

ComNav®

Marine Ltd.

**1500 Autopilot – Stand Alone System
1510 Autopilot – Network System**



**Operation & Installation Instructions
Version 2.0**



ComNav 1500 / 1510 Autopilot

Welcome

Congratulations on your purchase of ComNav Marine's NX2 1500 Autopilot System! At ComNav, we are proud of our prominence as a leader in the design and manufacture of marine Autopilot systems. Our dedication to performance and reliability will ensure your satisfaction with the ComNav 1500. Developed as a result of ComNav's many years of experience in Autopilot design, the 1500 system provides excellent performance and more features than any other Autopilot in its class.

Yours truly,

Don Morris
Vice President Operations
ComNav Marine Limited

Warranty Notice

Prior to the installation and/or operation of the equipment, ensure that you read, understand and accept the conditions of the warranties as detailed in Section 12 of this manual.

Operator's Warning

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

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

About This Manual

This manual provides essential information for the safe and reliable operation of the 1501 Autopilot System. You are urged to read this manual in its entirety before you use your Autopilot for the first time, and to keep it handy until you become thoroughly familiar with the operation of your Autopilot.

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

- Each time a push-button is referred to in this manual, the push-button name will appear in **bold** and CAPITAL letters, e.g. **MODE**.
- Unless otherwise stated, the push-button presses are momentary.
- Each time a function is mentioned in the text, it will be in brackets and in the same format, where possible, as displayed, e.g. [HDG] for HeaDinG.
- With the word navigator we mean a GPS, Loran or Decca instrument.
- Which instrument is navigating? By the term navigating, we mean the active instrument in which the waypoint memory is used for navigation to calculate the navigation data, i.e. BTW, DTW etc. There can only be one instrument on the NX2 Network which is keeping the waypoints in memory, but the waypoints can be reached from all instruments.

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1. INTRODUCING THE COMNAV NX2 1500 AUTOPILOT

1.1 Capabilities

The ComNav NX2 1500 and 1510 Autopilots are designed for power and sailing vessels from 26ft (8m) to over 160ft (50m) length. Design and manufacturing techniques developed over many years have resulted in a versatile and heavy-duty unit. Hydraulic drive units of the reversible motor variable speed (PWM) type provide precise control while consuming low battery power. Connection can be made to solenoid valves of electro-hydraulic steering systems, allowing use on very large vessels. Hydraulic linear drives provide powerful and accurate control when connected to mechanical steering systems and provide an independent hydraulic steering for added safety.

No Autopilot can steer better than its compass stability will allow and the flux gate compass excels in this characteristic. Silicone oil dampening of the flux gate prevents compass instability even for high speed vessels slamming in heavy seas. This combined with the high gimbal angle of +/- 45°, eliminates compass disturbance with vessel heeling or rolling. A sensitive automatic gain design provides improved compass operation especially in high latitudes and automotive deviation compensation ensures accurate indication. As an alternative an NMEA 0183 output flux gate compass can be connected to this Autopilot for greater interfacing flexibility. An optional fluid compass sensor may be used and slaved to the vessel's main magnetic compass if it is of the externally gimballed type. This is particularly important on steel-hulled vessels. For larger vessels a gyro-compass may be interfaced for even greater steering accuracy.

Power steering, either through the Control Head push buttons or an operational jog steering level may be used to avoid heavy wheel effort when maneuvering.

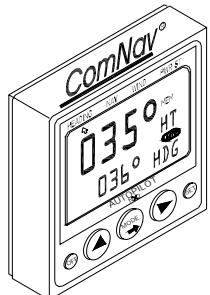
Alarms for off course, off track or watch alarm and other faults are included with provision for an optional loud remote alarm. Interface to radio navigational receivers including GPS, Loran, Satnav, Decca and Plotters allows precise waypoint arrival and multiple waypoint sequencing. Unique adaptive controls provide very powerful and smooth steering control which automatically adjusts to changing operational conditions.

A large number of Autopilot stations may be connected. Control techniques developed over many years allow very stable course holding with minimum corrections. Weather helm is automatically compensated for by an automatic trim and counter rudder that provides enhanced response in quartering seas under large course changes. Some Autopilot features described above may not be available with the 1510 system.

1.2 Principle of Operation

The powerful microprocessor in the Distribution Unit accepts heading information from magnetic or gyro compasses and radio navigation receivers and compares this against the course set by the Control Head and rudder information as sent by the Rudder Transmitter. Any difference between the set and actual course is compared along with the rate of change and trends in change (PID control), to drive the Pumpset motor or solenoid directional valve, moving the rudder as necessary to return the vessel back to course. The sensitivity to course errors and amount of correction are user adjustable to suit different vessels under changing sea conditions. Factory default settings establish a basis for normal steering and may be further optimized as necessary. During set up procedures, the compass is automatically compensated and installation errors such as reversed rudder feedback and reversed Pumpset wiring or piping are automatically diagnosed and corrected. During this procedure the rudder speed is automatically optimized. This greatly reduces installation calibration and sea trials time while eliminating possible Autopilot malfunction.

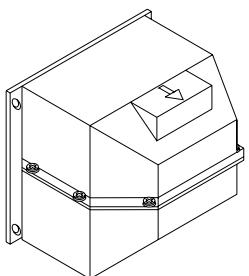
1.3 Components



1.3.1 Autopilot Instrument Control Head

The control and display of all Autopilot functions are provided by the Control Head. It is waterproof and may be mounted below or above deck. Multiple Control Heads are connected in parallel (daisy chain) and any station may be activated by pressing any one of its keys. A portable Control Head is also available for remote control (not shown).

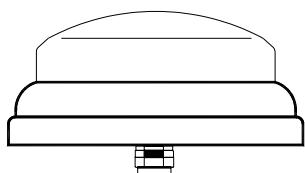
PN 20620044



1.3.2 45 ° Flux Gate Compass

The flux gate compass provides a stable heading reference for the Autopilot and course repeater function on the Control Head. It is gimbaled to accept up to $+/- 45^\circ$ of pitch and roll and should be bulkhead mounted below decks near the center of pitch and roll for maximum stability. Construction is splashproof. The Autopilot may also be used to transmit NMEA heading data to additional receivers such as radars, plotters, compass repeaters etc.

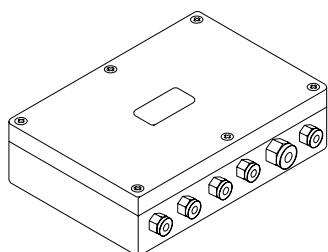
PN 20640006



1.3.3 35 ° Flux Gate Compass

The flux gate compass is low weight, fluid damped and compact in size allowing for mounting in cramped areas. It can be flush mounted and is auto-deviated from the Autopilot Instrument Control Head.

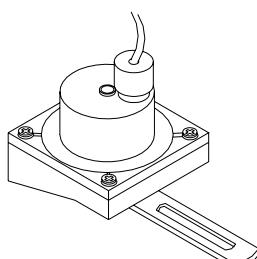
PN 20640007



1.3.4 Distribution Unit

The Distribution Unit contains the course computer and motor drive circuitry and acts as a central distribution for interconnecting wiring. This unit accepts data from the compass, Control Heads, radio navigational receivers and Rudder Transmitter. The DU-1500 is waterproof and may be mounted in any convenient and cool area. The DU-1510 is splashproof and should be mounted in a water protected cool area.

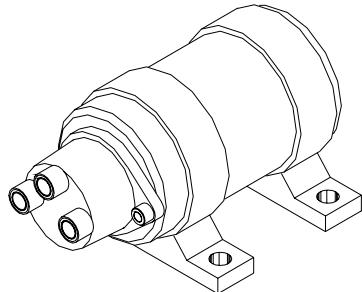
(shown) DU-1500 PN 20090002
DU-1510 PN 20100002



1.3.5 Rudder Follower & Linkage

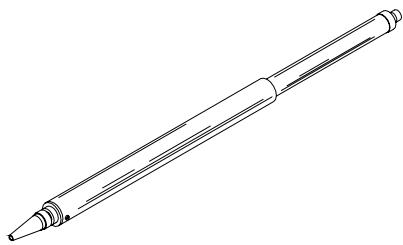
The Rudder Follower & Linkage provides the Autopilot with accurate rudder position information. It is mounted near the rudder shaft and connected to the tiller or quadrant with a ball joint linkage.

PN 20330008+20330007



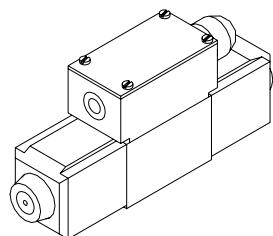
1.3.6 Reversing Pumpsets

Various sizes and types of Pumpsets are available which connect into the vessel's hydraulic steering system, pumping oil on command from the Distribution Unit so as to drive the steering cylinder to the required rudder angle. The reversing motor Pumpset is only operation when carrying out a rudder command. When the vessel is on course the motor stops. A variable speed motor drive adjusts maximum rudder positioning accuracy. Optional solenoid valve controlled Pumpsets are available for use on larger vessels. Construction is splashproof.



1.3.7 Linear Drive

A hydraulic cylinder is provided for driving the quadrant of mechanical steering systems. The cylinder is driven by one of the above Pumpsets and includes a small hydraulic reservoir and bypass valve that frees the hydraulic system when the Autopilot is not in use. This linear drive provides a cleaner installation (being entirely below deck) and delivers much more torque to the rudder than wheel driven units. In case the mechanical steering should fail, the cylinder provides a back up hydraulic steering.



1.3.8 Solenoid Valve Drive

On larger vessels the main hydraulic steering may be fitted with a Solenoid Valve controlled power steering. In this case the Autopilot does not need to be supplied with a Pumpset drive unit since the Distribution Unit output can be reconfigured with its board mounted DIP selector switch to provide drive for steering solenoids having coil voltages of 12 or 24 VDC.

1.4 Accessories

1.4.1 NX2 Autopilot Instrument Control Head

Additional Autopilot Instruments Control Head (PN 20620044) may be added. They are connected in a "daisy chain" fashion from one to the other, matching colors on terminals. Control may be transferred from one instrument to another by simply pressing any pushbuttons (except the OFF push-button) on the instrument where active control is desired. All other inactive instruments will display the same information as the active instrument, however in the lower display the text "passive" will blink once every seven seconds.

1.4.2 NX2 Remote Control Instrument

The Remote Control Instrument (PN 20620048) is an instrument in itself that can be set in either Autopilot mode to be used as an Autopilot instrument, or Instrument mode displaying all information on the NX2 Network. The Network Remote Control Instrument (PN 85006) can be used as a remote control for all instruments connected to the Network. It is the ultimate NX2 instrument!

1.4.3 NX2 Analog Rudder Angle Indicator Instrument (RAI)

The Analog Rudder Angle Indicator Instrument (PN 20620037) indicates the rudder angle (50°-- 0° -- 50°). This instrument is connected on the NX2 data bus cable as per color codes.

1.4.4 NX2 Multi Control Instrument with Server

The NX2 Server is the heart of the NX2 Network to which transducers for speed, depth, wind, compass and navigators are connected. The Multi Control is a multi-function instrument that displays a main and a sub-function, grouped into 4 pages for speed, depth navigation and wind information. The Multi Control instrument and the Server are the building components of the NX2 Network.

1.4.5 External Alarm Buzzer

An external alarm buzzer (PN 30620023) can be connected to the Server only. When activated, provides a local alarm at the Control Head in case the Autopilot falls off course, develops a fault or the helmsman should fall asleep. The buzzer can be positioned where it may be heard such as in the Captain's cabin, when any alarm is activated.

1.4.6 NFU Jog Lever

A Non Follow Up (NFU) jog lever (PN 20310002) may be connected through the Autopilot to directly control the steering Pumpset in any mode except standby mode. This is useful for docking or remote maneuvering such as required when picking up crab traps etc. In any automatic pilot mode, the jog steering can be used as a dodge function and when the jog lever is let go, the boat will revert to the previous pilot course setting.

2. INSTALLATION

2.1 General Comments

More than any other piece of marine electronics, reliable and accurate operation of an Autopilot depends on correct installation. Please read and be sure you fully understand the installation requirements before attempting installation.

The installation includes 6 major steps:

1. **Read the installation and operation manual completely.**
2. Plan where to install the equipment.
3. Run the cables.
4. Install the transducers and instruments.
5. Make the attachments needed for Pumpset and cylinder and install them.
6. Learn the functions and calibrate your system.

Before you begin drilling ... think about how you can make the installation as neat and simple as your boat will allow. Plan where to position the transducers, Server and instruments. Think about leaving space for additional instruments in the future.

A few "do nots" you should consider:

- Do not cut the cables too short. Allow extra cable length at the Distribution Box (Servo Unit) so it can be disconnected for inspection without having to disconnect all attached cables.
- Do not place sealant behind the display. The instrument gasket eliminates the need for sealant.
- Do not run cables in the bilge, where water can appear.
- Do not run cables close to fluorescent light sources, engine or radio transmitting equipment to avoid electrical disturbances.
- Do not rush; take your time. A neat installation is easy to do.

The following tools and materials will be needed:

- Wire cutters and strippers.
- Small and large Philips and small flat head screw driver.
- Hole saws: 63mm OD (2½") and 89mm OD (3 ½").
- Drill bit for 5mm OD (1/4").
- Plastic cable ties

If you are doubtful about the installation, obtain the services of an experienced technician.

2.2 Distribution Unit 1500 & 1510

Location

The Distribution Unit must be mounted on a dry, flat and vertical surface below deck, at least 500 mm (20") from radio receiving equipment. Since all wiring originates at the Distribution Unit, it should be centrally located to minimize lengths of wiring. It is most important to minimize the runs of power and motor leads since voltage drop in these cables will reduce steering capacity.

Installation

Note: The 1500 and 1510 Autopilots are designed for different applications:

The **1500** is designed as a **Stand Alone System**.

The **1510** is designed to work as part of a **Network System**, by connecting it to the NX2 Network.

Place the adhesive drill template provided in the desired location for the appropriate Distribution Unit and drill accordingly. (Reference the following pages). Remove the template. To mount the Distribution Unit, remove the cover screws. The 4 inner mounting holes are now exposed. Mount the Distribution Unit with 4 screws (not supplied).

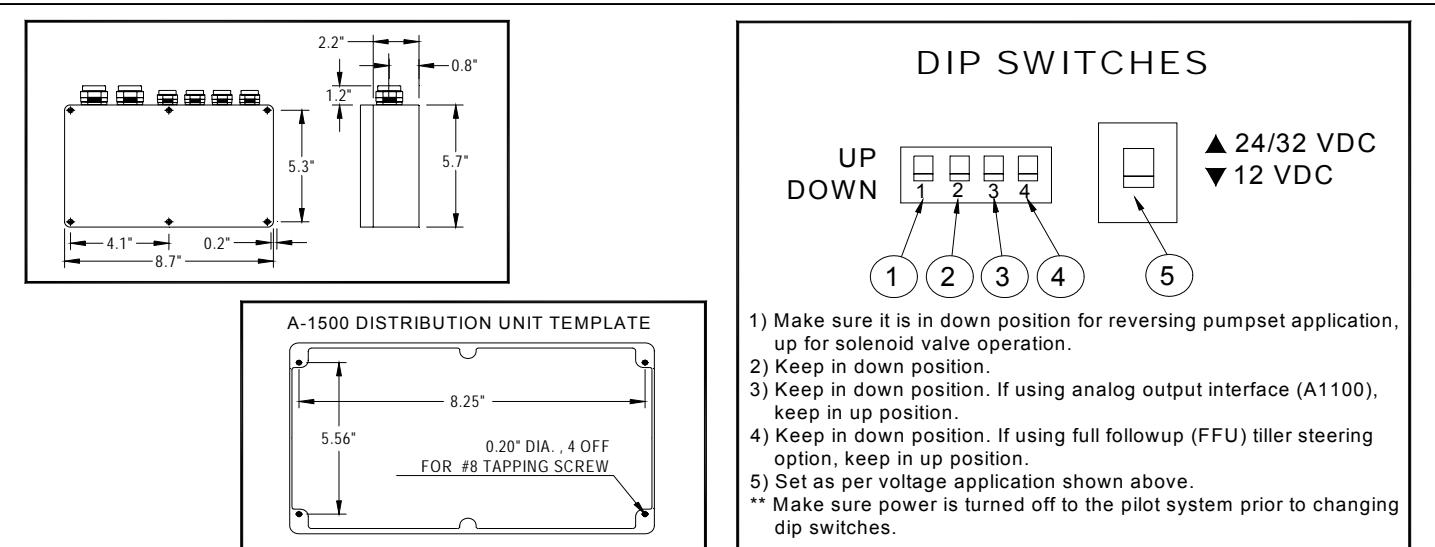
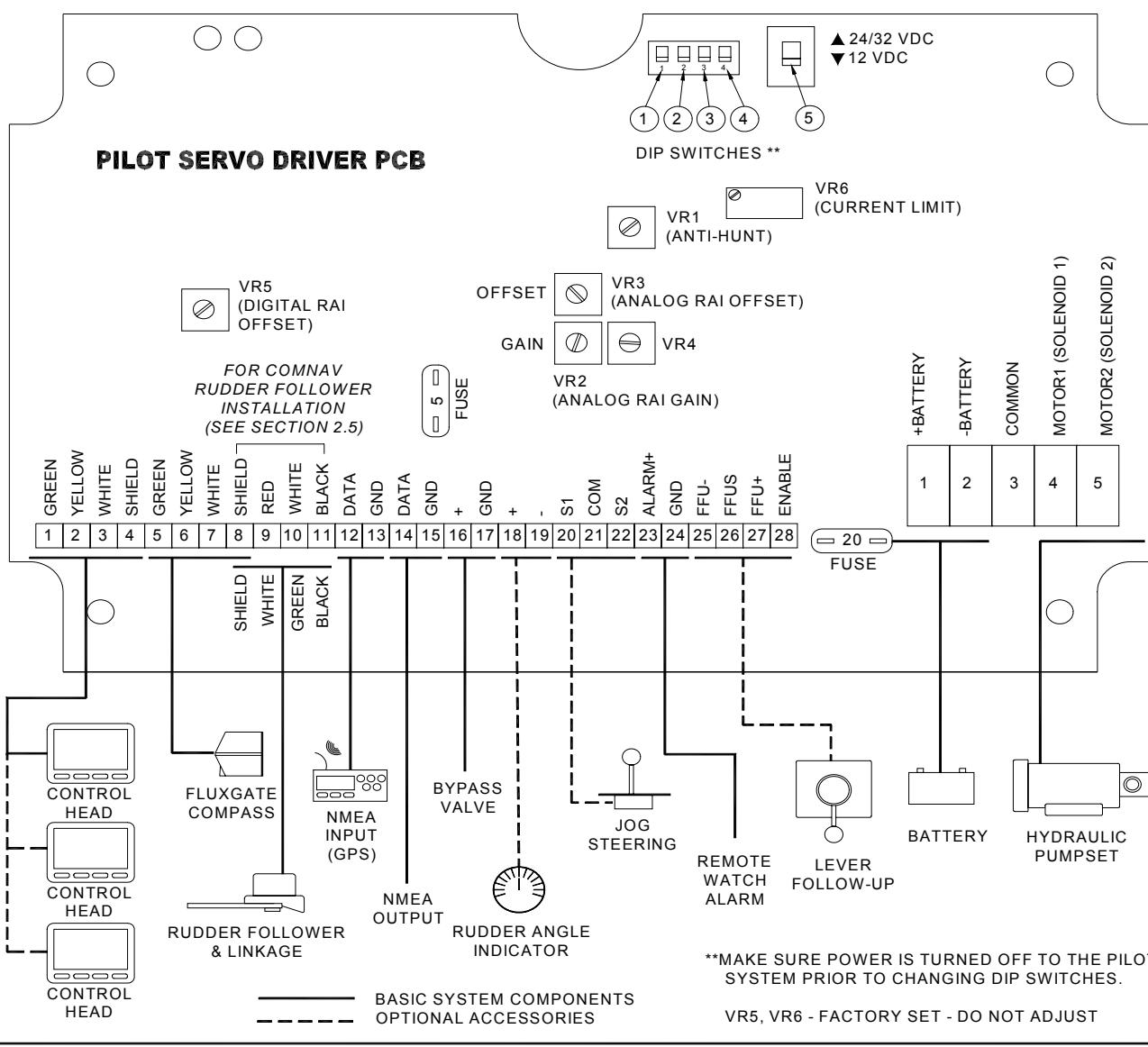
Note for the 1500 Distribution Box: If any waterproof cable glands do not have cables inserted, install the short rubber plug provided in order to maintain water tightness. If many options are connected and not enough glands are available, use a separate junction box and route the excess wires through one large cable in one of the large glands.

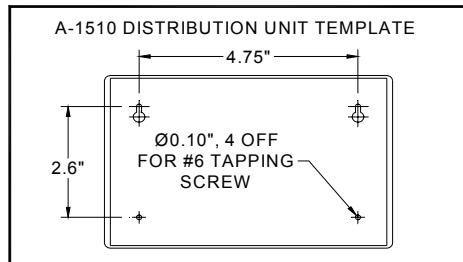
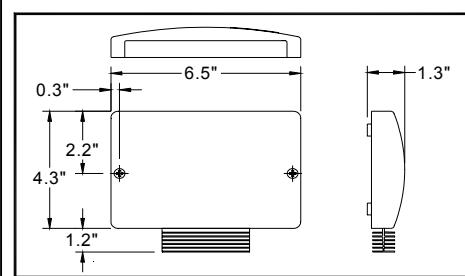
Note for the Autopilot Instrument / NX2 Network connection. If you want to run the NX2 Network instruments separate from the Autopilot, do not connect green wire to (pin 1) to the left in Distribution Unit. Instead insulate the green wire.

Wire thickness - Important! Use the following table to determine wire thickness. Total distance from battery to Distribution Unit and distance from Distribution Unit to Pumpset must be used to determine the wire thickness from the table.

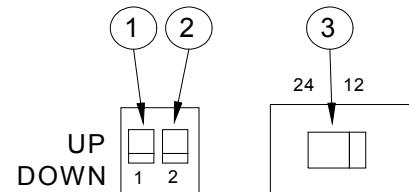
Cable Length Maximum (m)	Cable Length Maximum (ft)	Wire Size (mm ²)	Wire Size (AWG)
3	10	2.5	14
5	16	4	12
7.5	25	6	10
12	40	8	8

Make sure, that the wire size between the battery and the point where you will connect the wire to the Distribution Unit is big enough to secure power supply to all other connected electrical units on board. If you are in doubt, ask your local technician.

**A-1500 SYSTEM WIRING DIAGRAM (FOR REVERSING PUMPSET)**

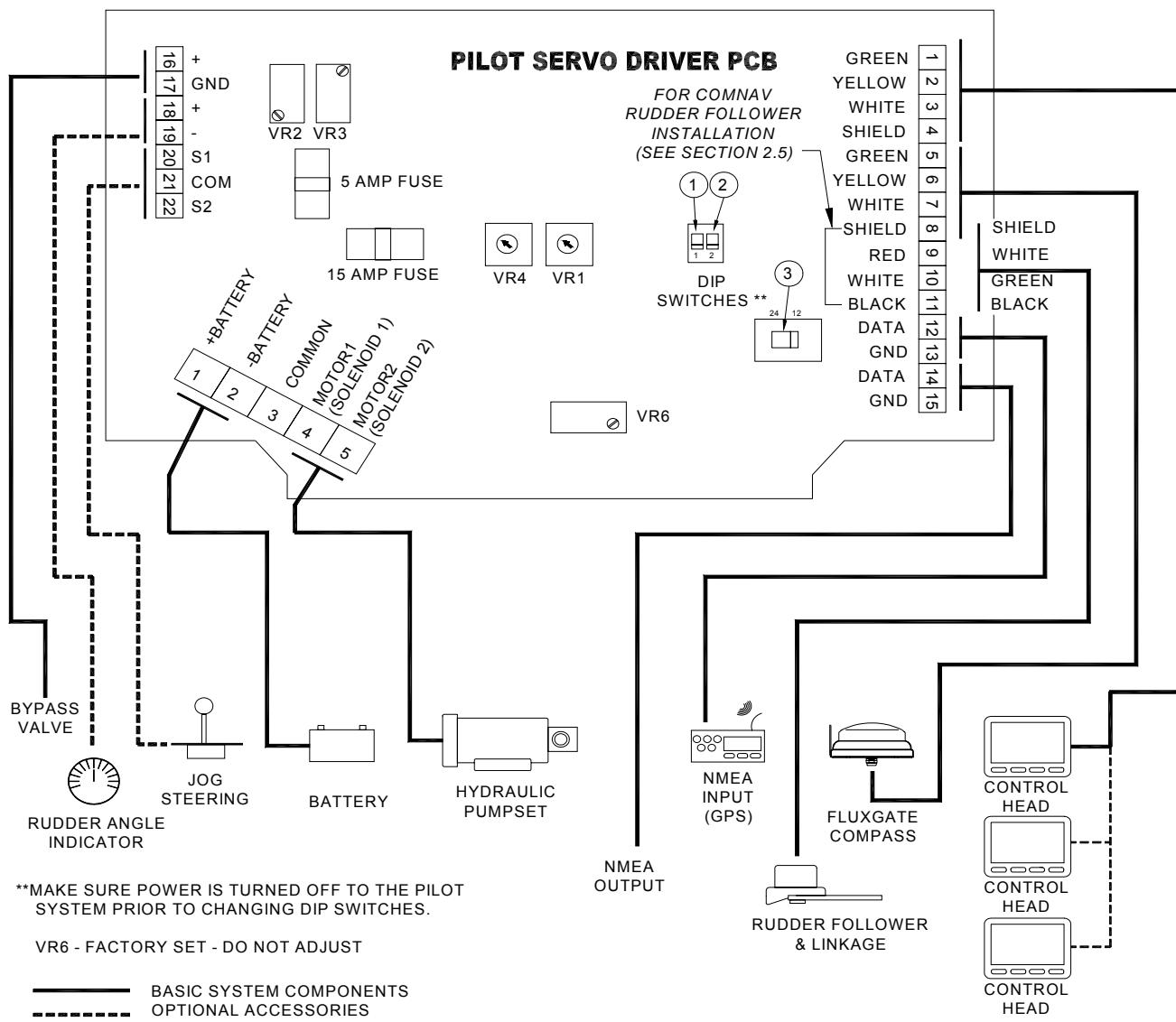


DIP SWITCHES



- 1) Make sure it is in down position for reversing pumpset application, up for solenoid valve operation.
 - 2) Keep in down position.
 - 3) Set as per voltage application shown above. Switch should be set to 12 for 12 VDC application or set to 24 for 24 VDC application.
- ** Make sure power is turned off to the pilot system prior to changing dip switches.

A-1510 SYSTEM WIRING DIAGRAM (FOR REVERSING PUMPSET)



2.2.1 Distribution Unit Connections

Distribution Unit connections should be according to the System Wiring Diagram provided and in addition, the following points:

2.2.2 Safety Switch

Important! An external safety switch or circuit breaker (not supplied) should be installed in line with power input. Make sure it is rated greater than or equal to 25 Amps.

This switch will serve as your Autopilot ultimate safety OFF switch.

2.2.3 DIP Switches

The main circuit board has 2 DIP Switches, which must be pre-set during installation to suit the installed configuration.

Important! With power turned off to the system, do the following:

- a) Locate DIP Switch for 12 or 24/32 VDC voltage and make sure it is set to the voltage supply connected.
- b) Locate DIP Switch for "Solenoid Valve" or "Pumpset" and make sure it is set to the type of drive you have installed.

2.2.4 Trim Potentiometers

If an external Rudder Angle Indicator is fitted to a 1500 Distribution Unit, it can be calibrated with the 2 trim potentiometers as indicated on drawing. Adjust VR3 labeled offset, for rudder center and VR2 labeled gain, for maximum deflection.

Note that this is just to calibrate an external Rudder Angle Indicator Instrument. The NX2 instruments must be calibrated by changing the rudder angle transmitter arm length.

2.3 Control Head

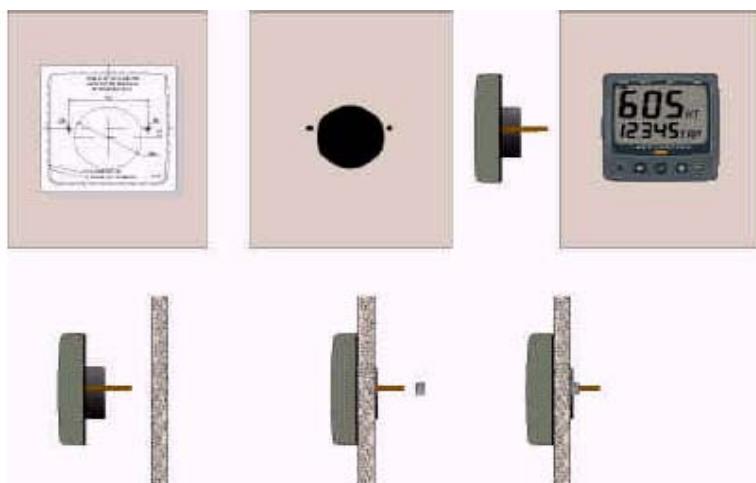
Location

The Control Head is waterproof when gasket mounted to a flat surface. It should be mounted near the steering position for ease of visibility and transfer from manual to automatic.

Installation

Place the adhesive drill template on the desired location for the Control Head. Drill the 2 holes using a 5mm (1/4") drill for the two pin bolts. Use a 63mm (2½") hole saw to machine the clearance hole for the Control Head connection socket.

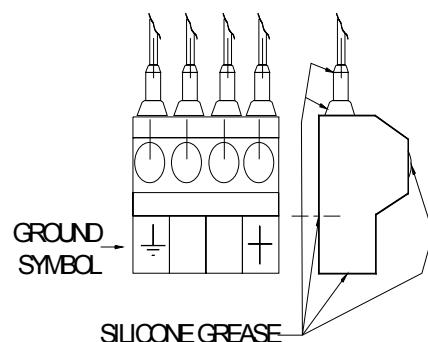
Remove the template.



- Screw the two pinbolts to the instrument.
- Put the instrument in place.
- Screw the two nuts from the back.

Note! The two nuts should only be hand tightened. Do not use a wrench.

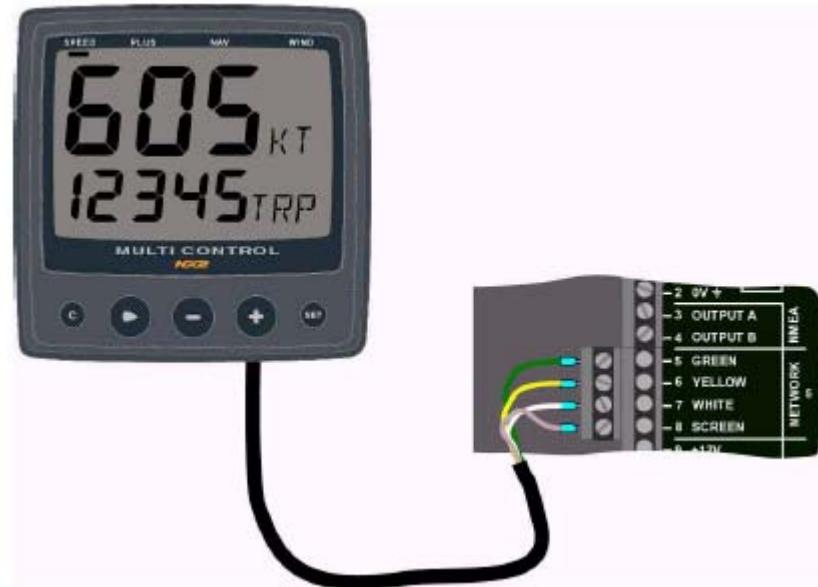
- Run the NX2 Network cable from the Distribution Unit to the Autopilot Instrument Control Head. Connect to terminals #1, 2, 3 and 4 (see System Wiring Diagram).
- If you want to cut the NX2 Network cable to length, disconnect 4-pole jack plug and cut the cable. Peel off about 35 mm (1,4") of the cable insulation. Remove about 6 mm (1/4") from the 3 isolated wires (the 4th wire is an earth / screen). Attach the 4 cable protectors to the wires using a pair of flat pliers.
- Connect the 4 cable protectors to the 4-pole jack plug as shown.
- Apply silicon grease on all locations as shown. This must be done to avoid corrosion.





- Apply silicon paste to the instrument connection pins at the back of the Instrument. Press the jack plug onto the instrument pins. Press the cable in to the cable leads.
- Secure the back cover with the screw.

All NX2 instruments are connected directly to the NX2 Network in a daisy chain. They all use the same colour coded 4-pole jack plugs.



2.4 Flux Gate Compass

Location

Compass location is most critical. This compass operates with an automatic deviation feature. Best performance will be obtained if mounted at the center of pitch and roll, in order to minimize undesirable accelerations which can degrade compass stability. On most vessels this would be about 1/3 forward, on the centerline and approximately at sea level. Various obstructions or magnetic interference may exist at this ideal location and a reasonable compromise is acceptable in establishing the exact location. The fore-aft arrow on the compass should face forward and parallel to the boat centerline. If this is not possible, the compass error resulting (lubber line error) may be corrected after Autodeviation has been performed. The compass should be mounted with the cable outlet at the bottom (See diagram on following page).

The following safe magnetic distances should be maintained where possible:

OBJECT	SAFE DISTANCE	
	Ft.	m.
Main Engine	7	2
Radar Magnetrons	5	1.5
Horizontal and Vertical Steel Plates, Tanks	3	1
High Power Electric Motors (bilge pumps, refrigerators)	3	1
HF or VHF Antennas	10	3
High Current DC wires	3	1
Magnetic meter movements and loud speakers	3	1
Large bolts or fasteners	2	0.6

The above may not always be possible to maintain due to problems unique to each vessel. If in doubt, check for local magnetic disturbance using the Installation procedure.

Steel vessels are a special case and an experienced compass adjuster should be consulted since the automatic compass compensation only corrects for horizontal errors and significant deviation from vertical fields such as Vertical Heeling Error can occur.

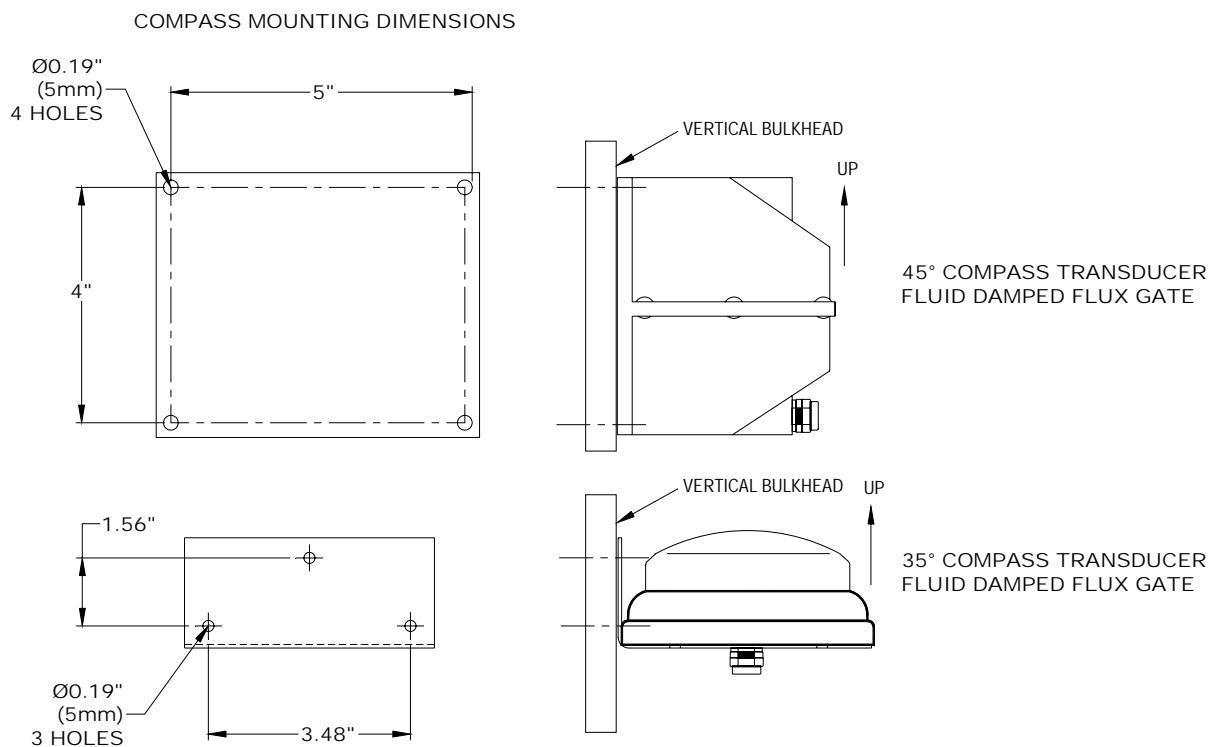
Installation

At the dock, hold the small pocket compass (supplied) in the proposed compass location, and while keeping it pointed in one direction, slowly move it up and down over about 3ft (1m). Then move it slowly fore-aft and athwartships over about 3ft (1m) while keeping it on the same bearing and at the proposed mounting height. If the compass heading does not change by more than 30°, the location is probably acceptable. Another test is to temporarily mount a fluid compass at the proposed Autopilot location and then turn the vessel slowly while comparing the compass heading against the corrected main steering compass heading. If differences are less than 30°, the automatic compass compensation will operate satisfactorily. The automatic deviation *may* correct for much larger errors, but best Autopilot response will be achieved if a location with low magnetic interference is chosen.

- **45° Compass:** With cable outlet at bottom, place the compass on a flat vertical surface and mark the 4 mounting holes. Drill accordingly and mount with stainless steel fasteners.
- **35° Compass:** With cable outlet at bottom, place the bracket on a flat vertical surface and mark the 3 mounting holes. Drill accordingly and mount using stainless steel fasteners.

For Both 1500 & 1510 Autopilots

Connect the compass cable to the Distribution Unit terminals #5, 6, 7 and 8, matching the colors as marked on the circuit board (see System Wiring Diagram).



2.5 Rudder Follower & Linkage

Location

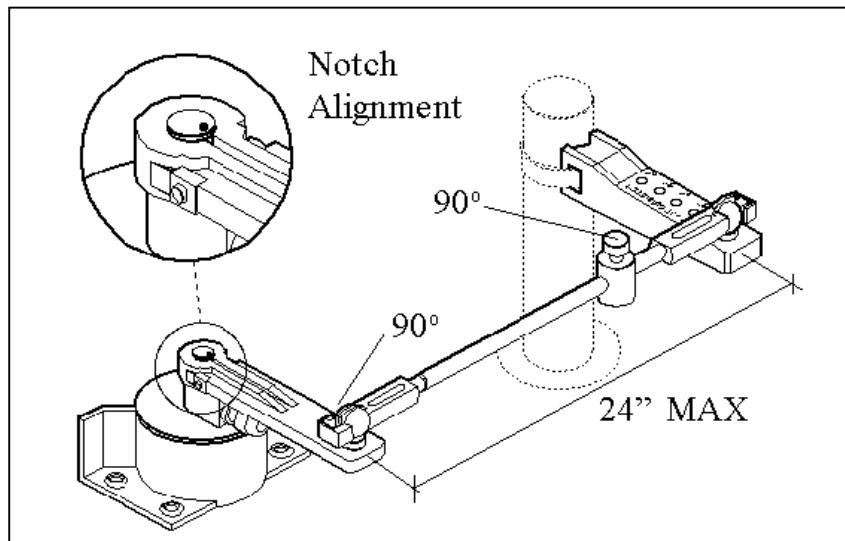
The Rudder Follower is used to transmit the position of the rudder back to the Autopilot. It should be connected to whatever parts of the steering system the Autopilot controls. Normally, this will be the vessel's rudder. However, if the vessel has 2 stage steering, where the Autopilot drives a control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

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

Installation

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

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



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

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

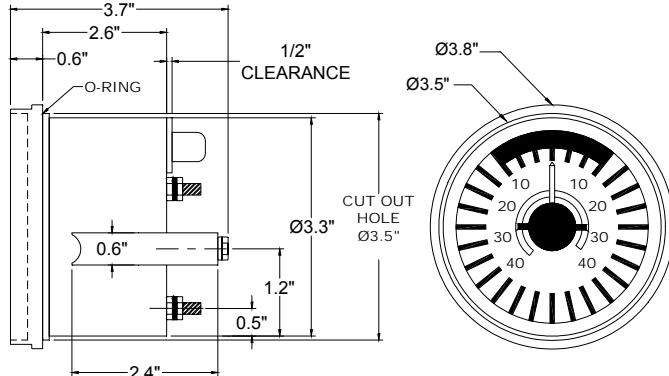
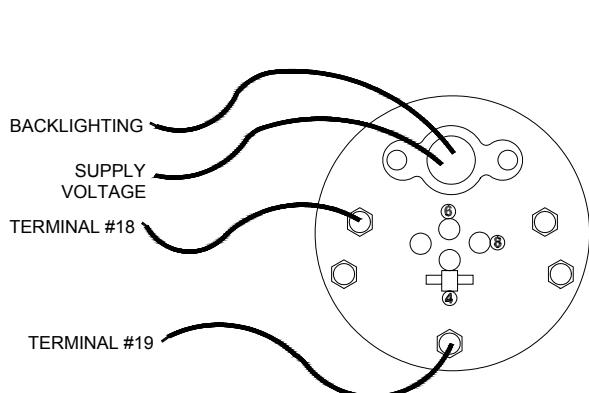
The Rudder Follower is supplied with approximately 15.5m (50') of cable. Run the cable from the Rudder Follower towards the SPU, ensuring that a hose or conduit protects it wherever it passes through fish or cargo holds, or any other area where it could be damaged.

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

Connect cable to Distribution Unit terminals #8, 9, 10 and 11. Rudder Follower Wires: shield to terminal #8 (Flux Gate shield), white to terminal #9 (marked red), green to terminal #10 (marked white) and black to terminal #11 (marked black).

2.6 Analog Display Rudder Angle Indicator

Single or multiple analog display Rudder Angle Indicator repeaters can be added as per the System Wiring Diagrams. If the rudder direction indication is reversed, reverse the wiring connections at terminal #18 and #19 in the Distribution Unit. If a ComNav Rudder Angle Indicator is fitted, adjustments of potentiometers VR2 and VR3 on servo unit circuit board may be necessary. Potentiometer adjustment details are outlined in Fine Tuning Section. If multiple Rudder Angle Indicators are fitted, they must be wired in series.



2.7 NMEA 0183 Compass Interface

For the 1500 Distribution Unit: Use the NMEA 0183 Compass Interface available from ComNav. Wiring interconnection instructions are provided with the NMEA 0183 Compass Interface. Calibration parameter “CAL c6” can be used to adjust for heading offsets.

For the 1510 Distribution Unit: the NMEA 0183 Output Compass can be connected directly to terminals #14 and #15.

2.8 LFU101 Full Follow Up (FFU) Tiller Steering

If you do not have a Full Follow Up (Tiller) lever, go to next item. The FFU steering control lever or knob can be used to maneuver the vessel. The FFU steering will control the rudder to the angle commanded by the follow up control lever or knob. The DIP Switch on the servo until circuit board must be set up correctly to use this function. The use operation and instruction manual for the FFU steering lever or knob control is provided with the unit. The FFU steering feature is not available with the A-1510 Distribution Unit.

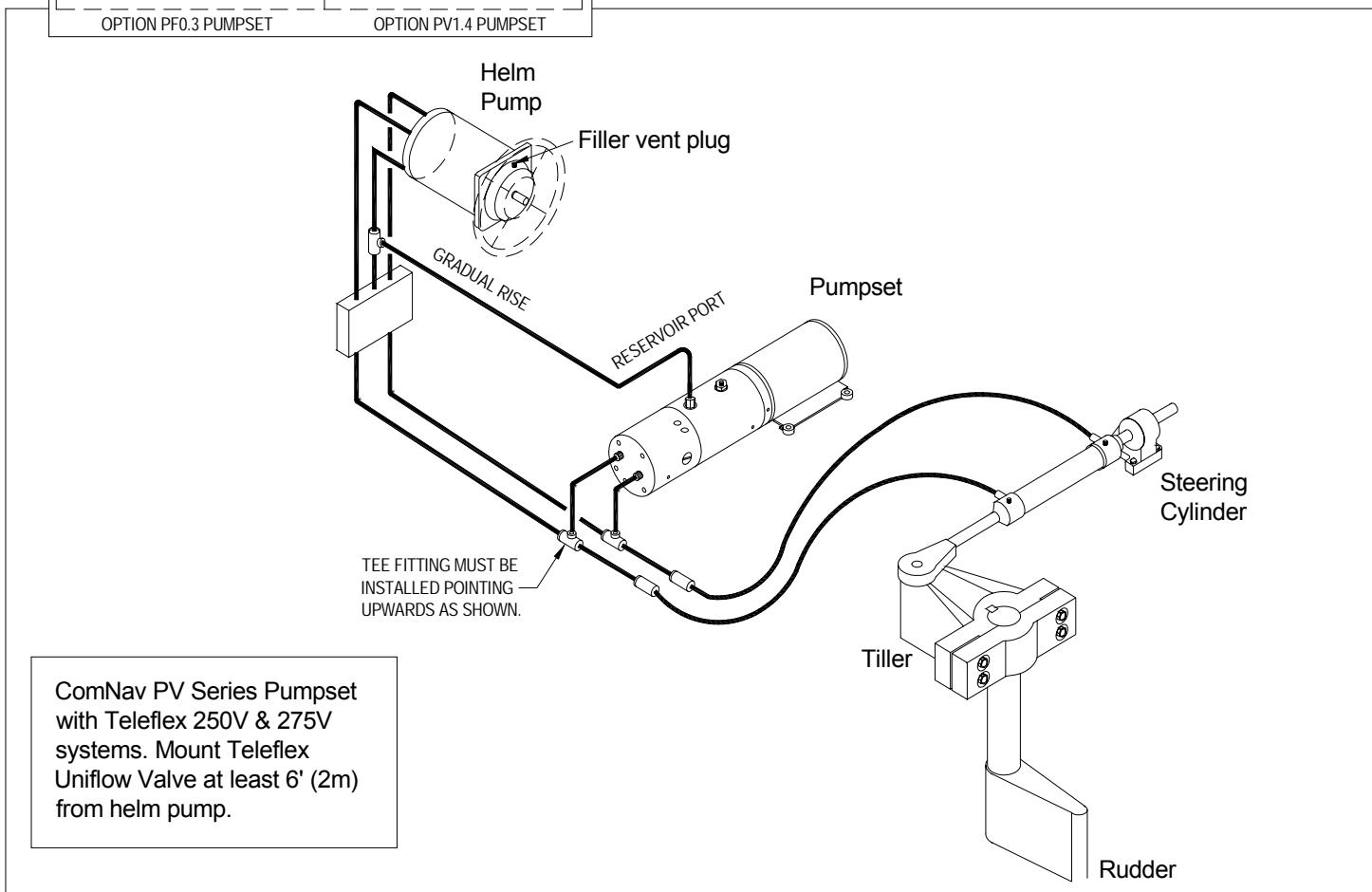
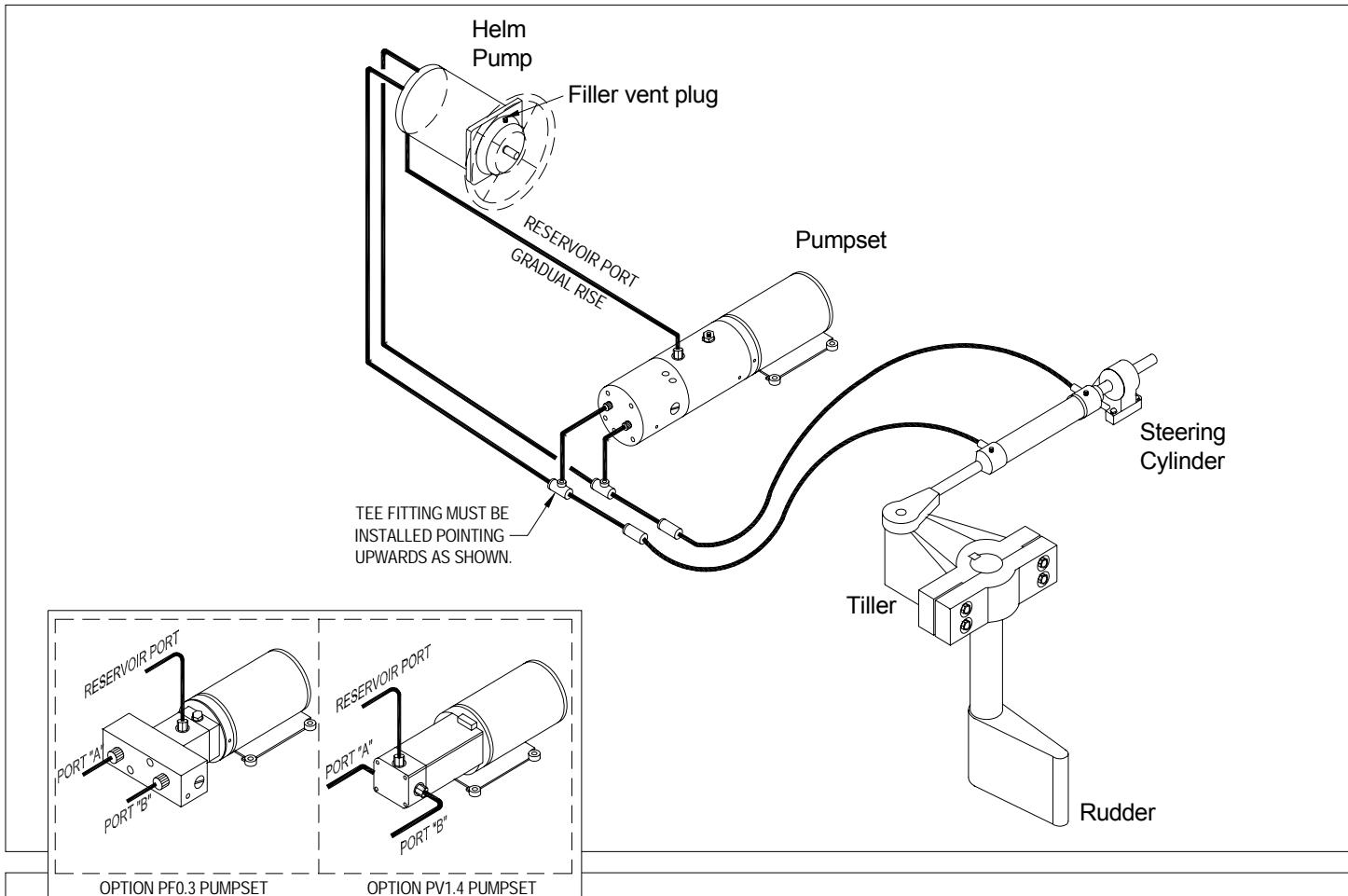
Installation

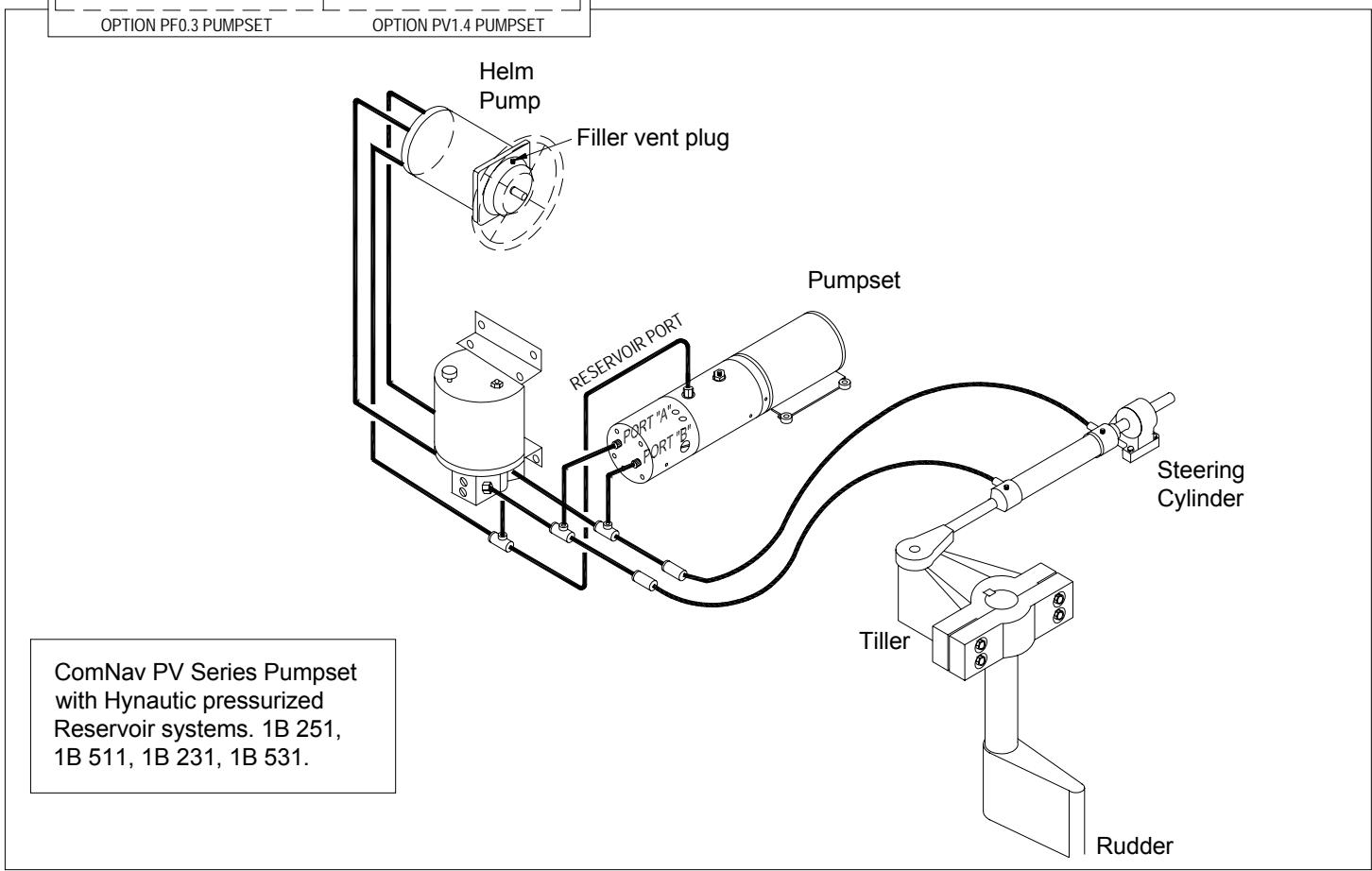
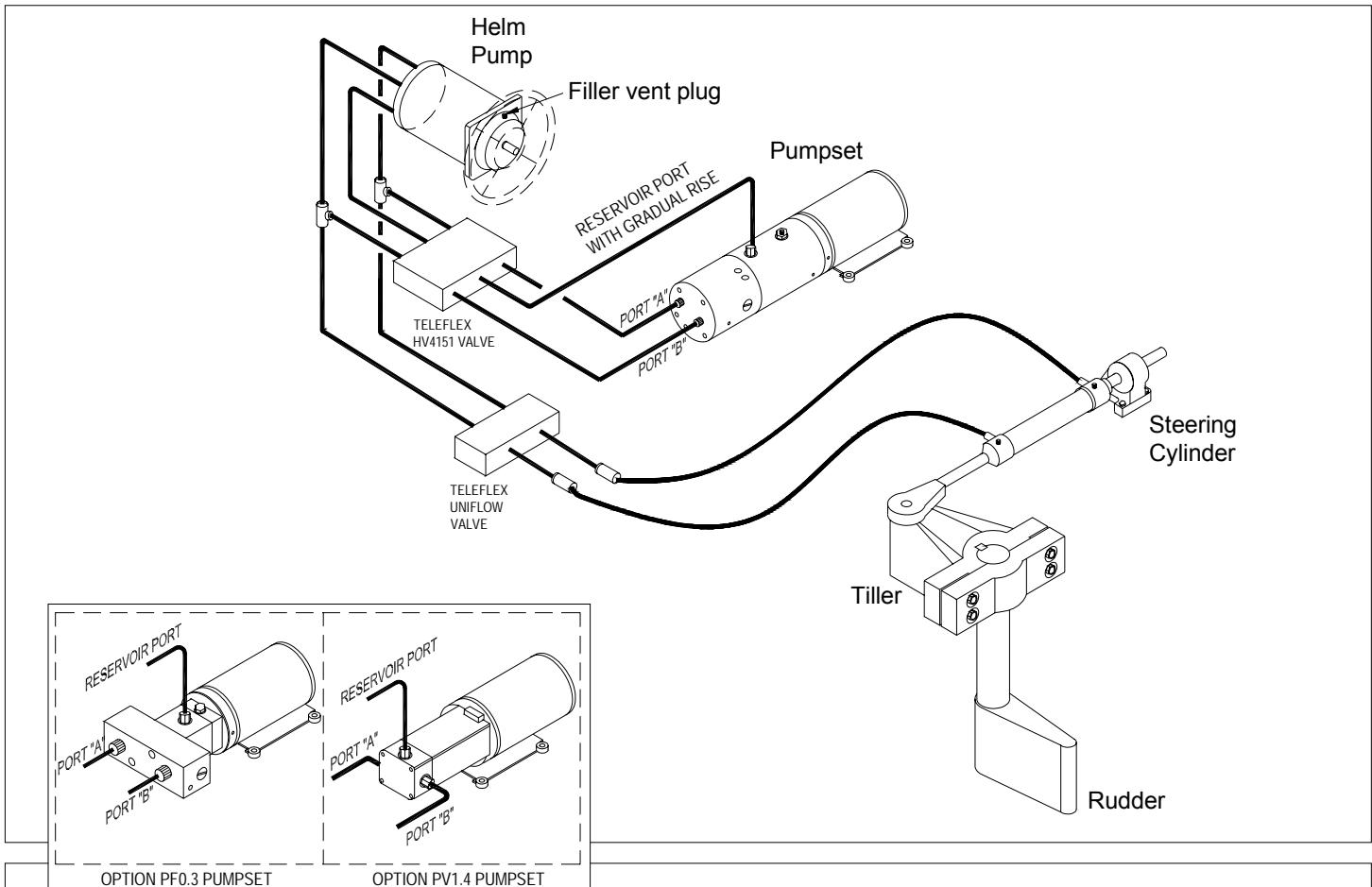
The jog switch should be wired at terminals #20, 21 and 22 in the Distribution Unit. If using a ComNav Jog Lever, the white wire from the Jog Lever should be connected to terminal #20 of the Distribution unit. The green (common) wire of the Jog Lever should be connected to terminal #21, and the black wire should be connected to terminal #22. Additional jog levers may be added to the system by electrically wiring them in parallel to terminals #20, #21 and #22 of the Distribution Unit.

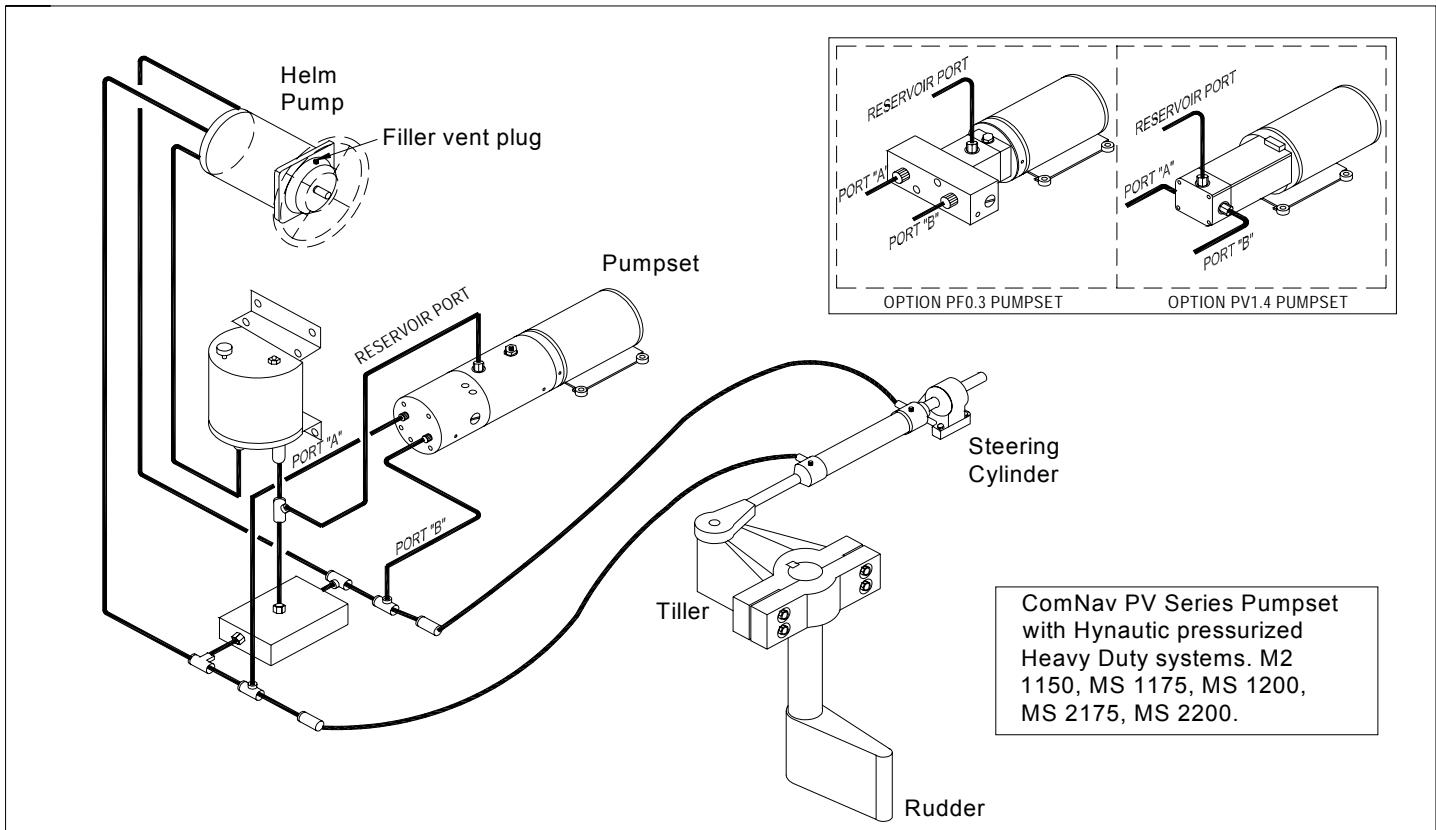
2.9 Reversing Pumpsets

Pumpsets should be connected into the vessel's hydraulic steering system according to piping schematics shown on the following pages. Most multiple station steering systems have lock valves, which automatically isolate stations from each other and from the Autopilot Pumpset. Where a lock valve is not fitted, it should be obtained from ComNav and installed to isolate the helm. The Pumpset is splashproof and should be mounted in a cool dry location, which minimizes hydraulic piping and wiring runs.

Reference the following 3 pages for various hydraulic steering systems complete with required fittings.







2.10 Installing Fittings

It is recommended that all fittings be installed and aligned in the Pumpset before it is mounted. The type of fitting required i.e., straight or 90° will depend on the mounting position of the pump and the location of piping. Refer to “Mounting the Pumpset” for permissible orientations. All ports on the Pumpset are 1/4” NPT. Pipe sealant or Teflon tape is required on all male pipe thread fittings. Be certain to keep the sealant or tape at least two threads away from the starting threads to prevent shredded tape or sealant from contaminating the system. The tube fittings selected must be suitable for the tubing size used. 3/8” OD (outside diameter) or equivalent is recommended.

2.11 Mounting the Pumpset

The Pumpset may be mounted horizontally (motor feet down) or vertically with the pump positioned above the motor. Be certain to leave adequate space to access the bleed fitting and flow-adjustment nut.

Four #10 screws and washers are required to hold the Pumpset to the mounting surface.

2.12 Piping the System

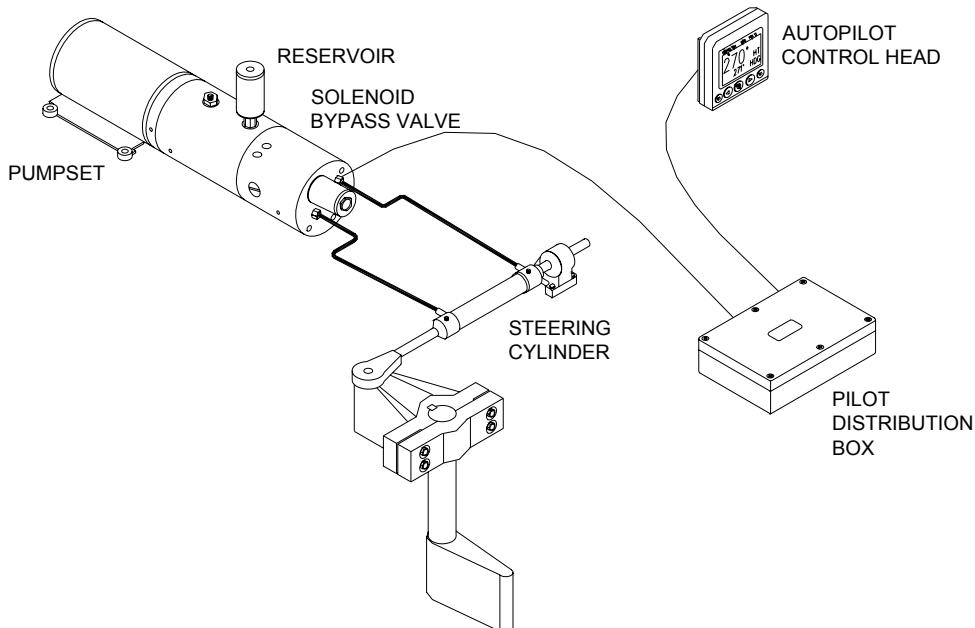
3/8" OD copper tubing suitable for a working pressure of 1,000 psi or equivalent is recommended for all connections. Flexible hose may be used but must have a rated working pressure of 1,000 psi.

2.13 Filling the System

Once the main steering system has been filled, open the Pumpset bleed screw (labeled on top of Pumpset), two complete turns. Wait until clear oil, void of any air, exits the bleed fitting. Re-secure the bleed screw. Be certain that the flow adjusting wheel is set at the maximum flow position if applicable. Top up the uppermost helm pump or reservoir, if necessary. Once the cylinder responds instantly, most of the air has been removed and the system is usable. The remaining air trapped in the system will vent automatically with use. Refill the steering system reservoir as necessary with oil as recommended by the steering manufacturer. Where no recommendation is available use hydraulic oil of viscosity grade ISO 32.

2.14 Linear Drive

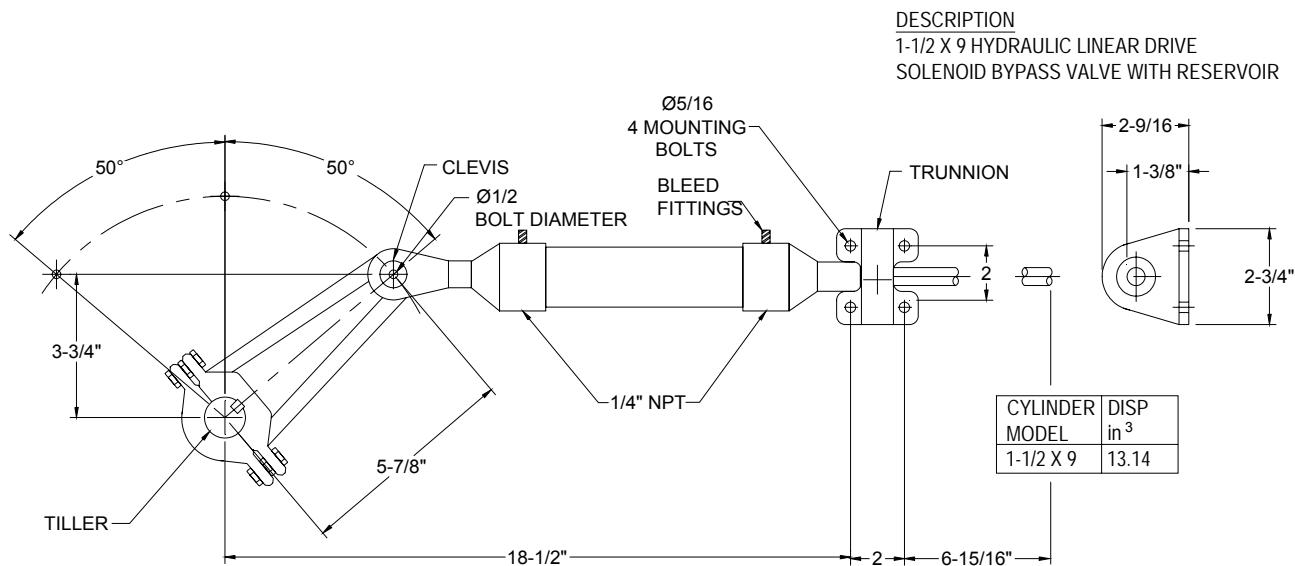
The Linear Drive is only fitted on vessels with mechanical steering. The Linear Drive consists of a hydraulic cylinder, which is connected to the mechanical steering system to provide rudder steering drive for the Autopilot. A hydraulic Pumpset is connected to the steering cylinder. The Pumpset motor is driven clockwise or counter-clockwise by the Autopilot to produce port or starboard movement of the rudder. When the Autopilot is turned off, a solenoid operated bypass valve opens, permitting hydraulic oil to shuttle from one side of the hydraulic cylinder to the other, allowing the mechanical system to regain control.



The hydraulic cylinder should be connected to the mechanical steering quadrant with a $\frac{1}{2}$ " bolt and locknut through the quadrant arm and according to the geometry shown below. A bridging bracket may have to be made across the quadrant arm if a suitable connection point is not available. Alternatively, a separate tiller may be connected to the rudderstock above or below the quadrant and the cylinder rod end bolted to it. The cylinder has self aligning and self lubricating bearings making alignment less critical and eliminating any maintenance. A strong support must be made for the cylinder trunnion mount since forces of over 1600lb. (700kg) can be developed. Connect the Pumpset to the cylinder with flexible hoses capable of 1000PSI (70 bar) working pressure. Fill the Pumpset reservoir with ISO32 or equivalent following instructions in Dockside Setup. If operating in cold temperatures, hydraulic oil of viscosity grade ISO 10 is recommended. The bypass valve should be wired to the Distribution Unit terminals #16 and #17 as per System Wiring Diagram. If the bypass valve wiring connection is reversed, it has no effect.

Installing reservoir into the Pumpset: Thread into reservoir port on the Pumpset. Do not tighten reservoir by the reservoir body. Tighten by using the flats on the fitting at the bottom of the reservoir.

Warning: Hand steering is not possible when an Autopilot Mode is selected with a Linear Drive. The Autopilot must be turned off with the OFF button to disengage the Autopilot drive and enable the mechanical steering. It is the skipper's responsibility to brief all crew members on this procedure.



2.15 Solenoid Valve Controlled Pumpsets

If the vessel is already fitted with a Solenoid Valve Controlled Pumpset having coils for 12 or 24 VDC, connect the solenoid coils directly to the Distribution Unit as per System Wiring Diagram provided. DIP Switch 1 is set in the “up” position (refer to System Wiring Diagram).

Solenoid Valve Controlled Pumpsets should be adjusted to speeds of 14 seconds from hardover port to hardover starboard or slower for maximum accuracy. Faster hardover times will require increased anti-hunt settings to prevent hunting (overshoot of the rudder).

To adjust anti-hunt setting, first complete procedures in Dockside Setup and Sea Trails. Engage the Autopilot and with the Pumpset running, make 10 ° course changes to port and starboard. If the rudder hunts (i.e. oscillates rapidly back and forth during these course changes), gradually increase the anti-hunt control (i.e. very slowly adjust VR1 trim potentiometer counterclockwise) until the rudder remains stable. Do not increase the anti-hunt control any more than necessary as this can begin to degrade course accuracy.

2.16 Accessories

Install any accessories as per instructions included with them and according to wiring as shown in System Wiring Diagrams included in this manual.

When you finished the installation, perform the Dockside Testing routine.

3. ADVANCED OPERATION

3.1 Adjusting Response (See Calibration Menus).

Note: the rudder [RUD] and counter rudder [CRD] settings are inter-related and may effect the performance of each other. Setting by trial and error may be required.

3.2 Rudder [RUD] Function

The most critical adjustment for good steering is the rudder. Too high a setting will cause excessive amounts of rudder to be given that force the vessel to hunt rapidly back and forth across the course. Too low a setting lets the vessel slowly fall off course with repeated corrections required to get back on course. The rudder should be set to the position where positive control of course is achieved without undue activity. Run the vessel at its cruising speed and make a course change with the keypad of 40°. The vessel should not overshoot by more than 3° to 4°. Adjust the rudder until this is achieved.

3.3 Sea State [SEA] Function

The parameter is a combination of yaw dead-band (compass sensitivity) and compass damping. The minimum setting may only be used under calm sea conditions to avoid unnecessary rudder correction due to compass acceleration errors. Smaller vessels and high-speed vessels, which are subject to more acceleration in lighter seas, will have to use higher settings. Larger and more stable vessels can use lower settings since there is less compass disturbance. The factory default setting should work on most vessels in light to moderate sea conditions. Following seas, no matter how rough, require lower settings to catch course error trends quickly in order to minimize excessive yaw.

3.4 Counter Rudder [CRD] Function

This feature senses the rate of change of heading and gives additional rudder corrections if the vessel is rapidly falling off course, and backs off the rudder as a vessel approaches the desired heading. Its effect is to rapidly catch the tendency to yaw in a quartering sea, provide initially high rudder control when making a large course change and to decelerate the swing of the bow as vessel approaches the desired course. When using this feature, course holding of heavy and difficult to steer vessels is greatly improved. Insufficient counter rudder will allow the vessel to overshoot on large course changes and too much will cause unnecessary rudder corrections and a tendency to stop short of coming to a new course, requiring several successive corrections before easing up to the new heading. To optimize counter rudder, initially set it to minimum and adjust the rudder so that the vessel responds smartly to a 40°-course change with less than 3° to 4 ° of overshoot. Then increment the counter rudder one step at a time while testing 40 °-course changes, until the vessel achieves an overshoot of 2° or less. **Remember any air in the hydraulic system will prevent precision control.**

3.5 Automatic Trim [ATC] Function

Automatic Trim Adjustment is not critical. It constantly compares the course set against the course steered. If a persistent error exists due to wind, waves or unbalanced forces (such as a single screw operation of a twin screw vessel), or an off-center tow or weather helm on a sailing vessel, the automatic trim slowly applies more rudder as necessary to reduce the error to zero. If the trim time is set too high, it will take a long time to eliminate the course error. If it is set too low it can start to degrade course stability. In general, longer trim times (higher settings) should be set for large vessels and sailing vessels and shorter trim times (lower settings) for small vessels and high speed planning vessels. The factory default setting should be acceptable for all but extreme applications.

4. AUTOPILOT INSTRUMENT CONTROL HEAD OPERATION

4.1 Instrument Overview



4.1.1 Instrument Display

The display consists of two lines, a top-line with 24mm (1") digits and a lower-line with 13mm (0.5") digits.

4.1.2 Instrument Pages and Functions

The Autopilot instrument has its functions divided into 4 pages. The page names are printed above the display:

HEADING (Compass), NAV (Navigation), WIND and PWR ST (Power steer)

The selected function is indicated by the page-arrow at top of the display.

4.1.3 Instrument Modes

- | | |
|-----------------|---|
| Standby Mode: | The instrument functions as a passive compass repeater. |
| Autopilot Mode: | When any Autopilot function is activated. |
| Setup Mode: | Allows calibrating your Network settings. |
| Edit Mode: | Allows editing settings (when digits are flashing). |

4.1.4 Power On/Off

You will switch on/off your NX2 instruments by using the instrument switch on your electrical panel as the instruments have no separate power on/off-button.

4.2 How to Use the Push-Buttons

4.2.1 MODE

A press on **MODE**, moves one page to the right, indicated by the page-arrow at top of the display.

In edit mode, a press on **MODE** moves the cursor one step to the right. If the cursor is at the farthest right hand side, a further press will cause it to rotate back to the left hand side.



4.2.2 LEFT

When the Autopilot is activated, a short press on **LEFT** decreases the course by 1°, a long press decreases the course by 10°.

In setup mode a press on **LEFT** moves to the previous setup function. In edit mode a press on **LEFT** decreases a digit by one.



4.2.3 RIGHT

When the Autopilot is activated, a short press on **RIGHT** increases the course by 1°, a long press increases the course by 10°. In setup mode a press on **RIGHT** moves to the next setup function. In edit mode a press on **RIGHT** increases a digit by one.



4.2.4 SET

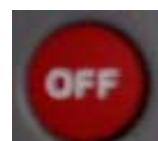
A press on **SET** engages the Autopilot in the selected steering function (HDG, NAV WIND, or PWR ST).

In Setup Mode, a press on **SET** unlocks a digit to access edit mode. When unlocked, the digits are "active" (flashes) and can be edited by pressing **LEFT**, **RIGHT** and **MODE** as required. When finished editing, lock the digit by another press on **SET**.



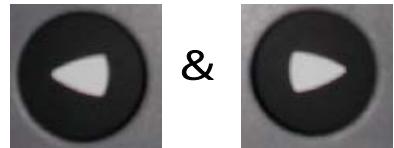
4.2.5 OFF

A press on **OFF** turns the Autopilot.



4.2.6 Tack

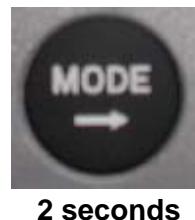
A press on **LEFT** and **RIGHT** together, performs a Tack when steering in wind mode.



4.2.7 Setup Mode

To access Setup Mode, press and hold **MODE** more than 2 seconds. [Lit OFF] flashes. To move to next setup group, press **MODE** again.

To return to standby mode, press **SET** when the text return [RET] is displayed.



2 seconds

4.2.8 Lighting

The instrument uses red back lighting for the display and the 4 push-buttons. The light can be set at 4 different levels.

To access the light control, press and hold **MODE** for more than 2 seconds. The flashing text [Lit OFF] will be displayed and the display will be lit momentarily.

To select between the 4 light levels [LOW], [MID], [MAX] and [OFF], press **RIGHT**. To lock the selected level, press **SET**.

If the Autopilot is connected to an NX2 network, the selected light level will be copied on to the Network. It is not possible to reduce or turn off the lighting on an individual instrument.



5. FUNCTION

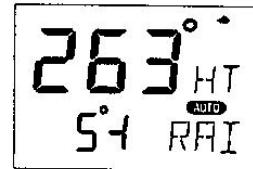
5.1 Standby Mode

At power On, the Autopilot starts in standby mode and operates as a passive compass repeater. No page-arrow is shown at the top of the display.

The current course is displayed on the top-line.

The rudder angle is displayed on the bottom line.

In any function, the top-line displays the heading at all times.



5.2 Autopilot Mode

Prior to activating any automatic steering function, the boat should be steaded on the desired heading and on track for 5 to 10 seconds to minimize large course changes when activated. The Autopilot operates with course errors up to 90°, and cross-track errors up to 2 nautical miles.

5.2.1 Activate Automatic Steering

To select a steering function, press **MODE**.

The page-arrow at top of the display indicates the selected page.

To activate the selected steering function, press **SET** when the lower-line text is flashing.

The reversed lit text [AUTO] to the right and in the middle on the display always confirms that an automatic steering function is activated. The function text at lower-line to the right confirms which steering function is activated, ex [HDG] for compass steering.



Note! If a page is not available, such as when no waypoint information is programmed / activated or no navigator or wind transducer connected, the page-arrow will not stop at that page.

5.2.2 Turn Off Automatic Steering

To turn off automatic steering, press **OFF**.

To turn off the Autopilot when you are in the process of changing functions or are in setup mode, press and hold **OFF** for more than two seconds.

5.2.3 Automatic Steering by Compass

To select compass steering, press **MODE** until the page-arrow appears under HEADING, and [HDG] is flashing on the lower-line. Your present course is displayed on the top-line. This course will become the reference course the Autopilot will keep when automatic steering by compass is activated.



To activate compass steering, press **SET** when [HDG] is flashing. The present heading now becomes the reference course and is displayed on the lower-line to the left.

To change the reference course to port, press **LEFT**.

To change the reference course to starboard, press **RIGHT**.

A short press changes the course by 1°, a long press by 10°.

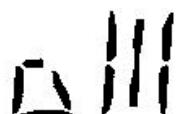
5.2.4 Automatic Steering by Navigator

Automatic steering by navigator is only possible if a navigator is connected and it is navigating towards a waypoint.

To select steering by navigator, press **MODE** until the page-arrow appears under NAV, and [NAV] is flashing on the lower-line. Your present course is displayed on the top-line.



XTE to starboard



XTE to port

Caution! Before activating [NAV] steering, make sure your present heading corresponds approximately with bearing to waypoint, and that the cross track error is less than 2 Nautical Miles, because the Autopilot will turn the boat towards the track line first and then onto the heading set.

To activate NAV steering, press **SET** when [NAV] is flashing. Bearing to waypoint or cross track error to waypoint are now displayed on the lower-line to the left. To alternate the display between bearing and track on the lower-line, press **LEFT** or **RIGHT**.

Caution!

The NAV function will automatically change course when the next waypoint information is displayed and the helmsman should ensure that there are no boats or other hazards on the new course as the waypoint is changing. When using waypoint sequencing in a route list, it is extremely important that the helmsman is at the steering position and ready to override the pilot if the course change would cause collision with other boats or objects.

Set all waypoints in navigators away from navigational hazards by at least 100 meters as the boat may require this radius or more on waypoint advance. The NX2 GPS Navigator will allow you to select a route list with automatic sequencing, or with a confirming push-button press for each waypoint.

5.2.5 Automatic Steering by Wind

Automatic steering by wind is only possible if the Autopilot is connected to a NX2 Network with a wind transducer connected.

Note! The apparent wind speed must be more than 3 knots. If the apparent wind speed falls below 3 knots, wind signals are disabled and the Autopilot will maintain the current magnetic heading reference instead.

Before activating wind steering, optimize your sail trim.

To select wind steering, press **MODE** until the page-arrow appears under WIND, and Apparent Wind Angle [AWA] is flashing on the lower-line. Your present course is displayed on the top-line.

To activate wind steering, press **SET** when [AWA] is flashing.

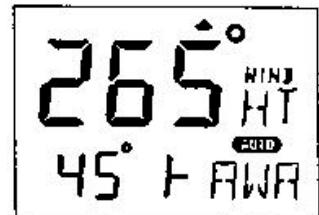
The present [AWA] now becomes the reference angle, and is displayed on the lower-line to the left, followed by a sign to describe wind from port or starboard.

To steer to port, press **LEFT**.

To steer to starboard, press **RIGHT**.

A short press changes the value by 1°, a long press by 10°.

When making large changes of over 30°, it may take about 1 minute for an accurate course to be re-established due to changes in boat balance, which must be recognized by the automatic trim function.



Starboard



Port

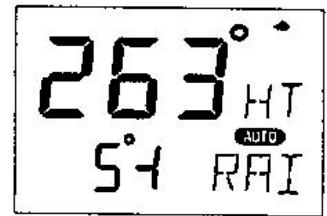
To tack, press **RIGHT** and **LEFT** together and the boat will come about the same apparent wind angle on the opposite tack.

Tack angles greater than 80° off the wind are not recommended due to the possibility of an accidental gibe.

Warning! Pressing for a tack when the wind is abaft the beam will result in a gibe!

5.2.6 Power Steering

To select power steering, press **MODE** until the page-arrow appears under PWR ST, and Rudder Angle Indicator[RAI] is flashing on the lower-line. Your present course is displayed on the top-line.



To activate power steering, press **SET** when [RAI] is flashing. The rudder angle, followed by a sign for port or starboard is displayed on the lower-line.

To change the rudder angle to starboard press **RIGHT** and hold it, until the desired rudder angle is displayed.

To change the rudder angle to port press **LEFT** and hold it, until the desired rudder angle is displayed.

5.2.7 Dodging and Returning to last Automatic Steering Function

To dodge, turn off the automatic steering by pressing **OFF** and dodge manually.

If you want to re-activate the last steering function and value, press **MODE** and **SET** together, within 10 minutes after turning off the automatic steering.

This function is not available after 10 minutes after Autopilot off, or if the Autopilot has been turned off by pressing **OFF** for more than two seconds.

6. SETUP

6.1 Setup Mode

To get the most out of your 1500 or 1510 Autopilot, it is important to carefully setup and calibrate your Network. The settings are stored in a non-volatile memory, which means they will remain in memory after you have turned off the power. To get an overview of your Network settings, we recommend that you note your settings.

6.1.1 Setup Mode Divided into 4 Setup Groups

[Lit OFF] = Lighting setup group
[P0] - [P9] = Pilot setup group
[A0] - [A4] = Alarm setup group
[C0] - [C6] = Compass setup group

6.1.2 Access Setup Mode

To access setup mode, press and hold **MODE** more than 2 seconds.

To move to next setup group, press **MODE**.

To scroll up and down in each group press **LEFT** or **RIGHT**.

6.1.3 Change a Setting

To unlock a setting, press **SET**.

To change a setting, press **LEFT**, **RIGHT** and **MODE** as required.

To lock a setting, press **SET**.

6.1.4 Return to Previous Mode

To return to previous mode, press **SET** when the text return [RET] is displayed.

6.1.5 Factory Default Settings

After each setting we have listed the factory default settings. This allows you to manually get back to factory default settings, if needed. There is no automatic way to get back to factory default settings, it has to be done manually.

All Autopilot instrument settings are central, and affect all connected Autopilot instruments and their commands.

Note! The APC routine automatically sets these settings:

[RUD], [SEA], [CRD], [ATC] and [RRS].

Therefore these settings and their minimum and maximum values and times, depend on how your boat behaves.

Caution! All setup routines can be adjusted while the boat is underway with Autopilot functions activated. Always be in a position to monitor the boat's heading and to watch for navigational hazards when calibrating the Autopilot. Be prepared to turn off the Autopilot by a long press on **OFF**, to revert to manual steering immediately if an undesired heading occurs. If navigating with an automatic steering function in a hazardous situation, do not adjust setup routines while underway.

6.2 Lighting Setup Group [Lit]

The instrument uses red back lighting for the display and the 4 push-buttons. The light can be set at 4 different levels of brightness.

To select between the 4 light levels [LOW], [MID], [MAX] and [OFF], press **RIGHT**. To lock the selected level, press **SET**.



The selected light level will be copied to all NX2 instruments connected to the Network. It is not possible to select the lighting level individually for single instruments.

6.3 Autopilot Setup Group [P]

6.3.1 P0, Return [RET]

To return to previous mode, press **SET** when the text [RET] is displayed.



6.3.2 P1, Rudder [RUD]

Possible settings are [0] = Minimum to [9] = Maximum.

Set by the APC routine.

The setting affects the degree of rudder angle used.

The most critical adjustment for good steering is the rudder. Too high of a setting will cause excessive amounts of rudder movement, which forces the boat to hunt rapidly back and forth across the course. Too low of a setting lets the boat slowly fall off course, with repeated corrections required to get back on course.

The rudder should be set to the position where positive control of the steered course desired, is achieved without undue activity. Run the boat at its cruising speed and make a course change of 40°, with the push buttons. The boat should not overshoot by more than approximately 5°. Adjust the rudder until this is achieved.

6.3.3 P2, Damping of compass heading [SEA]

Possible settings are [0] = Minimum to [9] = Maximum.
Set by the APC routine.

This setting is a combination of yaw dead-band (compass sensitivity) and compass damping. The minimum setting may only be used under calm sea conditions to avoid unnecessary rudder correction due to compass acceleration errors.

Smaller boats and high speed boats, which are subject to more acceleration in lighter seas will have to use higher settings. Larger and more stable boats can use lower settings since there is less compass disturbance. Default setting should work on most boats in light to moderate sea conditions. Following seas, no matter how rough, require lower settings to catch course error trends quickly in order to minimize excessive yaw.



6.3.4 P3, Counter Rudder [CRD]

Possible settings are [0] = Minimum to [9] = Maximum.
Set by the APC routine.

This setting senses the rate of change of heading and gives additional rudder corrections if the boat is rapidly falling off course, and backs off the rudder as a boat approaches the desired heading. Its effect is to rapidly catch the tendency to yaw in a quartering sea, provide initially high rudder control when making a large course change and to decelerate the swing of the bow, as a boat approaches the desired course.



Course holding with heavy and difficult to steer boats is greatly improved when using this feature. Insufficient counter rudder will allow the boat to overshoot on large course changes. Too much will cause unnecessary rudder corrections and a tendency to stop short of coming to a new course, requiring several successive corrections before easing up to the new heading.

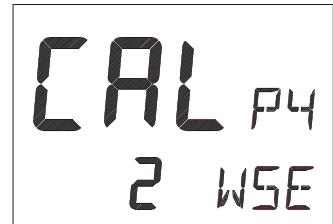
To optimize counter rudder, initially set it to minimum and adjust the rudder (see, [RUD] 5.3.2). Increment the counter rudder one step at a time, while testing 40° course changes, until the boat achieves an overshoot of 1° to 2° or less. Remember, that any air in the hydraulic system will prevent precision control.

6.3.5 P4, Damping of wind [WSE]

Possible settings are [0] = Minimum to [9] = Maximum.

Default setting is [2].

Damping of wind transducer. The factory default setting should be adequate. In very heavy weather or unstable wind conditions, unnecessary corrections may be minimized by increasing the setting.



6.3.6 P5 Automatic Trim Calibration [ATC]

Possible settings are [0] = Minimum to [9] = Maximum.

Set by the APC routine.

[ATC] is not critical. It constantly compares the course set against the course steered and slowly applies more rudder as necessary to reduce any errors to zero. Errors may be due to wind, waves or other unbalanced forces such as single screw operation of a twin screw boat, an off-center tow or weather helm on a sailing boat, etc. If the trim time is set too high, it will take a long time to eliminate the course error. If it is set too low it can start to degrade course stability.



In general, longer trim times (higher settings) should be set for large boats and sailing boats and shorter trim times (lower settings) for small boats and high speed planning boats. The factory default setting should be acceptable for all but extreme applications.

6.3.7 P6, Adaptive Control [ADC]

Possible settings are [OFF] or [On].

This function is reserved for future functions.



6.3.8 P7, Automatic Pilot Calibration [APC]

Possible settings are [ON] or [OFF].

The APC routine automatically sets: [RUD], [SEA], [CRD], [ATC] and [RRS].

The Autopilot will not function unless the boat passes the APC routine. The APC will automatically determine and correct how wires and pipes are connected. It will also learn how the boat reacts on different rudder commands and automatically calibrate itself.

To learn how to perform the APC function, see Sea Trials.



6.3.9 P8, Rudder Reduction Speed [RRS]

Possible settings are [0] = Minimum to [9] = Maximum.

Set by the APC routine.

The [RRS] controls the flow of the Pumpset. It will effect the Pumpset, but not a solenoid valve steering system.

The [RRS] will be set to [5] after the APC routine is performed. It is then possible to increase or decrease the speed reduction of the Pumpset motor.



6.3.10 P9, Rudder angle limit [LIM]

Possible settings are [00°-99°]. Default setting is [00°].

An angle of 00° is the same as rudder angle limit disconnected (OFF).

Note! Make sure [LIM] is set to 00° (OFF) during installation.

The rudder angle limit sets maximum angle for the rudder. If the limit is set to 45°, it is not possible to exceed a rudder angle 45° on either port or starboard. Check the maximum rudder angle by turning the steering wheel to port and starboard and read the maximum angle. If the angle is greater on one side, decrease the smallest angle by 3°, and enter that setting as the limit.

6.4 Alarm Setup Group [A]

To silence an alarm, press any push button.

6.4.1 A0, Return [RET]

To return to previous mode, press **SET** when the text [RET] is displayed.



6.4.2 A1, Pilot Course Alarm [PCA]

Possible settings are [OFF] and [00°-99°]. Default setting is [OFF].

When the boat's average course differs more than the [PCA] setting, the alarm will sound and the display will blink.



6.4.3 A2, Timer Watch Alarm [TMR]

Possible settings are [OFF] or [On]. Default setting is [OFF].

On = audible alarm activated.

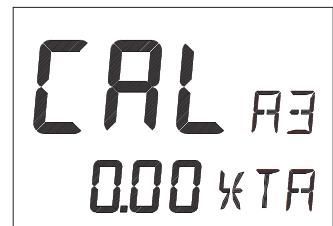
The audible alarm will sound every 5 minutes to alert the person on watch to confirm and restart the timer, press any push-button. If not confirmed within 1 minute, the optional external alarm buzzer, if connected to the NX2 Server, will sound for 1 minute, to alert the rest of the crew.



6.4.4 A3, Cross Track Error Alarm [XTA]

Possible settings are [0.00] = OFF to [9.99]. Default setting is [0.00].

This function is only available in NAV function when the Autopilot is connected to a NX2 Network and a navigator is connected to the NX2 Server.



If the pilot's cross track error exceeds the set threshold of distance of the track, the alarm will be activated.

6.4.5 A4, Push-Button Beep [KEY]

Possible settings are [OFF] or [On]. Default setting is [ON].

[On] = Sound when push buttons are pressed. [OFF] = No sound.



6.5 Compass Setup Group [C]

Auto-deviation, auto-deviation-check and auto-deviation clear, are only available if a NX2 compass transducer is connected. The auto-deviation routine will automatically correct all possible faults, except alignment.

Note! As soon as you place any kind of ferrous items close to the compass, the auto-deviation and auto-deviation check routines should be repeated. So if you have packed your boat for the vacation, think about where you place ferrous items in relation to the compass transducer.

6.5.1 C0, Return [RET]

To return to previous mode, press **SET** when the text [RET] is displayed.



6.5.2 C1, Magnetic Heading [MAG]

Possible settings are [OFF] and [On]. Default setting is [OFF].
 [On] = All headings will be magnetic.
 [OFF] = All headings will be true, i.e. corrected for local variation set in C2, Local variation [VAR]. This is local setting.



6.5.3 C2, Local Magnetic Variation [VAR]

Possible settings are [+/-0.0°-99.9°]. Default setting is [00.0°]
 Easterly variation = underlining (_) sign.
 Westerly variation = minus (-) sign.
 The local magnetic variation is usually printed in the sea chart.



6.5.4 C3, Auto-Deviation [Auto DEV]

This function is used to automatically correct the deviation of your compass.

Take the boat into a slow turn, in calm sea and away from other boats or obstructions. There is no need to perform a perfect circle.

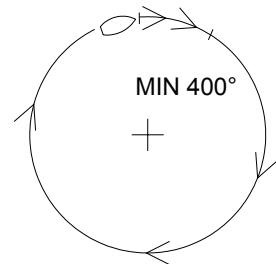
When steady, select C3 [Auto DEV] and press **SET** to start. The present "uncorrected" compass heading is displayed and the compass auto-deviation is in progress. Turn the boat in a 1 ¼ circle, and when ready press **SET** again.



If successful, the text [CAL C3] [Auto DEV] will be displayed.

If not successful, an error messages can be displayed:

- [Err 15]: Make sure an Autopilot function is not activated and carry out the auto-deviation procedure again.
 - [Err 16]: Auto-Deviation is not possible, because a NMEA compass is selected as compass for the NX2 Network.
 - [Err 17]: The 1 ¼ turn was not performed or the compass is affected by strong magnetic distortion.
- You may interrupt the auto-deviation procedure at any time by pressing **LEFT** and **RIGHT** together.
- To check the auto-deviation, carry out the auto-deviation check routine.



6.5.5 C4, Check Auto-Deviation [Auto CHK]

This function is used to check your auto-deviation.

The result of [Auto CHK] will be compared with [Auto DEV]. If the deviation is less than 1.5°, the average value from the comparison between [Auto DEV] and [Auto CHK] will be stored.



Take the boat into a slow turn, in calm sea and away from other boats or obstructions. There is no need to perform a perfect circle.

When steady, select C4 [Auto CHK] and press **SET** to start.

The present compass heading is displayed and the compass Autodeviation check is in progress. Turn the boat in a 1 ¼ circle.

To end the routine, press **SET** again.

If successful, the text [CAL C4] [Auto CHK] will be displayed.

If not, [ERR 17] or [ERR 19] will appear, i.e. the difference between the last auto-deviation and this autodeviation check was too great to be accepted.

Make a new auto-deviation-check, and if you still get [ERR 19], make a new auto-deviation, since the last one was probably disturbed.

6.5.6 C5, Clear Auto-Deviation [Auto CLR]

To clear the calibration created by the auto-deviation, select C5 [Auto CLR], and press **SET**.



6.5.7 C6, Adjust Compass Alignment [ADJ]

Possible settings are [000°] to [359°]. Default setting is [000].
Compass transducer alignment correction or the so called,
"A-fault".

Allows 180° reversed mounting if needed. Never mount the
transducer at right angles to the boats fore-aft line.

Make sure that the local magnetic variation is entered before
you make the alignment adjustment, otherwise you are unable
to see the difference between local magnetic variation and
alignment error.

To check the transducer position, sail/steer your boat in a straight
line towards two visible objects in a line. If the actual heading taken
from the sea chart is 330° and the compass displays 335°, then set
the value of 360° - 5° to 355°.



7. DOCKSIDE TESTING

7.1 Preparations

Start checking the following:

- Familiarize yourself with the operating procedures by reading sections Operation, Function and Setup.
- Double check all wiring connections and DIP Switch settings prior to connecting power to the system.
- Make sure rudder angle limit [LIM] is set to 99° (OFF).
- Ensure that the oil reservoir is 3/4 full and maintain that level throughout the test procedure.

Warning! Do not activate any of the 3 Autopilot functions Compass, Nav or Wind at dock as the rudder may go hard over, since the APC routine has not been carried out yet. It will be done as explained in Sea Trials.

7.2 Dockside First Start Up

7.2.1 Power On

At each power on, the instrument will perform a self test. The display will first show all segments, then the software version and the NX2 Network ID number.

7.2.2 Initializing the Instrument in a NX2 Network

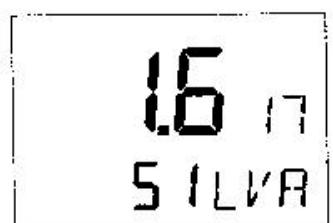
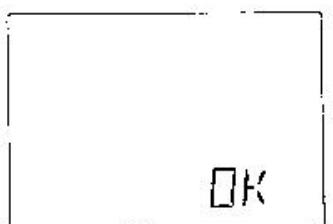
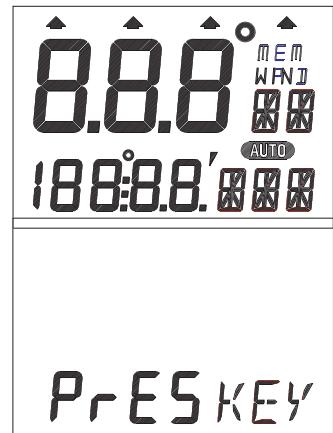
At the first power on after installation, you will be asked to press **SET** [PrSKEY]. This will give the instrument a logical ID number from 16 and upwards on the NX2 Network.

To initialize the instrument, press **SET**, one instrument at a time, on all installed digital instruments.,

**Warning! Always wait for the text [Init OK]
to be displayed, before you press SET
on the next instrument!**

The NX2 Distribution Unit or the Server automatically gives the first unit ID number 16, then 17 and so on. The order in which you press **SET**, will be the same order as the instruments will be given a logical ID number on the NX2 Network, and the same order they will be addressed by the Remote Control instrument if used.

The example shows that the instrument version number is 1.6 and the logical ID number given is 17.



Warning! Do not activate any Autopilot functions until Dockside Testing and Sea Trials APC routine have been performed.



7.2.3 Re-Initializing the Instrument

If two instruments have been given the same ID number by mistake, you must re-initialize the instruments to avoid Network disturbance and blockage of data.

To re-initialize the instrument, be prepared to press **Left** and **Right** together during the short power up sequence, i.e. when version and ID numbers are displayed.

The display test is then re-started on all instruments and you will be asked to press **SET** on one instrument at the time as explained above.

Note! If you do not succeed to re-initialize, we suggest you disconnect (just pull out the connection plug) on all, except one of the instruments that had the same ID number, then re-install the instruments and repeat the above procedure.

Run the procedure as described in Dockside First Start Up.

7.3 Remove Air from System

Filling the hydraulic system (for reversing Pumpsets and liner drives only). Select PWR ST function by pressing **MODE** until the page-arrow appears under PWR ST.

To activate the Autopilot, press **SET**.

Press and hold **LEFT** or **RIGHT** until the Pumpset begin to run and the rudder moves.

If port rudder is given when you press starboard (**RIGHT**) push-button, and vice versa, ignore the reversal. It will be corrected automatically when doing the APC routine at Sea Trials.

It may take time before the steering begins to move due to air in the system. Continue to press and hold the push-button until the steering reaches its stops. Then reverse direction with the opposite push-button. Repeat this procedure 10 times or more until the system appears to move smoothly.

After 5 or 10 minutes of this purging, let the system rest so that entrained air can settle out of the oil. After 5 minutes of rest, repeat the above procedure.

(With linear drives the wheel cannot be turned to assist purging unless the bypass valve is temporarily disconnected. Make sure that the valve wiring is reconnected before further testing. Also, with linear drives, when attempting to get air out of the system make sure the flow adjusting wheel is set at a mid flow position).

Air in the system may cause noisy Pumpset operation. When the Pumpset becomes quieter and the steering moves smoothly and the linear drive responds instantly in both directions, it may be assumed that most air is out of the system. To check that all air is removed, select power steer function and try to turn the steering wheel. In this function the steering wheel should be stiff. If you can turn the wheel a certain amount with a increasing pressure as a result, there is still air in the system.

Continue to ventilate the system until the steering wheel is stiff before you proceed with the sea trials.

Do not attempt to activate the Autopilot in other functions than power steer, until all air is out of the system. Sloppy course holding will result if you do. The very last air removal will be done as the boat is tested underway.

7.4 Adjust the Pumpset Flow Rate

The Autopilot is capable of automatically adjusting the flow rate of the Pumpset. If using a fixed flow rate Pumpset there is no adjustment of the flow rate required. However, if using a variable flow rate Pumpset, adjust the flow rate of the Pumpset for approximately 14 seconds hardover to hardover time or slower for best steering accuracy.

7.5 Functional Tests

Read Operation, Function and Set Up of the manual to familiarize yourself with the operating procedures. Try the different modes at the dock to verify that all systems are working and ready for sea trials.

Do not try to make course changes in pilot modes as the rudder may go hardover, since the [APC] Pilot Calibration has not been conducted yet.

When you finished the Dockside Testing, perform the Sea Trials.

8. SEA TRIALS

8.1 Preparations

Take your boat out at half speed to calm seas away from other boats or obstructions to run the sea trials. Then proceed as per below.

Warning! Do not activate any of the Autopilot functions (Compass, Nav or Wind) at dockside as the rudder may go hard over, since the APC routine has not been carried out yet.

8.2 Compass Calibration

Enter the compass calibration.

Note! If you are using an existing NX2 Compass transducer that already has been compensated, it is not necessary to run the auto-deviation [Auto DEV] procedure again.

Local Magnetic Variation:

Run the calibration routine local variation [VAR].

Automatic Compass Compensation:

Run the calibration procedure auto-deviation [Auto DEV].

Automatic Compass Check

Run the calibration procedure auto-deviation-check [Auto CHK].

Misalignment Correction

Run the calibration procedure compass alignment [ADJ].

8.3 Automatic Pilot Calibration [APC]

The Autopilot will not function unless the boat pass the APC routine. The APC will automatically determine and correct how wires and pipes are connected. It will also learn how the boat reacts on different rudder commands and automatically calibrate itself.

The APC routine automatically sets: [RUD], [SEA], [CRD], [ATC] and [RRS].

Select P7 [APC]. To unlock, press **SET**. To change to [On], press **LEFT** or **RIGHT**. To activate the APC, press **SET**.

All 4 page arrows at top of display will now be lit to confirm the APC procedure is in action.

The boat should automatically turn slightly to port and starboard and return to original course.

If the APC fails: Error message 34 (calibration failure) is displayed. This is most likely caused by too much air still in the system. To escape the error message, press any push-button. Revert to 10.3. "How to remove air from the system". **Note!** You can "help" the APC process by manually pulling the steering wheel or tiller in same direction as APC turns the boat to pass the APC.

If the APC is successful: All 4 page-arrows disappear, the instrument leaves the setup mode and returns to standby mode automatically.

Note! You may interrupt the APC routine at any time by a press on **SET**.

Congratulations, your Autopilot calibration is done.

Now go ahead and activate the Autopilot and enjoy the NX2 performance.

9. FINE TUNING

The factory default settings and the APC routine will provide acceptable performance for most boats, but each boat has different steering characteristics and some fine tuning may be necessary for optimum performance.

For individual settings referred to below, see the setup section.

The tests should be performed under fairly calm sea conditions with minimal wind or tide. If wind and/or tide are unavoidable set a course for minimum effects from these causes. It is recommended that these sea trials not be done in restricted or busy waters.

Step by Step Instructions How to Fine Tune the Autopilot:

1. Check that Dockside Testing, Sea Trials including the APC routine has been done. If not, go back and make sure they are done.
2. Activate the Autopilot on a course and ensure that it holds without excessive understeering or oversteering.
3. With the boat travelling in a straight line at its normal cruising speed in calm water, activate the Autopilot compass function. Make a 40° course change using the **LEFT** or **RIGHT** and the boat should not overshoot by more than 1° to 2°. Continue making 40° course changes while adjusting the Rudder [RUD] setting until the boat overshoots the correct course a few times prior to setting on the course. This is the optimal [RUD] setting that can be used on the boat at the current cruising speed and load, in calm waters.
4. Continue making 40°course changes while slowly increasing the Counter Rudder [CRD] setting, until the boat settles onto course with only one overshoot of 3° or less. On some boats, the [RUD] setting may have to be decreased by one position to get the boat to control properly. The [RUD] and [CRD] settings are set to the maximum combined settings that should be used on the boat at that speed and under the existing sea conditions.

The [RUD] and [CRD] settings may need to be increased in rough weather. The higher the [CRD] setting relative to the [RUD] setting for calm weather, the less it will need to be increased in rough weather. As the boat's speed decreases, the rudder becomes less effective.

The [RUD] and [CRD] settings may need to be increased as the speed decreases. The higher the [CRD] setting relative to the [RUD] setting, the less it will need to be increased at lower speeds.

To find the optimal [RUD] and [CRD] settings at different boat speeds, or when the boat is towing, follow the procedures outlined in #3 and #4 above. Make a record of the different settings needed to control the boat at all typical speeds, loads and weather conditions normally experienced. Due to the wide dynamic control range and self-tuning features of the microprocessor control, settings determined for cruising speed in calm seas may be found acceptable without further change at slower speeds and in heavier seas.

5. The compass damping [SEA] setting is a combination of yaw dead-band (compass sensitivity) and compass damping. The minimum setting may only be used under calm sea conditions to avoid unnecessary rudder correction due to compass acceleration errors.

Smaller boats and high-speed boats, which are subject to acceleration in even lighter seas, will have to use higher settings.

Larger and more stable boats can use lower settings since there is less compass disturbance. Factory default setting should work on most boats in light to moderate sea conditions.

Following seas may require lower settings to catch course error trends quickly in order to minimize excessive yaw and steering activity.

6. Automatic Trim Calibration [ATC] adjustment is not critical. It constantly compares the course set against the course steered. The automatic trim slowly applies more rudder as necessary to reduce any persistent errors to zero. Such errors may exist due to wind, waves or other unbalanced forces such as single screw operation of a twin screw boat, or an off-center tow or weather helm on a sailing boat. If the trim time is set too high, it will take a long time to eliminate the course error. If it is set too low it can start to degrade course stability.

In general, longer trim times (higher settings) should be set for large boats and sailing boats and shorter trim times (lower settings) for small boats and high speed planning boats. The factory default setting should be acceptable for all but extreme applications. If after fine tuning all routines and auto-deviation routine has been done and poor steering is noted only on some but not all headings, magnetic interference is present which must either be compensated for by a compass adjuster and/or another compass location must be found.

9.1 Optional Fine Tuning for Special Applications

Potentiometer adjustments, functionality on Distribution Unit.

VR1: Anti-hunt control for rudder: Inappropriate adjustment could result in steering oscillations or degradation of steering performance. The potentiometer is factory set at minimum deadband setting. Adjustment of this potentiometer can be used to adjust deadband for rudder response, compensating for slack in steering system, and/or lack of stiffness in cylinder support.

VR2: Analog External Rudder Angle Indicator Instrument deflection adjustment (if applicable).

VR3: Analog External Rudder Angle Indicator Instrument offset adjustment (if applicable).

VR4: Factory set; counter rudder delay primarily used on large vessels (over 100' in length).

VR5: Control head digital display Rudder Angle Indicator offset adjustment; potentiometer is factory set; to be minor adjusted by Autopilot technicians if rudder transmitter linkage can not be adjusted; inappropriate large adjustments could result in poor Autopilot performance; do not adjust when in full follow up steering mode. This is not available on 1510 Distribution Unit.

VR6: Current limit adjustment for servo drive; potentiometer is factory set; do not adjust.

10. PROBLEM SOLVING

10.1 General

Before you contact your ComNav dealer, and for them to give you better service, please check the following points and make a list of:

- . All connected instrument and transducers, including their software versions.
- . NX2 Network ID numbers for each instrument (displayed at power up).

In most cases, the reason for faults in electronic equipment is poor installation. Therefore, always first check for the following:

- . Installation and connections are made per instructions for instruments and transducers.
- . Screw terminals are carefully tightened.
- . There is no corrosion on any connection points.
- . No loose ends in the wires, causing short cuts to adjacent wires.
- . Cables for damage and that none are squeezed or worn.
- . Battery voltage is sufficient, should be at least 11 V DC.
- . The fuse is not blown and that the circuit-breaker has not opened.
- . The fuse is of the right type.
- . Two instruments do not have the same ID number.

10.2 Symptom - Cause - Action

In the table below, causes marked [*] are more likely to occur during installation or when rewiring has taken place.

SYMPTOM	CAUSE	ACTION
Autopilot does not turn off.	* Voltage below minimum.	Make sure 12/24 volts is applied to battery terminals in Distribution Unit.
Autopilot does not turn on.	* Voltage not applied.	Make sure 12/24 volts is applied to battery terminals in Distribution Unit.
	* Voltage polarity is reversed.	Make sure + and – is applied to correct terminals.
	* Boats safety switch is open.	Close the safety switch.
	* Fuse burned out.	Check and replace fuse as necessary, located in the Distribution Unit.
Autopilot turns on, but the Pumpset doesn't run	Slow blow (high current) fuse in Distribution Unit is blown.	Replace fuse. If fuse regularly blows, check for excessive rudder load or mechanical defects in steering system.
	Rudder speed set too low.	Decrease RRS setting.

SYMPTOM	CAUSE	ACTION
Motor Pumpset turns but the rudder doesn't move.	Pumpset drive section in Distribution Unit may have failed to open.	Replace transistors, integrated circuits or entire circuit board.
	Broken or loose motor coupling	Replace or tighten coupling as necessary.
	Pumpset contamination.	Clean or replace Pumpset.
Blinking [Low Bat] on bottom line of display.	Low battery voltage. Automatic shut-off in case of voltage lower than 10.5V for 12V battery and 21.5V for 24V battery. Poor wiring connection. Power wiring is undersized. Voltage drop across circuit breaker.	Turn Autopilot off and charge batteries or correct voltage loss. When proper voltage restored, restart Autopilot. Check for voltage drop and repair. Replace wiring with correct gauge. Make sure 25Amp circuit breaker is used.
When Autopilot engaged, rudder goes hardover.	APC routine not performed.	Pilot calibration "APC" required.
	Power transistors in Distribution Unit may be shorted.	Replace transistors or entire circuit board.
	Rudder Transmitter linkage disconnected.	Re-connect and align as per Installation Instructions.
	Rudder Transmitter wiring shorted or open circuit.	Check and repair wiring as necessary.
	Rudder Transmitter pot defective.	Replace.
Autopilot wanders on some headings.	Magnetic interference is present. The worst steering is usually on northerly headings in the northern hemisphere and southerly headings in the southern hemisphere.	Perform Auto-Deviation-Clear [CLR] and Auto-Deviation [DEV] again, or try another compass location. Investigate for magnetic disturbances around compass, e.g. Masses of steel, motors, loudspeakers, etc.
Autopilot wanders on all headings.	Severe magnetic interference.	Choose another compass location.
	Air in hydraulics.	Fill and purge the steering system.
	Slack in the steering system.	Repair any loose or worn parts.
	Rudder Transmitter potentiometer is "noisy" or intermittent.	Replace rudder potentiometer.
	Compass damaged; intermittent wiring connections.	Repair any loose or worn parts; recheck and connect wiring.
	Slow wander means rudder control is set too low (understeering).	Increase Autopilot setting [P1] [RUD]
	Fast wander means rudder control is set too high (oversteering).	Decrease Autopilot setting [P1] [RUD]
Rudder movement erratic.	Excess rudder load.	Reduce rudder friction, increase steering cylinder size, increase power of the Pumpset.
	Air in system.	Check for leaks and bleed the system.

SYMPTOM	CAUSE	ACTION
Rudder Angle Indicator is displaying erratic values.	Rudder Transmitter is defective (noisy).	Replace Rudder Transmitter or potentiometer within.
	Check for loose or broken wires in terminal strips.	Reconnect tightly.
	Check for broken wires in cables.	If wiggling of cable where it flexes causes rudder activity, replace cable.
Boat overshoots on large course changes.	Rudder control set too high.	Decrease Autopilot setting [P1] [RUD]
	Counter rudder set too low.	Increase Autopilot setting [P3] [CRD]
Course set on Autopilot instrument is different from ship's steering compass.	If constant error, Autopilot compass is not aligned with for aft line of boat.	Use compass setting [C6] [ADJ] to adjust alignment of compass.
	Variable error in heading caused by magnetic interference.	Verify that the steering compass is accurately corrected and then correct the Autopilot compass as per installation instructions.
	Larger errors not corrected by above remedies or lack of change in course set point with different headings indicate a defective compass.	<ol style="list-style-type: none"> Run Auto-Deviation-Clr [C5] [CLR] Run Auto-Deviation [C3] [DEV] Recheck compass again.
	Ships compass is not correct.	Compensate ships compass.
	Compass: no reading or wrong heading.	Check that the local magnetic variation [C2] [VAR] is set properly.
	Irregular values.	Check the Sea Damping [P2] [SEA]
NMEA does not engage, NAV arrow does not come on.	NMEA receiver not installed correctly.	Check receiver settings for proper output.
	No NMEA 0183 data received.	Check Nav cable for connection to the correct port.
	Unreliable NMEA data detected upon engagement.	Check connections and setup in transmitting instrument.
	No active waypoint.	Activate a waypoint.
After some use, NAV arrow does not come on.	Poor NMEA data detected. Last "good" NMEA heading is used until good data restored.	Check for poor navigator installation causing bad signal to noise ration. Check for erroneous data as detected by navigator. Revert to magnetic course only, if situation can not be corrected.
Course under NAV steering is erratic.	May appear when close to waypoint due to GPS-S/A error.	Accept situation, or revert to compass course steering only.
	Compass heading information is not consistent with navigator.	Set heading type in Autopilot to match output from Navigator. (i.e., set to true if Navigator outputs true. Set to magnetic if Navigator outputs magnetic).

10.3 NX2 Network Error Messages with Cause and Remedy

If an error message [Err #] is displayed, an error has been detected by the NX2 Network. The message can assist you to diagnose the cause and remedy the error.

To escape from an error message, press any push-button. If not possible to escape, reset power (turn off and on again), then remedy the situation as suggested below.

Note! For errors marked with [*], contact your ComNav dealer or the factory in order to return the unit for rectification.

NO.	MESSAGE AND CAUSE	REMEDY	*
01	Activated watchdog timeout	Reset power.	*
02	NX2 Network data frames are missing.	Check connections and setup.	
03	No data received within approx. 10 sec.	Check connections.	
04	EEPROM read.	Reset power.	*
05	EEPROM write.	Reset power.	*
06	RAM memory error.	Reset power.	*
07	Auto-log full, in GPS Compass.	Clear Auto-log memory.	
08	Break reset.	Reset power.	*
09	EEPROM auto initiation, or NMEA transmit fail. (NX2 Server only).	Reset power.	*
10	Range error, input e.g. 17° 70' = too many minutes.	Correct input format.	
11	Remote control setup error. Command can not be executed.	Check connections and settings.	
12	No response from Navigator	Check navigator connection and settings.	
13	Waypoint not defined.	Define a waypoint.	
14	Impossible command when used with an external NMEA navigator.	Use only possible command.	
15	Impossible command when in Autopilot mode.	Use only possible commands.	
16	Auto-deviation is not possible.	Check for extreme magnetic field, upside down mounting of transducer or wrong transducer type.	
17	Auto-deviation check failed.	1-1/4 turn not complete or extreme magnetic disturbance.	
18	Auto-deviation. Function denied.	Function denied since compass is busy with the Auto-deviation routine.	

NO.	MESSAGE AND CAUSE	REMEDY	*
19	Auto-deviation failure.	Error larger than 1.5°. The boat probably hit a wave during the turn. Redo.	
20	GPS to CPU communication error.	Reset power.	*
21	GPS acquisition failure (time out).	Maximum allowed time for searching satellites. E.g. When try to navigate indoors. Check GPS antenna location.	
22	CPU to GPS communication error.	Reset power.	*
23	DGPS (RTCM) data ignored.	Change the DGPS (RTCM) setting.	
24	GPS bad fix, no fix position (time expired at one-fix).	Check GPS antenna location.	
25	No Autopilot response. Object is not connected.	Check wiring connections and fuse.	
26	The unit is not allowed to power up Because there is too high input voltage.	Check input voltage.	*
27	Extended object server busy or error.	Set one GPS Navigator instrument to master.	
28	Route command error. The waypoint Bank memory is full.	Clear waypoint bank to make space.	
29	DGPS mode is interrupted.	Check the DGPS receiver.	
42	Bad transducer input / bad measurement.	Reset power.	*
	NX2 Autopilot Distribution Unit		
30	General Autopilot failure Reset power.	Reset Power.	*
31	Autopilot compass input failure in Autopilot standalone connection.	Check compass connection at Autopilot Distribution Unit.	
32	Autopilot compass input failure in Autopilot Nexus Network connection.	Check compass connection at NX2 Server or at the Compass Data instrument.	
33	Received wind data input failure.	Check wind wire connection.	
34	Autopilot calibration failure.	Check for air in the system and redo the APC routine again in calm water.	
35	Navigation data not available in Autopilot stand alone connection.	Check NMEA input connections and settings in the navigator.	
36	Navigation data not available in Autopilot Nexus Network connection.	Check connections and navigator settings.	
37	Autopilot Network re-initialization.	Check connections and wire gauge.	

11. MAINTENANCE

11.1 Instrument Maintenance

- . To clean the instrument, use only mild soap solution and rinse with water.
- . Do not use detergents or high pressure washing equipment.
- . At least once a year, check all your connections and apply additional silicon paste at each connection point.
- . When the instrument is not in use, always fit the instrument cover for protection
- . Storing of instruments when not in use for longer periods: It is advisable to remove the instruments and transducers and store them inside the boat or at home preferably at room temperature.

11.2 Drive Unit Maintenance and Inspection Schedule

Perform the following inspections every three months or as per running hours listed in the table below, whichever is less.

Warning!

Failure to rectify any faulty conditions discovered as a result of the inspection could cause sudden loss of Autopilot control, with consequential danger. It is recommended that all items referenced in the following table be inspected before commencing any cruise.

TYPE	EQUIPMENT	CHECKS	REMEDY	INSPECTION FREQUENCY In Hours
Hydraulic	Oil reservoir level	Correct	Fill	200
	Oil conditions	Discoloration Contamination	Flush system and replace the oil	1000 1000
	Hydraulic piping	Damage Leaks & Corrosion	Replace	1000
	Hydraulic fittings	Damage Leaks & Loosening	Replace Tighten	500
	Piston rod seals on Pumpset	Leaking	Replace	1000
Mechanical	Linear drive	Corrosion	Replace or Repair	2000
	Tiller arm	Corrosion	Replace	2000
	Tiller bolts	Corrosion Loosening	Replace Tighten	2000 500
	Rod end bolt on linear drive	Corrosion Loosening	Replace Tighten	2000 500
	Trunnion bolts on linear drive	Corrosion Loosening	Replace Tighten	2000 500

12. 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;

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

NO OTHER WARRANTIES. TO THE MAXIMUM EXTENT PERMITTED BY APPLICABLE LAW, COMNAV DISCLAIMS ALL OTHER WARRANTIES AND CONDITIONS, EITHER EXPRESSED OR IMPLIED, STATUTORY OR OTHERWISE WITH RESPECT TO THE EQUIPMENT, INCLUDING BUT NOT LIMITED TO IMPLIED WARRANTIES OR CONDITIONS OF MERCHANTABILITY AND FITNESS FOR THE ORDINARY PURPOSES FOR WHICH THE EQUIPMENT IS USED OR FITNESS FOR A PARTICULAR PURPOSE AND ANY OTHER OBLIGATIONS ON THE PART OF COMNAV, ITS EMPLOYEES, SUPPLIERS, AGENTS, OR REPRESENTATIVES.

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

REMEDIES NOT TRANSFERABLE. The Purchaser's remedies under this Agreement only apply to the original end-user of the ComNav Equipment, being the Purchaser, and only apply to the original installation of the Equipment. The Purchaser's remedies under this Agreement are not transferable or assignable by the Purchaser to others in whole or in part.

NOTICE OF DEFECT. The Limited Warranty and the Extended Warranty will not apply with respect to any defective Equipment unless written notice of such defect is given to ComNav, by mail to the address for ComNav set forth above, or by facsimile to ComNav at 1-604-872-3955, 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.

1. **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:

- (a) If the Equipment, or any part thereof, proves to be defective within the relevant warranty period, the Purchaser shall do the following:
 - (b) contact ComNav by phoning 1-604-207-1600 to discuss the nature of the problem and obtain shipping instructions (many times a satisfactory solution can be reached without returning the item); and prepare a detailed written statement of the nature of the circumstances of the defect, to the best of the Purchaser's knowledge, including the date of purchase of the Equipment, the place of purchase, the name and address of the installer, and the 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.

13. TECHNICAL SPECIFICATIONS

13.1 Autopilot Instrument

Dimensions:	113mm x 113mm x 23mm (4.3" x 4.3" x 0.9")
Weight:	260g (9.17 oz)
Enclosure:	Water proof
Instrument cable:	0.4 m (16")
Power supply:	12 V DC (10-16 V). The instrument is polarity protected.
Power consumption:	0.08 W. At max lighting 0.8 W.
Current consumption:	7 mA (at 12V). At max lighting 70 mA (at 12V).

13.2 Distribution Unit A-1500

Dimensions:	220mm x 145mm x 55mm (8.7" x 5.7" x 2.2")
Weight:	800g (28.2 oz)
Enclosure:	Splash proof
Cable:	8m (26ft) NX2 cable
Power supply:	12 or 24 V DC (10-40 V)
Power consumption:	4 W, plus drive unit demand
Current consumption:	0.3A (at 12V)
Max. motor output drive:	25 Amps
Output:	NMEA 0183 compass, RAI

13.3 Distribution Unit A-1510

Dimensions:	160mm x 110mm x 38mm (8.7" x 5.7" x 2.2")
Weight:	420 g (14.8 oz)
Enclosure:	Splash proof
Cable:	8m (26ft) NX2 cable
Power supply:	12 or 24 V DC (10-30 V)
Power consumption:	3 W, plus drive unit demand
Current consumption:	0.3A (at 12V)
Max. motor output drive:	15 Amps
Output:	NMEA 0183 compass, RAI

13.4 Rudder Follower & Linkage

Dimensions:	51mm x 96.5mm x 89mm (3.0" x 3.8" x 3.5")
Transmitter arm:	127mm (5") long
Ball joint linkage arm:	2 arms, each 394-635mm (15.5"-25") long
Weight:	1.8 kg (4 lbs) (without cable and linkage arm)
Enclosure:	Water proof
Cable:	15m (50ft), 3-lead.
Power supply:	From Distribution Unit
Power consumption:	2.5mW
Current consumption:	0.5mA
Rudder angle:	± 55°
Resistance:	1k ohms
Life:	10 million cycles dither

Temperature range:

The above products have the same temperature range.

Storage: -30°C to +80°C (-22°F to 176°F)

Operation: -10°C to +70°C (14°F to 158°F)

13.5 Pumpsets

Enclosure: Splashproof

Ambient Temperature Range: -5°C to +50°C

Model	Max. Flow (GPM)	Max. Pressure (PSI)	Max. Current (A)	Average Current (A)
PF0.3	0.3	1000	20	2-3
PV1.4	1.4	400	20	4-6

13.6 Linear Drive

Enclosure: Splashproof

Ambient Temperature Range: -5°C to +50°C

Rudder Speed: 12 seconds

Max. Rudder Angle: 2 x 50

Max. Force: 1600 lb.

13.7 Solenoid Valve Drive

Voltage: 12 or 24 VDC

Max. Current: 15 Amp

13.8 NX2 Network Specification

The NX2 Network is a high performance, non-collision multi-talker, multi-receiver data bus, specially designed for marine navigation applications. The most important features are the high update rate, fast response times, very low data latency (25ms) and very high data security even at long distances. Another important feature is that data transfer efficiency will not degrade even when used in large and complex systems. It utilizes the RS485 standard with up to 32 senders and/or receivers to form a Local Area Network. Data is transmitted asynchronously with 1 start-bit, 8-data-bits, 1 parity-bit, two stop-bits in 9600 baud.

The link between NX2 Network and your PC-application is the PC interface FD (Full Duplex) / NMEA (PN 20620010). This is supplied with a 9-pole D-sub connector on a 1m (3.3 ft) cable for the RS232 PC port. The PC interface is a useful tool to monitor and log real time data, or when editing waypoints to/from PC-file or to/from NX2 Network.

CE Approval:

The above products conform to the EMC requirements for immunity and emission according to EN 5008-1 and EN 55022.

14. Abbreviations

Abbr.	Description
ADJ	ADJust
ALM	ALarM
APC	Automatic Pilot Calibration
ATC	Automatic Trim Control
AWA	Apparent Wind Angle
BAT	BATtery
BOD	Bearing Original Destination
BRG	BeaRinG
BSP	Boat SPeed
BTW	Bearing To Waypoint
C10	Calibrate 10
CAL	CALibrate
CDI	Course Deviation Indicator
CE	Communaute Europenne
CHK	CHecK
CLR	CLeaR
COG	Course Over Ground
CTS	Course To Steer
d	differential
DEV	DEViation
DGPS	Differential GPS
dGPS	differential GPS
DTW	Distance To Waypoint
E	East
Edit	Edit
EEPROM	Electronically Erasable Programmable Read Only Memory
EMC	Electro Magnetic Compatibility
EN	European Norm
GPS	Global Positioning Network
HDC	HeaDing Compass
HDM	HeaDing Magnetic
HDT	HeaDing True
HM	Heading Magnetic
HT	Heading True
id	identity
INI I	NIltiation
Init	Initiation
KT	KnoTs
KTS	KnoTS
LCD	Liquid Crystal Display
LOW	LOW
m	metre

m/s	m etres per s econd
MAG	M agnetic N orth
MAX	M A X
MEM	M EM O R y
MID	M ID
MIN	M INimum
MN	M agnetic N orth
MOB	M an O ver B oard
N	N orth
NAV	N AVigate
NM	N autical M ile
NMEA	N ational M arine E lectronic A sso C iation
OCA	O ff C ourse A larm
PCA	P ilot C ourse A larm
PWR	P o W e R
RAM	R andom A ccess M emory
RET	R ETurn
RRS	R udder S peed
RUD	R udder
S	S outh
S/A	S elective A vailability
SAT	S atellite
SEA	S ea
SEC	S econds
SOG	S peed O ver G round
STR	S Tee R
tru	true
USR	U Se R
VAR	V ariation
VER	V er S ion
W	W est
WP	W ay P oint
XTE	Cross Track error



The boat is right of the desired track



Apparent wind angle from port



Apparent wind angle from starboard



Rudder angle port



Rudder angle starboard



Minus



Plus