A.2 – Battery Connection to Master P4 Head

### ***NMEA Network Power Supply***

It is important to follow the guidelines of NMEA 2000 installation to make sure a balanced network structure is achieved.

## **Input Interface and Menus**

### **Input Interface**

The 10 buttons and the knob (with a push button on the top) serve as the input interface for the user. A quick guide to the functions of each button is given below.

<b><u>BUTTON</u></b>	<b><u>DESCRIPTION</u></b>
ROTARY KNOB	ALARM: Press knob to silence an alarm  When in MENUs, rotate to move between selections, press knob to gain submenus, press to select an item for change. Rotate to change values or choices, press to go back, choice will be saved. Knob press = enter.  When in AUTO, 1 click, left or right = 1 degree of course change, left or right. A quick spin of the knob = 10 degrees of course change. Spins are additive. 3 spins = 30 degrees of course change.  When in Power Steer (P-STR), each click, left or right = adds or subtracts 1 degree of rudder. A quick spin adds or subtracts 10 degrees of rudder. Spins are additive in P-STR. Use caution.
ALL MODE BUTTONS	Applies for modes: AUTO, NAV, STANDBY, and P. STEER.  To change from one mode to another, press desired mode. <i>Double pressing</i> a given mode button accesses a shortcut menu pertinent to that mode, double press to exit menu. Double press timing, <i>think; one, two.</i>
STBY/ON-OFF 	Press until LCD display lights up for on, short press to re-enter Standby from a steering mode. <b>S</b> will appear on screen. Use long 3 sec. press for off, screen will prompt with count- down to off. <i>Double press</i> for shortcut to USER CONFIGURATION menu from main SETUP menu.

BRIGHTNESS 

*Long press* toggles from day to night palette. *Short press* brings up brightness level scale on screen. Repeated short presses adjust brightness level in a loop.

WORK

Special mode to adapt rudder offset angle and movement when engaged in special work situations while at slow vessel speed. Work is only accessed when the pilot is in the AUTO or NAV mode. See section on Work Mode. *Double press* for shortcut to WORK menu from main SETUP menu.

NAV

Turns the autopilot over to properly configured steering instructions coming from the ship's connected navigation system to follow an activated route or a single go to mark or waypoint. **N** will appear on screen. When in NAV, press again to toggle back and forth between 2 NAV screens. *Double press* for shortcut to NAV menu from main SETUP menu.

AUTO

A press of AUTO commands the autopilot to assume the compass heading that was being read at the moment of press. **A** will appear on screen. Change course with KNOB. See above. *Double press* for shortcut to AUTO menu from main SETUP menu.

CMD

*Short Press* to take command from any other remote station. **R** will appear on the screen if another station is in command.

*Double press* gains access to the complete menu trees for: System, Network Config., Setup and Factory.

If you are already in a menu, *double press* to exit menu or to go back to the previous menu.

P-STR

POWER STEER, a manual steering mode: When in P-Str, the vessel can be steered with the ships steering wheel, the left right arrows, any connected NFU jog lever, or the course change knob (see above). *Double press* for shortcut to P-Steer menu from main SETUP menu.

ARROWS

In AUTO mode, to avoid obstacles, the red arrow dodges the vessel to the left, the green to the right. The rudder runs to the left or right as long as the operator holds an arrow button down. When released, the autopilot steers the vessel back to the commanded heading.

In P-STR mode, pressing an arrow key runs the rudder left or right as long as the button is held down. The rudder stops when released and stays at that rudder angle until brought back by the opposite arrow key, course change knob, jog lever, or steering wheel.

During DOCKSIDE setup an arrow click is used to make a selection.

TURN

*Double pressing* the TURN mode button accesses the TURN shortcut menu. The TURN menu has the options: Enable/disable special turn, Change turn, Pre-tack angle and Fishzag time. A subsequent *double press* on the TURN mode button will exit the TURN menu.

While in AUTO mode, a *short press* on TURN displays the default special turn, a subsequent *short press* will shuffle to the next turn. To initiate the selected turn, press the ARROW key corresponding to the desired turn direction. A *short press* on TURN after turn has initiated will stop the turn.

## Menus

Several changes have been made in the user interface since the initial release of P4 Head to give more intuitive operations to users. This section provides information on these changes.

### ***Entering Dockside Setup Menu***

Dockside setup menu can only be accessed at the time when the SPU is turned on. If a P4 Head is added to the system while the SPU is already on, you need to turn off the system, and turn on the system again to access the dockside setup menu.

When the P4 Head is initializing, you will be prompted on the screen with the message “Press < and > “to enter the dockside setup menu. Pressing the red and green arrow buttons will initiate the Dockside setup menu.

### ***Turn Menu***

A new menu is added to the group configurable items for the autopilot special turn functions. The TURN menu can be accessed by double pressing the TURN button.

The TURN menu includes the following items:

1. Enable/disable special turn  
This is a new configuration in SPUs available in software versions 1.03 and above. When the Special Turn is disabled, the TURN button is disabled in AUTO mode.
2. Change default turn type  
This is the same item previously available in the User Configuration menu. It sets the default Special Turn type when you initiate the special turn function. (See Turn button description).
3. Pre-tack turn angle  
This item allows you to set 5/10/15/20/90 degrees as the tack angle in pre-tack turn.
4. Fishzag Time  
This item is the same one previously available in the User configuration menu. It sets the time interval for Fishzag turn.

## **Recommended Settings for NMEA 0183 at NAV1 and NAV2 ports**

The number of sentences that can be fed to a NMEA 0183 port depends on both the transmitting baud rate and the length of the sentence. NMEA 0183 sentence lengths varies depending on the message type (HDG, HDT, APB), and values (0° vs 359.9°).

The NAV1 port uses a fixed baud rate of 4800 while the NAV2 port can automatically adjust to baud rates ranging from 4800 to 38400. Because of the baud rate adjustment, it takes longer for the NAV2 input to establish the data flow, and, therefore, when using NAV2 port as a data source, expect some delay at the beginning of the input. Once the baud rate is synchronized, there will be no more input delay.

The P4 autopilot requires a 10Hz heading update rate to achieve optimal steering performance. When using a NMEA 0183 heading device, the sentence (HDG or HDT or HDM) update rate should be set to 10Hz. When using NAV1 for the heading input, the heading device should not output other sentences with an update rate higher than 10Hz. You can output a couple of low update rate (1Hz) sentences.

The same rule applies to NAV2 port. However, since the NAV2 port accepts higher baud rates compared to NAV1, more data bytes can be sent. For instance at a baud rate of 38400 you can roughly send 8 times more data bytes than the amount you can send at a baud rate of 4800.

**Note:**

Even if one selects a low update rate for the sentence length, one should still limit the total number of sentences from one device, especial when connecting it to NAV1 port. This is because most devices output sentences in burst. When the data burst exceeds the bandwidth, sentences will be lost.