

# CPT

AUTOPILOT

Optical Compass Model



## THE CPT MANUAL

Installation  
Operation  
Maintenance

MANUFACTURED AND SOLD DIRECT BY  
**CPT AUTOPILOT INC.**  
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## **Introduction to the CPT Autopilot**

The CPT has been installed in a large variety of sailing and motor vessels, in many different installations. This manual will help you install, operate, and maintain your CPT. We still service and repair older CPTs, so contact us if you have any questions or need service.

Mounting the CPT on a pedestal or bulkhead is a quick and easy installation. This manual also has advice for alternative installations, including slanted gear-driven wheels, wooden wheels, and large oversized wheels. This manual will help you choose the best installation method for your boat.

The CPT is an extra crew member to man the wheel, day or night, rain or shine. It is amazing to take your hands off the wheel and experience the freedom the CPT provides.

Always remember to maintain a proper look-out:

### **Warning!**

**Do not use the CPT in traffic or in waters where navigation is restricted!  
An autopilot is NOT a substitute for good seamanship. Always maintain a permanent watch by the helm.**

#### **INTERNATIONAL REGULATIONS FOR PREVENTING COLLISIONS AT SEA, 1972 (72 COLREGS)**

Part B - Steering and Sailing Rules

Section 1 - Conduct of Vessels in any Condition of Visibility

Rule 5 - Lookout

Every vessel shall at all times maintain a proper look-out by sight and hearing as well as by all available means appropriate in the prevailing circumstances and conditions so as to make a full appraisal of the situation and risk of collision.

### **WARNING!**

**KEEP CHILDREN AND PETS AWAY FROM  
THE CPT BELT.**

## **HOW TO USE THE CPT MANUAL**

1. Review the “Basic Mounting Requirements and Types of Installations” on page 6 to see how the CPT can best be mounted in your cockpit. The standard pedestal, bulkhead, or L-bracket mounts are the easiest, most straightforward installations. Review “Part I—Installation” for more detailed information.
2. Download installation templates from our website at [www.cptautopilot.com](http://www.cptautopilot.com). Print the templates and use them to get the measurements for mounting your CPT. Order your CPT and submit your basic measurements through our website, or by calling us at 831-687-0541
3. When your CPT arrives, follow instructions in “Part I, Installation” for installing the CPT. Then perform the “Dockside Check-Out” and “Sea Trials”.
4. To become more familiar with the CPT, review “Part II, Operation” and “Part III, Maintenance”.

If you have any questions or suggestions for improving this manual, please let us know. We are always pleased to receive photos of CPT installations and suggestions for improving the CPT.

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## **PART I – INSTALLATION**

### **1. Parts List**

Before beginning the installation, unpack and identify all parts:

#### **Standard Parts**

- Drive box (larger box with two knobs on front & clutch/gear on back) w/10' power cable
- Sensor box (4" cube with adjusting knob, attached to drive box w/10' cable)
- Wheel pulley (wheel adapter for steering wheel)
- Remote control w/10' cable
- Drive belt
- 316 stainless J-bolts with nuts & washers (quantity & length to suit boat's wheel)
- Stainless Sensor mounting bracket with hardware (U-shaped stainless steel)
- Slotted aluminum U-bracket for mounting Drive box
- Two 1/4x20, 5/8" length Carriage bolts w/T-handle nut, wing-nut, & washers for mounting Drive Box
- Spare shear pin set
- In-line fuse
- This manual

#### **Additional Parts, If Ordered**

- Pedestal mount kit (standard or shallow) w/hardware, hose clamps and anti-scratch rubber pads
- L-bracket for mounting Drive box, Drop-down plate, or Reverse-mount plate
- Waterproof plug & receptacle for 12-volt power supply
- Extra belts
- Extra shear pin sets
- Shim pads for mounting drive box, spacers for wheel pulley when reverse-mounting drive
- Custom cable lengths for power cable and sensor box cable, remote extension cord
- Remote extension cord, Miscellaneous spares, as ordered

### **2. Installation Summary**

Installation requires:

- A. Remove Wheel and mount the large wheel pulley on the steering wheel. (page 7)
- B. Mounting the drive box on pedestal, bulkhead, console or cockpit deck. (page 8)
- C. Running the power cable to the 12-volt power source. (page 13)
- D. Mounting the Sensor box. (page 13)

This installation can normally be completed in an afternoon, depending on the particular boat and installer; if boat's wheel has not previously been removed & greased a gear puller may be needed.

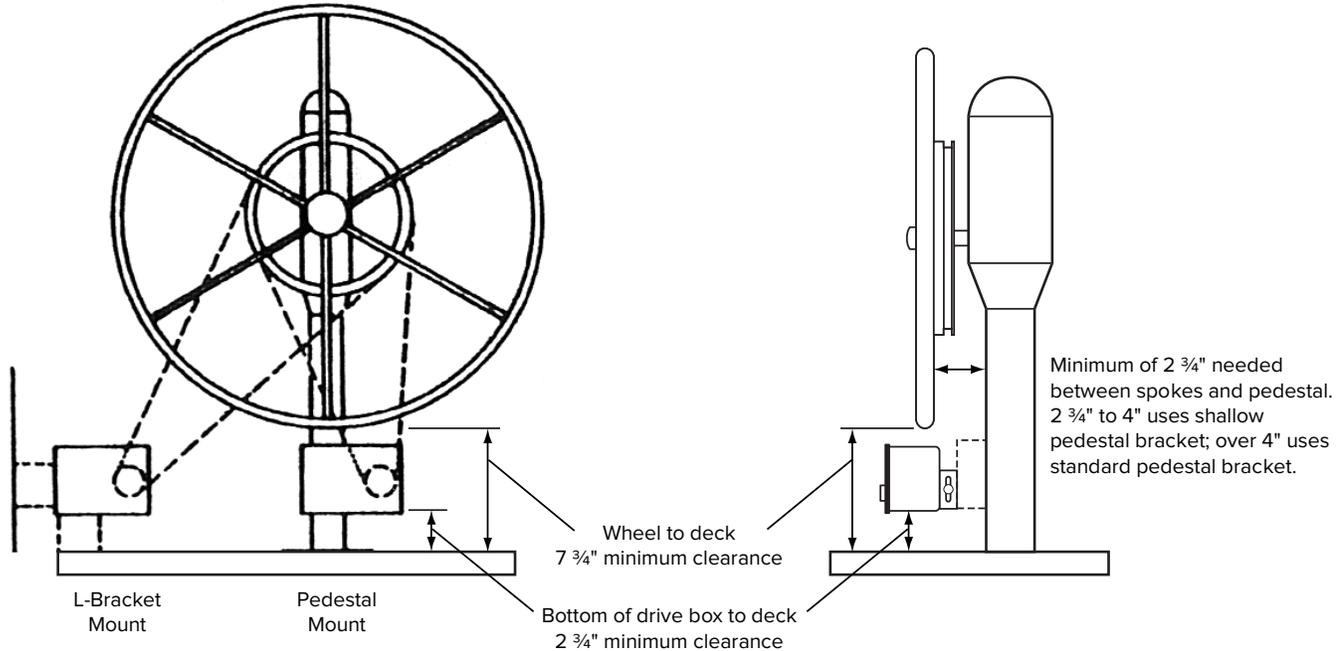
**The CPT cables are not removable; the black cable fittings on the power and sensor boxes are not removable plugs and should not be disturbed due to the watertight seals. Do not attempt to open the sensor box or drive box, there are no user serviceable parts inside. Loosening the black cable fittings or opening the unit will void your warranty.**

**Do not cut any wires or fit owner plugs until after sea trials**, when you are sure of the installation! If you wish to run power or sensor cable through a deck or bulkhead, the cable can later be cut at a point where the splice will be inside and dry. The sensor cable is four-conductor, color-coded. Solder the splices or use a terminal block with soldered lugs. A waterproof connector may be used on the power line. (See "Electrical Connection")

### 3. Basic Mounting Requirements and Types of Installations

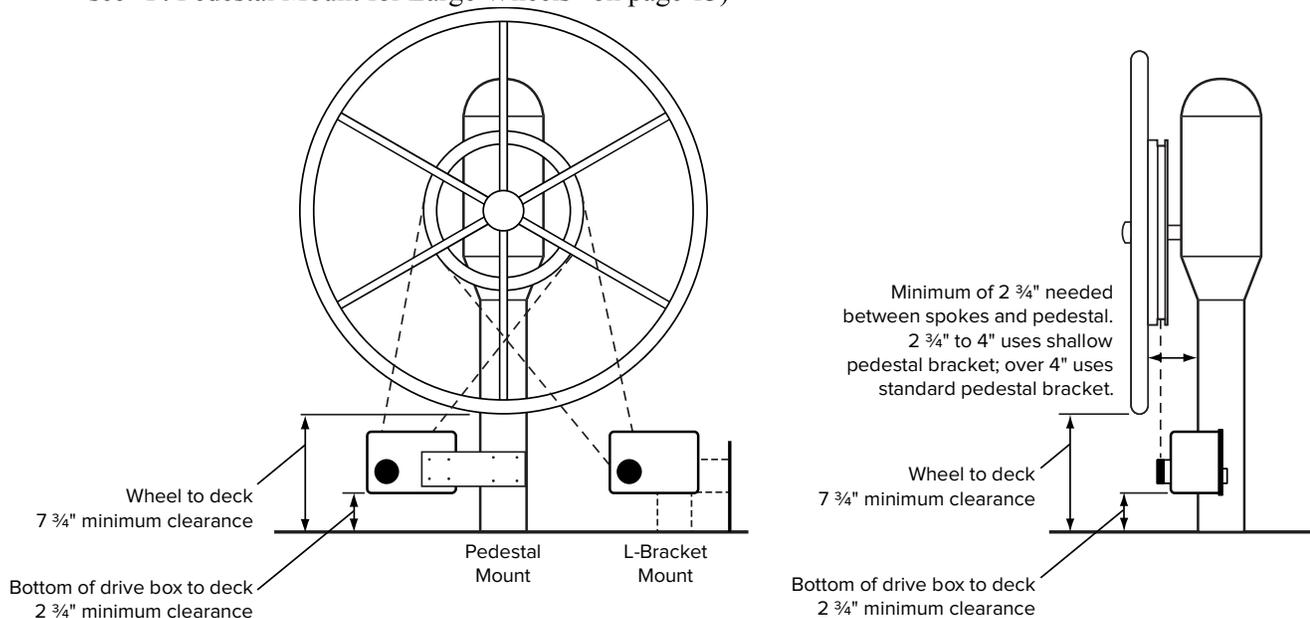
#### A. Standard Pedestal Mount, L-Bracket Mount, Bulkhead Mount:

- Recommended standard mounting; Rudder/deadband controls facing AFT
- Drive Box mounted with pedestal mounting kit (p.8) or directly to bulkhead (p.11)
- Drive Box mounted on PORT side of wheel with L-Bracket



#### B. Reversed Drive Box; L-Bracket or Pedestal Mount

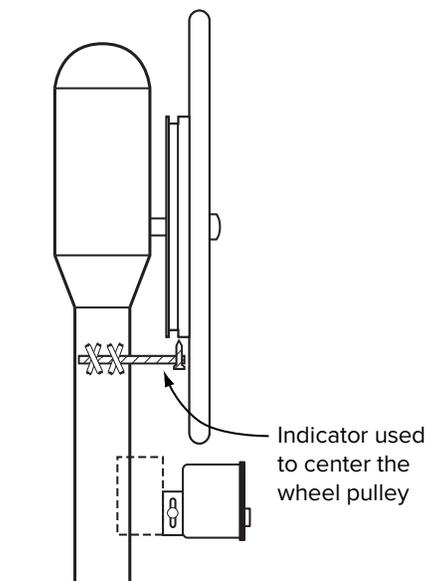
- Optional, for installations where space is restricted (Reverse the polarity of power wires)
- Drive Box is reversed, with Rudder/Deadband Controls facing FORWARD
- Drive Box mounted on STARBOARD side of wheel with L-Bracket
- Drive Box can be mounted directly behind the wheel (rather than below the wheel) by using a spacer ring on the wheel pulley to allow operation of the clutch. (contact us for details)
- Drive box mounted on the pedestal to PORT w/offset reverse-metal plate (more demanding installation, see "F. Pedestal Mount for Large Wheels" on page 13)



## 4. Mounting The Wheel Pulley

### A. Wheels with Metal Spokes:

1. Remove the steering wheel. (On older boats, this may require a gear puller. Grease shaft before replacing the wheel and you will have less trouble next time.)
2. Place the Wheel Pulley on back of wheel thick flange against spokes. Hook J-Bolts provided around spokes, and pass them through holes in pulley. Center pulley approximately on the wheel. J-bolts must all point the same way clockwise or counter-clockwise around the wheel. **If there are any gaps between a spoke and the wheel pulley, a shim must be fitted for support. Do not tighten the J-bolt to lessen the gap; it will cause eventual warp & distortion of the pulley.** Put a flat washer and a nut on each J-bolt; apply a drop of oil to the threads to avoid galling. (DO NOT fully tighten yet.)
3. Inspect fit of pulley against spokes. If steering wheel spokes are out of alignment and not in plane, low or angled spokes **will have to be shimmed**. Do not attempt to pull them into alignment by tightening the J-bolts – you will distort and warp the pulley. On dished wheels or if spokes are tapered, use tapered shims of teak or acrylic between pulley and spokes to even strain on the pulley; use a small dab of silicone to keep the shims in place.
4. Temporarily remount steering wheel (with mounted pulley) on shaft. Overlong J-bolt stems can be cut off flush later.
5. The J-bolts will tend to center the pulley on their own, but check centering on the wheel as follows:
  - a) As an indicator, mount a pointed tool, a coffee stick or two, taped together if needed works well. With one end close to pulley, tape it to pedestal so it does not move.
  - b) Rotate the wheel.
  - c) GENTLY tap pulley with your hand to adjust its center position on the wheel by watching the distance between the pointer & wheel. Centering to within 1/8" or so if fine.
  - d) Tighten J-bolt nuts. **Snug with a nut driver or small wrench using only one or two fingers on the wrench. Do not over tighten—you will warp & distort the pulley (35-40 Inch-lbs max). Although it will not warp immediately, if over tightened it will warp in time.**
  - e) Hang belt on wheel pulley BEFORE tightening wheel back onto shaft. (belt may not fit over large wheels)



### B. Wheels with Wooden Spokes

Proceed in the same general fashion as for metal-spoked wheels. It is possible to pad the spokes (self-adhesive insulating tape or clear tubing) to prevent crushing the wood or damaging the varnish under J-bolts. Clear vinyl tubing cut to length and slipped over J-bolt hooks works well.

If you prefer not to use J-bolts, you may screw the pulley to wheel directly with self-tapping or wood screws (Use pan-head screws with washers, not flat-head screws: flat-head screws will crack adapter):

1. Temporarily fasten pulley to wheel with a lashing of light line or tape works well.
2. Center pulley as described under "Metal-Spoked Wheels".
3. Mark and drill holes in wooden spokes or inner wood ring for the size fasteners used.
4. If desired, use bedding compound in the holes.

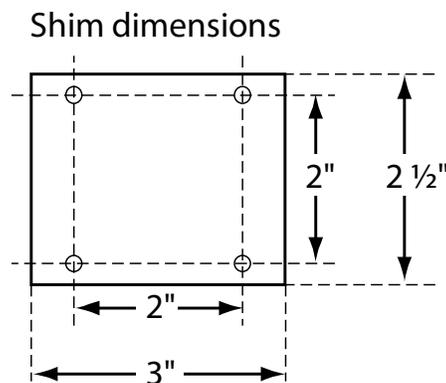
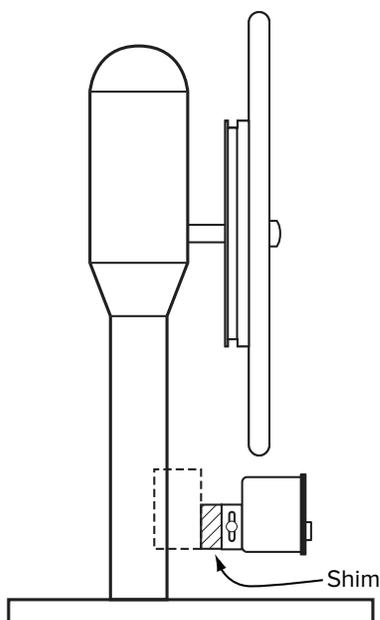
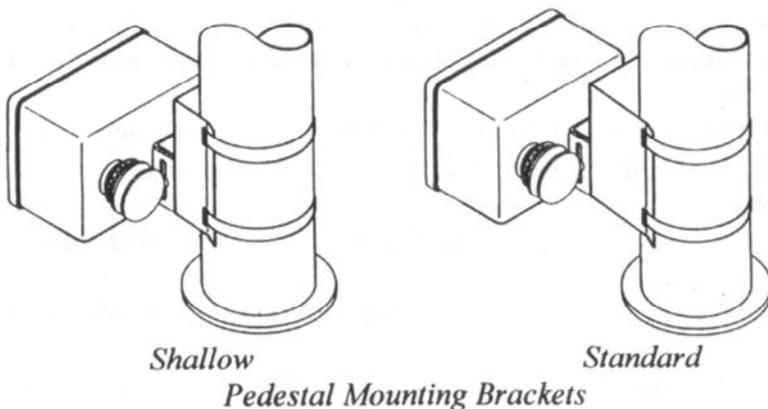
## 5. Mounting The Drive Box (only after Wheel Pulley is mounted)

- A) **STANDARD PEDESTAL MOUNT** (below): The CPT's Pedestal Bracket is designed to mount on most pedestals - it comes in two sizes (shallow for spoke-to pedestal clearances of from 2-3/4" to 4", and standard for spoke-to-pedestal clearances of over 4"). The pedestal bracket uses the slotted U-bracket to hold the motor box assembly.
- B) **L-BRACKET MOUNT** (on page 10): Mounting on a surface that is parallel to wheel shaft, such as a coaming, deck or cabin sole requires the L-bracket. The L-bracket also uses the slotted U-bracket to hold the motor box assembly.
- C) **BULKHEAD MOUNT** (on page 11): The slotted U-bracket by itself can be used with appropriate shims to mount the drive box assembly directly onto a console or bulkhead parallel to the boat's wheel.
- D) **TILTED WHEELS** (on page 12): The L-bracket is used to mount drive box on cockpit sole or cockpit side-wall for boats with tilted wheels or slanted gear-driven wheels.
- E) **REVERSE L-BRACKET MOUNT** for Large Wheels (on page 12): The L-bracket is used to mount drive box in boats with large wheels, or "Deck-sweeper" wheels, or to gain foot space behind the wheel.
- F) **REVERSE PEDESTAL MOUNT** (on page 13): An optional method for mounting drive box using pedestal bracket with a shimmed offset plate instead of the L-bracket; for large wheels & foot space.

### A. Standard Pedestal Mount:

*Shallow Pedestal Mount is for when wheel is 2 3/4" to 4" from pedestal.*

*Standard Pedestal Mount is for when wheel is over 4" from pedestal.*



Use #10 fasteners

*A shim can be used to obtain proper belt alignment between drive and wheel pulleys.*

*Note: If pedestal diameter is less than 4" (3", 3.5"), hose clamps may not provide adequate support. Proceed as directed, but use the six holes of pedestal bracket as a guide and drill six holes for #10 self-tapping screws, or drill and tap for #10 machine screws.*

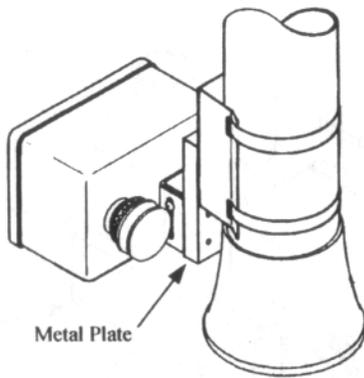
1. Hang toothed belt on wheel pulley, between flanges.
2. Mount the slotted aluminum U-bracket to Pedestal Bracket with supplied screws. Slots should be vertical at the sides of Pedestal Bracket.
3. Take the assembly and position the slotted aluminum U-bracket over fitting on back of Drive Box, and fasten them together with the 2 carriage bolts, washers, T-handled nut and wing nut. Since holes in the pedestal mount are offset to one end, pedestal mount may "point" up or down, whichever fits best on your pedestal. Center carriage bolt midway in the slots.
4. Place the drive pulley on drive box into the drive belt, holding the Pedestal Bracket against pedestal so that belt is reasonably snug. Check belt for a clear run between pulleys with no interference or rubbing. The pedestal mount bracket may be slightly spread apart or compressed to adjust the distance from the pedestal, or to fit different diameter pedestals. To check for good belt alignment, hold a yardstick or long straight-edge against the wheel adapter on your wheel: it should be parallel to the belt when you eyeball it.
5. Mark the position of the pedestal mount and hose clamp slots on the pedestal.
6. Lift the assembly off of pedestal, and remove the carriage bolts, washers, T-handled nut, & wing nut.
7. Thread straps of hose clamps through pedestal mount slots so that the tightening screws will be inside the mount and can be reached by a screwdriver through the two round holes.
8. Fasten the anti-scratch rubber strips provided around pedestal on areas where hose clamps will rest.
9. Fit the pedestal mount back on pedestal using the aligning marks, and insert ends of the hose clamps into pedestal mount slots and into hose clamp tightening screws.
10. Check position of the pedestal mount again, make sure the face of the mount is parallel to steering wheel, and tighten hose clamps.

*Re-tighten clamps after 2-3 days, as the rubber compresses.*

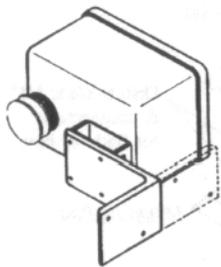
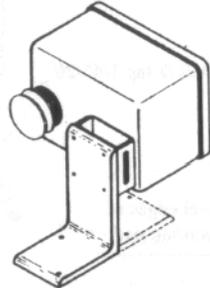
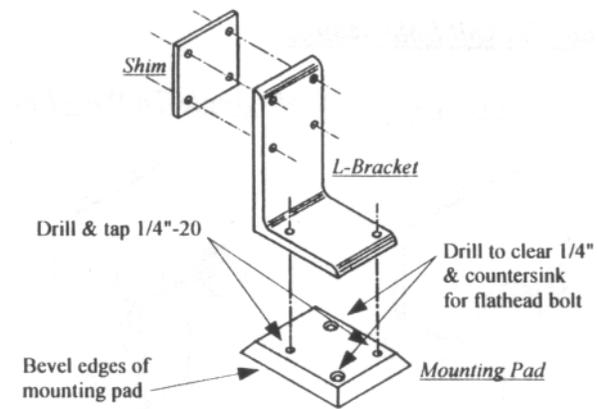
11. Place drive box in position and fit the carriage bolts, washers, T-handled nut & wing nut.
12. Slide drive box to the top of slot and fit drive belt on the wheel and drive pulleys.
13. Tension belt by sliding drive box down in the slots and tightening T-handled nut & wing nut.

**DO NOT OVERTIGHTEN THE BELT!** An over-tightened belt will destroy motor bearings and wear out belts and clutch.

14. Adjust the bracket or add/remove shims as necessary to have both pulleys in alignment when clutch is engaged. Shims if needed are included with the CPT, or acrylic, micarta or teak make good shim stock. Exterior plywood will do if the edge grain is sealed. Place shims between the slotted U-bracket and pedestal mount and fasten with the fasteners.
15. Check again to be sure that vertical alignment is correct and that both pulleys are parallel with the belt in place and clutch engaged. Adjust as necessary.

*Flanged Pedestal Base—Pedestal Mount (Flared base)*

If there is enough room to mount the CPT drive under the wheel, but the pedestal base is too high, a “dropped” installation can be used. Insert a sturdy metal or marineboard plate between pedestal mounting bracket and channeled U-bracket for the drive box. (available from CPT)

**B. L-Bracket Mount; Sidewall or Cockpit Sole Mount***L-Bracket on Surface At Right Angle To Wheel Face**Sidewall or Coaming Mount**Cockpit Sole or Deck Mount**L-Bracket - Optional Shim And/Or Mounting Pad*

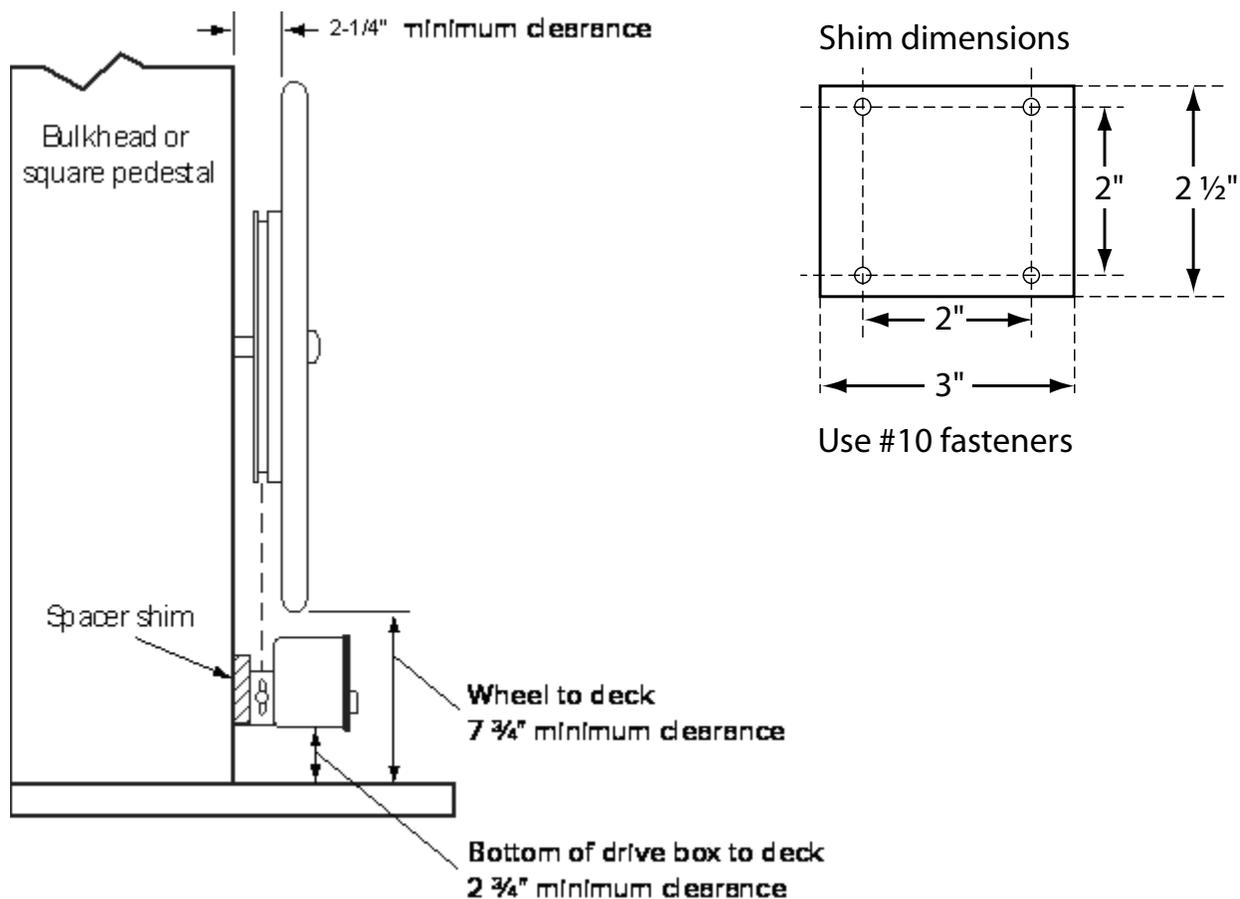
1. Determine if the L-bracket is to mount on a sidewall or deck. Use supplied bolts and nuts to attach the slotted U-bracket so slots will be vertical.
2. Using the carriage bolt, washer and T-handled nut, attach the slotted U-bracket to the fitting on back of drive box. Center the carriage bolt midway in the slots. (On sidewall or coaming mounts, a wing nut may be used instead of the T-handled nut.
3. Hold drive box approximately in its mounting position, and place drive belt over the wheel and drive pulleys.
4. Move drive box so belt is tight and both pulleys are aligned.
5. Mark the location on sidewall or deck for the two 1/4" mounting holes in base of L-bracket.
6. Drill holes for 1/4" fasteners (not supplied).
7. Use a backing block unless mounting surface is substantial and trustworthy.
8. If desired, use a mounting pad between the L-bracket and mounting surface to ease T-handled nut adjustment or to permit easy removal of the L-bracket. (See drawing)

### **C. Bulkhead Mount; Console or Square Pedestal Mount**

When the wheel is mounted on a bulkhead, console or square pedestal the drive box may be mounted directly without the use of either pedestal mount or L-bracket. A minimum of 2-1/4" clearance is needed between the wheel spokes and mounting surface for clearance of the clutch. The slotted U-bracket is centered on the fitting on back of drive box, and its position is marked on the surface it is to be mounted on. Shimming the mount for pulley alignment and adjusting belt tension is similar to the processes described in sections "Pedestal Mount" and "Sidewall-Cockpit Sole Mount".

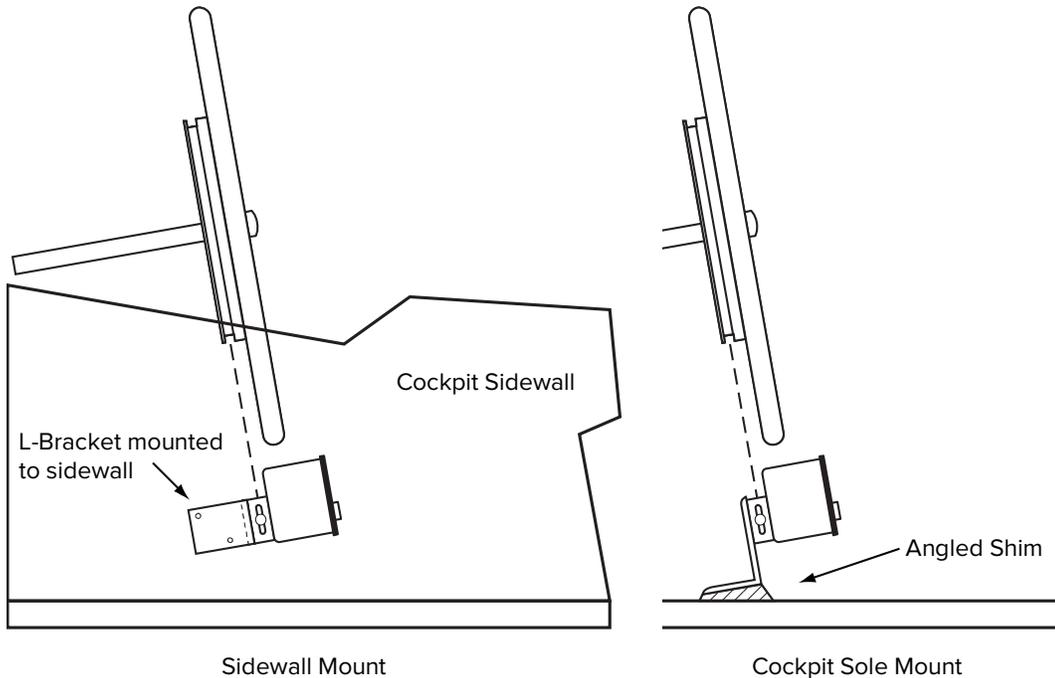
In some cases, a teak or acrylic plank may be needed to bridge a recessed area on mounting surface.

The fitting on the rear of motor unit can be rotated 90 degrees in order to permit horizontal instead of vertical tensioning of the drive belt. **DO NOT ATTEMPT TO REPOSITION THIS BRACKET YOURSELF! DOING SO WILL BREAK THE CASE SEALING AND VOID YOUR WARRANTY.** Contact CPT Autopilot for assistance (can be performed for no charge at time of purchase).



### **D. Tilted or Angled Wheels**

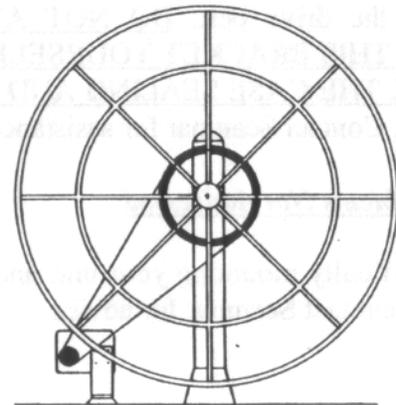
Angled or tilted wheels frequently found on boats with worm gear steering require use of the L-bracket. If the L-bracket is mounted on a coaming or sidewall, the entire drive box may be tilted at the same angle as the wheel, and no angled shim is needed. Proceed as per instructions in previous section. If L-bracket is sole or deck mounted, the L-bracket can be slightly bent to match the angle of the wheel, or an angled shim can be installed.



### **E. Reverse L-Bracket Mount, Large Wheels**

If there is less than 7-3/4" between the bottom of wheel and the cockpit sole, the L-bracket can be used to mount the drive box to the side of the cockpit or sole. If cockpit is too narrow to allow standard orientation, the motor unit can be mounted facing forward (reversed).

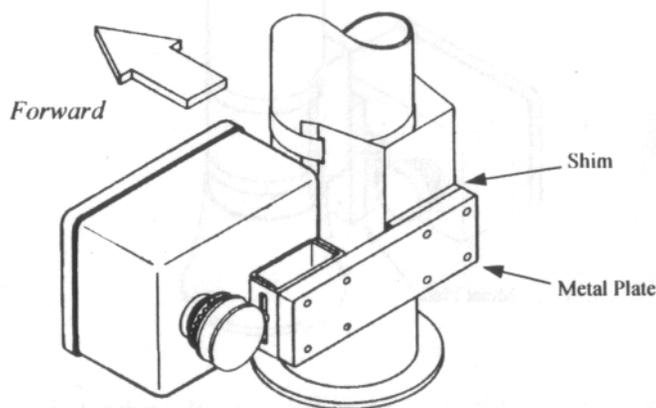
1. Turn drive box so knobs face forward and clutch faces aft. You must reverse polarity of the 12-volt power supply. (Black wire to 12v [+], white to 12v [-], Fuse must always remain on the 12v [+] line.)
2. Mount drive box only slightly on port side or on any distance on the starboard side so that most of the box is forward of wheel and does not obstruct cockpit. Follow mounting instructions outlined in "B. L-Bracket Mount". You may make and use the mounting pad described in step B. Drive box & clutch may be positioned further forward of the wheel if a wheel adapter spacer is used.



*Looking Forward*

### **F. Reverse Pedestal Mount; Large Wheels, Limited Helm Space**

For boats with large wheels or to mount the drive forward of the wheel for space considerations. An 8"x3" reverse plate offsets the drive to the port side. We stock predrilled reverse-mounting plates. The drive can also be mounted inside the perimeter of the wheel if a 1" spacers are used with the wheel adapter. With the drive reversed, polarity of the power cable must be reversed. Two wing nuts are used for adjusting belt tension. A minimum belt distance of 19" is needed. \*Fasteners must be used with the pedestal bracket; hose clamps are not firm enough



### **G. Mounting Problems Not Addressed**

If you have difficulty working out a mounting solution, contact CPT Autopilot for advice. The drive box can be customized to orient vertically or for the belt to adjust horizontally (trawlers & catamarans)

## **6. Electrical Connection**

Connect drive box power line to a good 12-volt power source. Use the included 10-amp inline fuse or a good quality 10-amp circuit-breaker. If possible, go directly to the battery or battery selector switch with good solid connections. If this is not possible, tie into 12 gauge wire minimum, with the shortest run. Do not tie into the ignition side of any source. A waterproof connector may be used on the power line, use a connector with a screw-down cap and plug, and a compression fitting for the wire as it enters the cap, tin the wire ends. Reversing the polarity of the power cable reverses the direction the wheel is turned. The black wire is normally 12 volt negative (-), the white wire 12 volt positive (+). If you installed the drive box with controls facing forward, you must reverse the power cable. (\*The pilot will be 90-degrees off-heading if polarity is wrong)

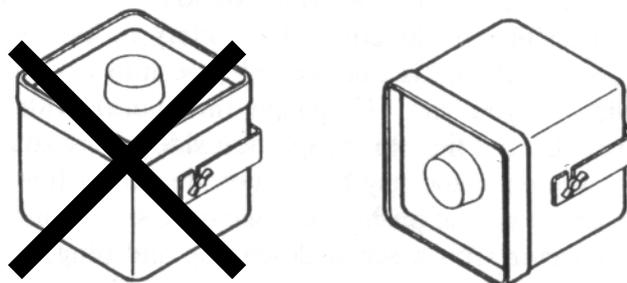
Do not leave supplied fuse holder out in the weather. It is not waterproof.

## **7. Mounting the Sensor Box**

The sensor MUST NOT be mounted too close to anything magnetic. Mounting the sensor on the pedestal 8-10" from the binnacle compass and 12" minimum above the drive box is usually fine. The binnacle compass, electric motors, radio speakers, tool boxes, and winch handles can cause interference, even on the opposite side of a bulkhead. If the sensor is mounted to a sidewall, do not mount directly to port or starboard of drive box. If you have a steel pedestal or steel vessel a suitable location for the sensor should be found before ordering, contact CPT Autopilot.

The CPT sensor compass is not compensated, and outside influences and mounting may cause it to disagree with the boat's compass; some deviation from the ship's compass is to be expected, 10-15 degrees is not uncommon. THE BOAT'S COMPASS MUST BE THE FINAL AUTHORITY AS TO REAL HEADING.

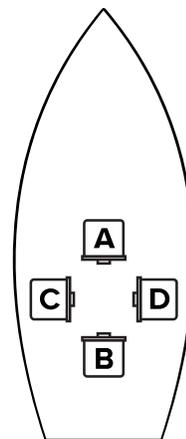
The sensor is heavily counter-weighted and internally gimballed. IT IS RUGGED, BUT DO NOT DROP IT. It is normal to hear a "clunk" as the gimbaling fetches up against its stops. The sensor is calibrated to have the knob facing aft and the number "0" up. *The dial face is not the top* (see drawing).



### **A. Sensor Orientation and Mounting Options**

The standard, and easiest place to mount sensor is on a pedestal pipe facing aft (A). There are other options, as shown in diagram:

If sensor will be reversed and facing forward (as in B), or facing 90 degrees to port or starboard (as in C or D) the sensor needs to be calibrated at the factory for that direction. There is no charge for this calibration if requested at time of purchase.



### **B. Sensor Mounting Requirements**

Try to keep sensor box at least 12 inches above drive box and 8-10" from the binnacle compass. Do not mount the sensor at the same level and directly to port or starboard of the drive box (sidewall mount); this to avoid interference from motor's magnetic field. A common cause of magnetic interference is locating the sensor too close to the drive box.

Mount sensor box in a location where you can see the binnacle compass while adjusting the sensor knob.

With the boat solidly moored, test the area selected for mounting with a hand-held compass to be sure it is free of magnetic influence. Check with engine both off and running, with any equipment within three feet on and off. This includes any equipment on the opposite side of a bulkhead. If a hand-held compass reads similar to your ship's compass in a certain location, the CPT sensor unit will generally operate fine there; expect some deviation from the ship's compass.

#### NOTE REGARDING STEEL BOATS:

On steel boats, check the location with a magnetic compass while the boat turns in a 360-degree circle. If the compass "hangs" and delays in certain positions while turning, and then breaks free, it will not work well in that location. Keep the hand-bearing compass level while testing the location.

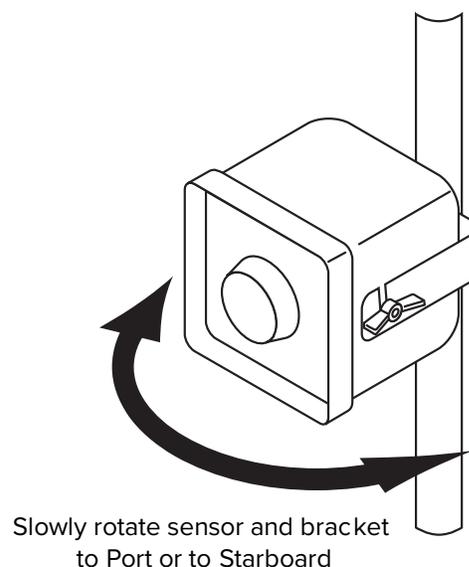
The CPT is steering many steel boats. Every steel boat is different. Some owners have had success mounting the pilot sensor on a stainless steel pedestal guard around an aluminum pedestal. Others have mounted the sensor unit on wooden boom gallows, aluminum or wooden mizzenmasts, under or on top of wooden coach roof, etc. Contact us for directions for performing a magnetic survey of your vessel.

The included pipe clamp kit is used to mount the sensor box on pedestal guard pipe. Alternately, mount the sensor bracket on top of or under a console, shelf or horizontal surface, or on the side of a vertical surface or bulkhead. A sensor L-bracket is available for mounting the sensor on a bulkhead or sidewall. Orient the bracket slots up so the sensor box will not fall out if the wing nuts loosen.

### **C. “Swinging the Sensor” before final mounting**

**Before** tightening the clamp to the pedestal pipe, (or drilling pilot holes to mount the sensor box bracket on a console), do the following steps:

1. Loosely clamp sensor box bracket to the pipe so that bracket can still be rotated to port or starboard on the pipe. Mount the sensor box using the wing nuts. (Always tighten wing-nuts only finger tight, never use pliers or the bolts can loosen). Keep the top of the sensor box level; do not tilt out of plumb in the bracket. (If you are mounting the sensor on a console or bulkhead and drilling pilot holes, only use the **center screw** and make only the center pilot hole at this point.)
2. Slip the belt OFF of the Drive Box pulley gear, and engage clutch. (Push the black pulley gear in while turning it until it snaps in.)
3. Turn the knob on the sensor box to match the heading on your binnacle compass.
4. Do not have the remote connected. Check to make sure that the 10 amp fuse is in place, and that power is available to the CPT. The black power normally goes to 12v(-), the white power wire to 12v(+).
5. Turn the Rudder control ON and set to 5, set the Deadband control to 3. Allow a 10 second warm-up. The motor will momentarily turn one direction during a 10 second warm-up, and may then turn and pulse to port or starboard intermittently if not perfectly on heading.
6. **Slowly rotate the assembled sensor box and bracket slightly back and forth** on the pipe several times, to port and then to starboard, as if the boat's heading was changing. You will notice that the CPT stops and changes direction as you rotate the sensor bracket on the pipe. (Or rotated on the center screw if mounting on a console)
7. Determine at which position the sensor finds a null point (where the CPT stops moving just before it reverses the direction of rotation). When the sensor is aligned, the motor will not move within a 20-30 second period. If the motor makes a brief movement every 10 seconds, rotate the bracket a bit more to find the center of the null. This will be the mounting position for the sensor bracket. Tighten the clamp in this position. Repeat step 6 if necessary
8. After tightening the clamp, turn the knob on the sensor clockwise to the right 10 degrees and the motor should rotate clockwise also, which would turn the wheel to starboard if the belt was connected. Turn the knob counter-clockwise 10 degrees and the motor should rotate counterclockwise, which would turn the wheel to port if the belt was connected.
9. If the motor is turning the wrong direction for the wheel, reverse the polarity of the power wires. (Switch the black power wire to 12v(+) and the white or red wire to 12v(-); the fuse must always be on the 12v(+) battery line.) This must always be done if you are reverse-mounting the drive box. **DO NOT** simply turn the sensor knob until the wheel turns the right direction, or the boat's compass and sensor will not match or operate properly. **DO NOT** remove or reposition the sensor knob on its shaft in order to have it match the boat's compass.
10. Magnetic interference: If the motor makes continual pulses in only one direction and a null cannot be found, this may indicate magnetic interference. Having to rotate the bracket 30-40 degrees to find a null can also be an indication. Try moving the sensor further from the drive box, or to a cockpit seat or other area to temporarily find the null. Another location for the sensor may have to be found, contact CPT for advice.



## **8. Dockside Checkout**

The CPT is run 24 hours at the factory before final testing. It should steer your boat easily and require not more than an hour or so of experimentation to become familiar with it. This dockside check should be performed after installation and before sea trials.

### **A. Checking the Steering System**

Before starting the dockside checkout, test the amount of play in boat's steering system. Play in the system, any movement not immediately reflected by movement in the boat's rudder, should be eliminated or reduced to a minimum. All boats have some adjustment mechanism to take up slack and this should be used to eliminate play. Inspect the system for chafing, frayed cables, or binding. Grease as appropriate. A large amount of play in a cable or geared steering system can transfer shock loads from the rudder to the wheel and can be hard on shear-pins, and can limit tight course-holding.

Hydraulic systems must be free of trapped air and cannot have excessive leakage past the piston seals. An indication of this is the ability to move the wheel with steady pressure when the rudder is locked. Air bubbles and leakage must be corrected if the CPT is to operate correctly. A few hydraulic systems for fishing vessels have play from valves that cannot be eliminated.

### **B. Performing the Dockside Checkout**

1. Do not connect the Remote Control at this time. The belt should be installed on both pulleys.
2. **Disengage clutch.** (Pull out on drive pulley on motor box until it clicks, and drive pulley is able to freely rotate). Center the boat's rudder.
3. Check that 10 amp fuse is in place in the 12 volt (+) line and power is available to the CPT. Set Sensor Box dial to match boat's compass heading.
4. Turn Deadband Control to 3 and turn Rudder Control On and set to 3. During a 10 second warm-up the motor will briefly run.
5. After 10 seconds, engage clutch. (Push in on drive pulley while slightly turning wheel to engage clutch pins.)
6. Rotate sensor knob 10 degrees to the right (clockwise). The wheel should turn right to starboard, then stop, and will then begin making short pulses to starboard.  
  
(If left in this state, the pilot will begin putting in small trim turns to starboard in an attempt to correct the boat's heading. **Do not** leave unattended or let the wheel rotate to its stops. To stop the wheel, turn the deadband up and disengage the clutch, or simply turn the unit off)  
  
If the wheel is turning the wrong direction, turning the wheel to port, you will need to reverse the polarity of the power wires, be sure the fuse remains on 12v(+). DO NOT simply turn the sensor knob until the wheel turns the right direction, or the boat's compass and CPT sensor will not match. Do not adjust the sensor knob on its shaft.
7. Rotate the sensor knob back to the boat heading. The wheel should turn left to port, and then stop and may periodically pulse. (see note below)
8. Rotate the sensor knob counterclockwise 10 degrees. The wheel should move briefly to port, and then stop. (It will pulse again eventually; see note below)
9. Rotate the sensor knob back to the boat heading. The wheel should turn right to starboard, then stop.
10. Turn off the rudder control. Disengage clutch by pulling out on the drive pulley.

*Note: The trim system will operate when the sensor knob is set to the boat's heading at the dock. The trim system will add and accumulate any error and begin to run the motor briefly every 15 -30 seconds. Do not allow the wheel to rotate to its stops. Disengage or turn it off.*

THIS COMPLETES THE DOCKSIDE CHECKOUT

## **9. Keeping Watch**

The CPT is a helmsman who only sees the compass and not the surrounding sea and traffic. The skipper is responsible for keeping a good watch at all times. Even so, there is a great difference between being on the helm continuously and being on watch. The freedom afforded by the CPT must be experienced to be appreciated.

**DO NOT ATTEMPT TO USE THE CPT IN TRAFFIC OR IN WATERS WHERE NAVIGATION IS RESTRICTED! ALWAYS MAINTAIN A PERMANENT WATCH!**

### **INTERNATIONAL REGULATIONS FOR PREVENTING COLLISIONS AT SEA, 1972 (72 COLREGS)**

Part B - Steering and Sailing Rules , Section 1 - Conduct of Vessels in any Condition of Visibility  
Rule 5 - Lookout

Every vessel shall at all times maintain a proper look-out by sight and hearing as well as by all available means appropriate in the prevailing circumstances and conditions so as to make a full appraisal of the situation and risk of collision.

**WARNING! KEEP SMALL CHILDREN AND PETS A WAY FROM THE CPT BELT!**

## **10. Sea Trials**

1. Choose a day with light winds and calm water. Initial trials should be at a speed of three to five knots under power. After performing trials under power and becoming familiar with the unit, perform trials under sail, maintaining a balanced sail plan - no excessive weather or lee helm.
2. Be sure there is plenty of room and no other traffic. The CPT should be off with the clutch disengaged, remote control disconnected.

Hold the boat on a steady heading. Set the sensor knob to the boat's compass heading. This initial setting puts the CPT in range and close your boat's heading.

With the clutch disengaged, turn the Rudder control on and set to 4 or 5, deadband to 2 or 3. Do not connect the remote control at this time. The motor will run briefly and then stop, and may pulse if not exactly on course.

3. After a 10 second warm-up, engage the clutch. (Briefly raising the deadband to 5 or more makes it easier to engage and disengage the clutch.)
4. The autopilot should make corrections to port and starboard to keep the boat on a straight heading. The dial heading will not exactly match your compass; the sensor is not compensated as the ship's compass is, and the dial may not match the actual heading because of the rudder and deadband settings.

If the Rudder control setting is too low, the wheel will not turn enough when the CPT makes corrections, and the boat may gradually fall off heading. If it makes repeated small corrections in one direction or the boat falls too far off a straight heading, movement of the wheel is not enough for the boat to respond; gradually raise the Rudder control until the boat responds to both port and starboard corrections. If the boat falls more than 20 degrees while adjusting the rudder setting, disengage the clutch and re-set the sensor knob to the new heading before **resetting the rudder control**.

If the Rudder setting is too high, the wheel will turn too much when the CPT makes corrections, and the boat will over-steer, going to far to port and then too far to starboard. Set the rudder control high enough so that the boat returns to heading with only one or two pulses or wheel corrections. If it makes large corrections too far to port or starboard, lower the Rudder control.

5. Once you are on a safe heading, remain on that course for a while. If the CPT waits too long to make corrections, gradually lower the deadband setting. If the motor runs continuously back and forth, to port and then to starboard too frequently, the deadband is set too low; gradually increase the deadband setting. This will reduce motor operation.

6. Turn the sensor knob about 1/4 inch for a 10-degree heading change. You'll find it's easier to turn the dial intuitively by feel without the need to look at the dial. The boat should turn to the new heading and settle there. If it turns past the new heading, and then makes a series of corrections, lower the rudder setting and try again. If it approaches the new heading with a major (deadband) correction and then additional small trim corrections, increase the rudder setting. With a few trial turns you should find a setting to bring the boat steadily to the new heading without over-steering or delays.
7. Having the Rudder control set too high can lead to "S" courses, while having the rudder setting too low will cause wheel corrections to be too small and allow the boat to fall off heading. Stalling at very slow speed, such as when you are pointing too high, in irons, or the wind dies can cause any corrections to the rudder by the autopilot to be ineffective. Disengage the CPT until you are making adequate headway.
8. The CPT will accept heading changes of up to 40 degrees at one time. Simply rotate the sensor knob and let the boat settle on the new heading. Always navigate by your ship's compass. If larger heading changes are needed, make them in 40-degree increments and allow the boat to come to the new heading before turning additional increments. Make adjustments in increments until you are on the ship's compass heading you require. If the boat is more than 40-degrees off-heading the pilot may not respond correctly to further dial changes, so wait for the boat to settle closer to the new heading.

NOTES:

- A pencil or tape mark works well to remember the rudder and deadband settings.
- When engaging the CPT, always set the CPT sensor to your boat's heading.
- Briefly raise the deadband to 5 or more to allow easy engagement and disengagement of the clutch.

THIS COMPLETES THE SEA TRIALS

## PART II - OPERATION

The CPT's performance can be improved by careful tuning, but continuous fussing with the controls is not needed. Once you find what works best for your boat, you'll use the same settings most of the time, and can make a small tape or pencil mark on the settings to help remember them.

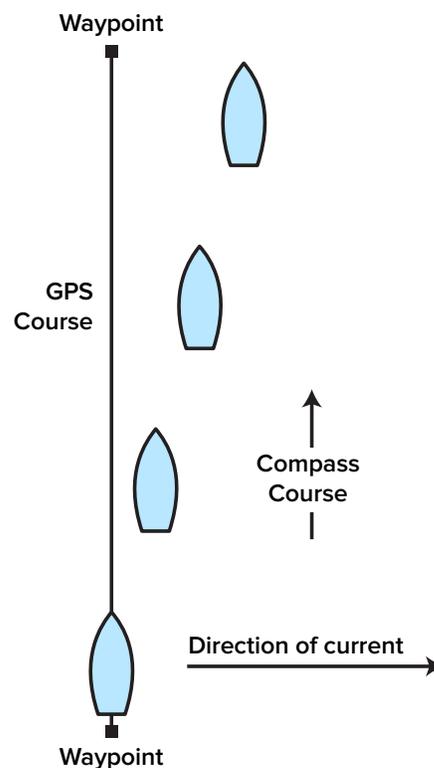
### **1. CPT Sensor Knob:**

When you initially set the sensor knob to the boat's heading, it sets the sensor in range and close to the boat's heading. You can then modify the heading with slight adjustments if needed. The CPT then keeps to its heading, and allows you to modify the heading in up to 40-degree increments.

The CPT sensor must be set to the boat's heading before the CPT is engaged, it cannot "seek-out" the heading on the sensor if it is out of range. You must "tell" the sensor the boat's heading when you first initially engage the autopilot. The dial heading will not exactly match your compass; the sensor is not compensated as the ship's compass is, and the dial may not match the actual heading because of the rudder and deadband settings.

The CPT keeps a vessel on a magnetic heading. Please be aware that this is not the same as a GPS course. In keeping to a compass heading, your vessel will point the same direction but will still be subject to drift from wind and currents. This drift will be apparent when observing your GPS over time, and periodic heading adjustments will keep the vessel on your waypoint course.

Notes: The sensor has several ranges, or windows, in which it will operate. If the CPT is engaged when the boat is more than 40 degrees off-heading from the sensor, it may operate in a different range improperly. Always set the sensor to the boat's heading before engaging the CPT.



### **2. Rudder Control**

The Rudder control basically tells the CPT how much to turn the wheel to when a correction is needed. The CPT performs like a helmsman in a fog who can only see the compass. If this helmsman is told to move the wheel exactly one inch for each five-degree heading error, he will do exactly that every time a correction is needed. If these motions result in under-control and sluggish corrections, you can tell him to move the wheel further for a given correction.

The rudder control is used to match the CPT's response to your boat's steering needs. Some boats take many turns of the wheel to move the rudder, while others take only a few. Ideally, the rudder control should be set high enough so that only one or two wheel corrections or "pulses" are need to keep the boat on heading. If the rudder control is set too high for your boat, wheel rotation will be excessive and the boat will over-steer on either side of the rhumb line. If the rudder control is set too low, it will make many small repeated corrections to return to the desired heading and will spend a lot of time on one or both sides of the rhumb line or gradually fall off heading.

Either of these actions is relatively easy to identify and, with some experimentation underway, you should be able to find the correct setting for your boat. A rudder setting that works while sailing in light winds may have to be raised when winds increase. The best rudder setting will return the vessel to heading with just one or two pulsing corrections.

A boat may require a slightly higher rudder control setting at low speeds than at higher speeds. A sailboat may require a higher setting when running than when beating and a higher setting when sailing than when motoring. Many boats steer nicely at a setting of 5-6, but this will vary depending on the wheel adapter used and the boat.

If you are becalmed, stuck in irons or not making headway, disengage the CPT. The CPT will continue to try and make heading corrections, but the vessel will not respond to rudder changes. If left unattended the rudder could eventually hit the rudder stops.

### **3. Deadband Control**

The deadband control basically tells the CPT how far it can stray from heading before a correction is needed. In a proportional pilot, there is always some deadband inside which the pilot does not activate. If this deadband is small, (about one-degree) the pilot will continuously run port or starboard making course corrections. In a seaway, a boat will yaw back and forth along the desired course as it makes its way over the waves, but generally it has enough directional stability to keep a fairly good average heading. An adjustable deadband will permit the boat to work its way through the waves without continuously using the rudder to try to straighten out the natural weaving.

The deadband setting is adjusted with the deadband control knob. Turning the knob clockwise increases the deadband. Most boats steer nicely at settings of 2-3. On long passages, turning the deadband and rudder up a bit higher can provide a good average course with low battery use. A deadband of “5” will allow about a 7-degree dead-range; small heading adjustments within this range will not take immediate effect until it is exceeded.

Rhythmic CPT steering corrections, in time with the roll of the boat, indicate that the deadband is too low. The deadband should be adjusted to avoid constant correction. A low deadband does not always mean that the boat will maintain a straighter course; it can cause the pilot to over steer if the rudder setting is too high. In rougher seas, the deadband should be higher to avoid constant corrections. A lower deadband setting generally helps when sailing downwind; it's better to head-off or take the wheel if there is any chance of broaching.

*Most of the CPT's steering action should be small trim corrections. Use as wide a deadband setting as possible to avoid excessive battery drain and strain on the CPT.*

*Clutch & warm-up tip: Briefly raising the deadband to 5 or more makes it easier to engage and disengage the clutch. When the CPT is turned on, the motor briefly activates during a 30 second warm-up period. Wait 30 seconds before engaging the clutch.*

### **4. Automatic Trim**

The automatic trim system of the CPT has two functions. It serves as a memory, keeping track of where the rudder is and how recently it has been moved. The other is to keep track of the average heading steered and calculates the deviation from the desired heading. Normally, a boat spends a little more time to the right or left of the heading. At the end of one cycle there will usually be a small error because the boat spends a little more time to the right or left. The automatic trim system keeps track of this error and, when it gets big enough, will run the motor briefly to make the necessary correction. When it does this, it also resets itself and begins to again accumulate the average error.

The amount of correction made during the trim operation is dependent on the setting of the rudder control. The higher the rudder setting, the larger the individual trim adjustments. This automatic trim system will make the adjustments needed due to changing wind velocity, weather helm, slip in hydraulic systems and other factors.

### **5. Remote Control Operating Instructions**

In “Compass” mode the pilot follows the sensor dial compass heading, and the remote knob can be turned to fine-tune the course +/- 5-degrees or more to port or starboard. In “Wheel” mode (remote steering mode) the knob will steer the boat remotely without input from the CPT sensor, and the sensor compass is disengaged. The remote is used for dodging ships and crab pots, and can also be used for tacking.

\*When plugged in, be sure the remote is in a location where the toggle won't be bumped and accidentally switched to wheel mode, which will disengage the sensor compass. In compass mode, the remote is designed to fine tune the heading, and will not replace the sensor. It is best to use the pilot without the remote when first getting familiar with the CPT.

#### **A. Plug and Connection**

The receptacle for the remote plug is located on the bottom of the drive box. It is the receptacle to the left when facing the front of the control panel. The plug for the remote is keyed so that it may be inserted into the receptacle in only one position. Fit the plug into its receptacle and, using SLIGHT pressure, rotate the plug until it slides in and seats. After the plug is seated in the receptacle, screw down the collar to seal it.

When the Remote is not in use, keep the attached screw-down cap in place on the motor box.

## **B. Remote Controls**

### **1. Remote Control Toggle and Turning knob**

The toggle switch position determines the operating mode of the remote.

Holding the unit with the toggle switch at the top:

“Compass” mode— toggle switch left.

“Wheel” mode—toggle switch right

Turning knob: Rotate the knob clockwise for starboard, and counter-clockwise for port. Keep the knob centered on the black line towards the toggle switch unless modifying the course.

- A. **Compass mode:** In “Compass” mode, toggle switched left, the pilot is controlled by the sensor compass. In “Compass” mode the remote knob can be turned to fine-tune the compass course to port or starboard up to 5-10 degrees. It can be used for minor course adjustments, for best performance keep the knob within 90-degrees of center, **not hard-over**.

B. **Remote Wheel Steering Mode:**

In “Wheel” mode, toggle switched right, the CPT sensor is disconnected and the Remote steers the boat like a second helm station. It can be carried to the bow of the boat to dodge crab pots if the extension cable is attached. Returning the knob to the centerline returns the wheel approximately back to center.

If the knob is left in a rotated position, the wheel will gradually make small additional adjustments, don't leave unattended. Raising the Rudder control increases the amount the wheel turns. Set deadband to lowest setting for best response.

**Returning to “Compass” mode:** (back to a CPT Sensor heading)

- 1) Turn the main CPT sensor knob to the boat's new heading.
- 2) Flip the toggle switch left to “Compass”. You are now back on a CPT sensor course

**Remember: You must make sure dial on the sensor is set close to the boat's heading before flipping the toggle back to “Compass” mode.**

You have to turn the sensor knob to your boat's new heading. You must “tell” the sensor the boat's heading. (see Part II, Operation: CPT Sensor Knob”)

### **2. Tacking With The Remote**

1. Set up the idle sheet and be sure the active sheet is ready to run.
2. Switch the remote to “Wheel” mode (switch right).
3. Turn the main CPT Sensor box knob to the new heading desired, usually 90-degrees to port or starboard.
4. Use the remote knob to turn the boat into the tack. Determine the amount of knob rotation needed for your boat. The rotation for port/starboard tacks may not be identical.
5. Release and sheet in.
6. When the boat is within 10-20 degrees of the new heading, immediately switch the remote to “Compass” mode (switch left).

\*When plugged in, be sure the remote is in a location where the toggle won't be bumped and accidentally switched to wheel mode, which will disengage the sensor compass.

## **6. Sail Trim**

Even the best autopilot can be crippled by poor boat trim.

*The boat must be balanced on all points of sail and in all wind conditions for proper CPT operation.*

This means that through the skipper's selection of sails and trim, the boat should tend to maintain a stable course without a significant amount of weather or lee helm. Reef & trim when wind and sea conditions increase .

When sailing, the boat should maintain adequate speed for effective rudder control; it must make enough headway for steering to be effective. When wind and seas increase, and especially when running downwind, quick rudder response becomes important; lowering the deadband and slightly raising the rudder control helps with full keels, and increasing vessel speed or falling off will lessen the effect of following seas. Fin keels may benefit from lowering the rudder setting due to increased speed. Always be aware of the relative wind angle, and keep the boat on a course to prevent an accidental gibe. If the boat is in danger of broaching, shorten sail and reduce speed, or put a competent helmsman at the wheel.

### **A. Boat Balance**

A balanced boat has very little or no helm, either weather or lee. A boat that is in trim and balanced does not round up to windward at every gust. A boat with a heavy weather helm is one that has been poorly trimmed or is carrying a poor selection of sails. The boat should be trimmed for consistent steering needs.

By spending time trimming the boat properly before engaging the CPT, you will place lower current demands on your boat's electrical system, steer a straighter average course and create less wear-and-tear on both your boat and your CPT. Practically any boat can be made to sail with a balanced helm for reasonable lengths of time. You should strive for this as closely as possible before engaging the CPT.

### **B. Beating**

Do not carry too much sail area and do not over-sheet the sails. This will create weather helm, excessive heel and probably slow you down. If the boat has weather helm, ease the main sheet until the main is on the point of luffing or just luffing slightly. If the boat still has significant weather helm, take in a reef on the main or slide the traveler car to weather while easing the sheet to put some twist in the main to allow the top of the sail to luff. In heavy weather conditions, where one sail will suffice, sail under jib alone.

In gusting conditions some boats, particularly fin keel/spade rudder boats and those with roller furling jibs, will head up at every gust. The main should be sheeted loosely enough so that it luffs as soon as the boat heads up. With some boats the main should be left luffing slightly when on course. This will allow the jib to push the boat off, as drive from the main is lost. Maintain a course that will give the boat an adequate steady speed and effective rudder control. The goal is to balance the boat, and eliminate the need to change steering with every gust.

### **C. Running**

If running downwind with twin poled-out jibs: the jibs should be sheeted a little looser than would be optimum so that if the boat tries to round up, the leeward sail will spill air and the boat will return to course.

If the main is carried, there should be a poled-out foresail on the opposite side. If conditions put the boat on the verge of broaching, the main should be dropped, or fall-off and change to a safer course. When it gets to surfing conditions, a competent helmsman should be in charge. Generally, at slow vessel speeds the rudder is less efficient and requires a higher rudder-control setting; higher speeds require a lower setting. Get to know your vessel's characteristics; there is usually an optimum vessel speed, course, and amount of canvas that best balances the boat to meet the wind and sea conditions.

### **D. Reaching**

Twin poled-out jibs or a main and a poled-out jib can be used up to 30 to 40 degrees off a dead downwind course. (See the comments above on running.)

In high winds and particularly in gusting conditions, both sails must be sheeted looser than usual, or sail area reduced. **THE MAIN SHEET MUST BE EASED!** If the boat still wants to head up at every gust, put twist in the main, reef it, or drop it.

*Always rig a preventer to the boom when running or reaching in case of an accidental jibe.*

## **PART III – Maintenance & Troubleshooting**

### **1. Maintenance and Adjustments**

#### **A. Belt Tension**

Sliding the motor unit down on its mounting bracket slots tensions the belt. Pull the belt snug by hand by putting downward pressure on the drive box and tightening the wing nuts. Do not over-tighten the belt or a the motor shaft may be bent. If it doesn't slip it is tight enough. An optional belt tensioner is available which keeps the belt tensioned and dampens shock loads.

#### **B. Drive Pulley and Clutch Maintenance**

The drive pulley is held in one of two positions (engaged or disengaged) on its shaft by a spring-loaded ball, which fits into one of two grooves on the shaft. All parts are either Delrin, Nylon or stainless steel.

Lubricate the drive pulley and shaft often. Salt water, however, may eventually cause salt crystal build-up in the locating spring and ball. The drive pulley should be removed, and soaked/rinsed in fresh water each season - more often in severe conditions. The shaft should be kept oiled/greased or sprayed with T-9, Teflon, or silicon.

Remove the belt from the small pulley when the autopilot will not be steering the boat for some time. Hang the belt on over the binnacle or wheel shaft. This will lessen wear and prolong the life of the clutch mechanism and shear pins when hand steering.

To service & lubricate the clutch/drive pulley:

1. Loosen tension on the drive belt and remove belt from the small pulley.

Remove the two screws from the back of pulley cap. (The black, grooved grip used to engage and disengage the clutch. The screws are also the shear pins.) **Do not attempt to remove the screws if the pin ends are bent. Reach and straighten them with long-nosed pliers or a small vise grip first.**

2. Remove pulley cap.
3. Remove stainless steel retaining clip from its groove at the end of the shaft.
4. Remove pulley.
5. Soak and rinse pulley in fresh water. Work the ball inside the shaft-hole in and out while submerged in fresh water.
6. Clean , dry and lubricate shaft.
7. Replace pulley.
8. Replace retaining clip.
9. Replace pulley cap.

Replace the two shear screws. Do not over-tighten screws, or the pulley may distort and bind on the shaft. Rotate the pulley on the shaft and observe the ends of the shear screw pins:

**Adjustment:** There should be an even gap (1/16" appx.) between the end of the shear pins and stainless steel shaft-plate. If one of the pins is too close to shaft-plate, it may tend to catch in the shaft holes when the wheel is turned. If the pulley does not turn freely, if the pins are not even, or too close to the shaft-plate, back off one or both of the screws slightly.

10. To remove the clutch drive-plate: Loosen the stainless allen-head setscrew in the side of the driveplate, and remove clutch assembly from motor shaft. Grease motor shaft, replace clutch, and be sure to tighten driveplate setscrew securely. If there is a dimple in the shaft, be sure the setscrew lands in the dimple before tightening. Replace belt and adjust the belt tension.

## **2. Connector Maintenance**

Connectors for the remote, power, and sensor cables, if installed, should be maintained with corrosion inhibitor, silicone grease, vaseline, T-9, or silicone sprayed into both plug and socket ends each season. Caps should be in place and tight if plugs are not fitted. Be sure to periodically grease the receptacle for the remote control on the bottom of the Drive Box, even if the remote control unit is never used. (\*Voltage is present in receptacle connectors; avoid corrosion)

*The black cable fittings on sensor and drive box are not plugs. Attempting to remove them will damage components and void the warranty. The sensor and power cables are soldered directly to circuit boards inside the boxes.*

## **3. Storage**

After use, lightly spray with fresh water and wipe the CPT down with a cloth and dry it. A light waxing will prolong the life of the finish. Store the unit in a dry place when not in use, or protect it with a wheel/binnacle cover or other appropriate cover. When the boat is laid up, take the pilot home if possible. Do not store it in a damp locker during lay-up, or a location subject to flooding or damp conditions. When stored, store sensor and drive boxes on their sides, with the control knobs facing sideways, not facing up or down.

### ***WARNING!***

***Do not store the CPT in the bilge or any locker liable to flooding, leaking, or standing water.*** (See technical specifications)

## **4. Wheel Pulley**

If preferred, wax the wheel pulley to maintain gloss. After each season check to make sure the wheel is still centered on the steering wheel and adjust if needed. (See “Installing Wheel Pulley”)

## **5. Factory Service**

It is recommended that the CPT be returned to the factory to have the watertight seals checked and the calibration tested every 8 to 10 years depending on weather exposure and use. This is also worthwhile if it has been used for several years and you are planning an extensive passage. There is a nominal charge for this testing, but if the seals fail and salt water enters the unit, repairs may be extensive. The drive, sensor, & remote should be securely bubble-wrapped with ½” bubble-wrap, then separated by cardboard & boxed, and boxed again with 1” of peanuts when shipping.

## **6. Troubleshooting**

Specialized equipment is required to seal and calibrate the CPT. For satisfactory and warranted repairs, repairs should be done only by the factory.

### **UNAUTHORIZED REPAIR ATTEMPTS VOID THE WARRANTY REGARDLESS OF CIRCUMSTANCES**

A voltmeter and test leads are required to perform the following troubleshooting procedures.

Disconnect the remote control before troubleshooting. If the CPT works with the remote disconnected, the remote is interfering with proper operation of the CPT.

### **Does Not Steer In Either Direction**

Test that CPT has a good 12-volt power connection. Check battery voltage (12.5 volts minimum), check voltage at power cable as pilot motor runs (turn rudder to 10); low voltage means poor connections. Trace back the power supply for breakage, loose/oxidized connections, a blown fuse, defective fuse holder, etc. Poor connections, switches, and small gauge wires can cause voltage drop, blown fuses and damaged circuits. Check remote receptacle for excessive corrosion.

**Motor Runs But Drive Pulley Does Not Rotate**

Check that shear screws are not broken, bent. The stainless drive plate is fastened to the motor shaft by a setscrew. If the stainless drive plate is loose, tighten setscrew with an Allen-wrench inserted in the hole of the drive plate; it must be securely tightened (62 inch-lbs). Motor will turn very slow with voltage loss in lines.

**Unit Will Steer In Only One Direction**

Check sensor cable for kinks & breaks in insulation. Cut out suspect section, splice, solder & apply shrink-wrap. (There are 4 color-coded wires inside outer jacket). Check remote receptacle under cap for corrosion, internal contacts can short. Check the battery condition, & all connections in the power line, measure voltage loss when pilot motor runs (rudder set to 10 w/belt off). Try the test for basic circuit function (below). If the pilot steers on some headings but not others it is an indication of magnetic interference with the sensor. If the boat is more than 40 degrees off from the sensor heading the sensor dial may not respond correctly and it may seem that the pilot only turns one direction; disengage and bring boat back to heading.

**Under steers, Boat Does Not Reach heading Or Does So Slowly, eventually falling off-heading**

Rudder control is too low - increase setting; turn rudder high as possible without causing over steering. Deadband may be too high – lower deadband setting (May be both conditions). Make sure boat is making adequate headway. Set rudder high enough so that only one motor-pulse brings the boat back to the rumblines.

**Over steers, Passes Course, “S” Turns**

Rudder control set too high - lower setting. Deadband may be too low - increase the setting (May be both).

**Rhythmic Steering, Corrects As Boat Rolls with swells**

Deadband set too low - increase setting.

**Belt slips, Excess Torque**

Balance the boat to lessen weather-helm and provide consistent steering (See “Sail Trim”). Check the steering system for binding, bad control cable leads, damage, or lack of lubrication. Correct as necessary. Make sure wheel pulley is centered on wheel, and that wheel pulley and drive gear are aligned.

**Belt Slips, Loose**

Tighten belt to recommended tension. Check to be sure the wheel pulley is centered on the wheel shaft (This can slip after installation). Check to be sure both pulleys are in alignment as the pedestal mount can also shift after installation.

**Clutch Disengages**

Motor unit is tilted so the drive pulley shaft is not parallel to the wheel shaft, and belt tension is disengaging the clutch. Pulleys must be aligned and parallel when the clutch is engaged. If in doubt or the wheel is not uniform favor a slight belt slant that will help keep the clutch engaged.

The setscrew recessed into the drive pulley-gear adjusts the ball bearing friction in the clutch. Slightly tightening this screw will lock the clutch more securely in position; tightening too much will make the clutch difficult to disengage. This normally does not need adjustment unless the screw has worked loose or there has been extensive wear. Use a little Lock-tight if the screw has worked loose.

**Shear Pin breakage**

Be sure all excess friction is removed from the steering system. Steering linkage with excessive play can transfer sudden shock loads from the rudder directly to the shear pins. Be sure the wheel adapter is centered on the steering wheel. Vessels with excessive rudder shock loads will benefit from use of a belt tensioner.

If the tip of a broken shear pin is not removed, it may get lodged behind the driveplate and cause a screeching sound behind the clutch. Remove the clutch & driveplate to remove the broken tip.

A worn clutch pulley with excessive hub wear will no longer rotate on center, transferring belt tension to the shear pins instead of the drive shaft; contact us for a replacement pulley gear. To prolong the life of the clutch and shear pins when hand steering, remove the belt from the small pulley, and hang the belt on over the binnacle or wheel shaft. Clean and lubricate clutch on a regular basis.

**CPT Steers When Windy And Rough, Not In Calm**

This is usually an indication of excess play in the boat's steering system. Anything more than a few degrees of play in the wheel MUST be removed. Shock loading from excessive play in the steering can be hard on shear pins. Air in hydraulic steering systems can cause 10 degree or more play at the wheel; the effect will be similar to operating the pilot at high deadband setting.

**Loose Power Connections & Voltage Loss:**

Just checking for 12v at the line is not enough; voltage loss will only show while pilot motor runs & draws current. Small drive-pulley may barely turn or vibrate with excessive voltage loss in power line. Also, CPT may fall off-course, then unexpectedly turn to port, then correct back to starboard with a loose connection. When the CPT is powered-on, the motor briefly activates to port during a 10 second warm-up. Loose power connections can cause the unit to intermittently turn off and power-up again, initiating another warm-up and motor activation.

**CPT turns to port when turned on:**

You are turning the unit on with the clutch engaged, and the motor briefly activates to port during a 10 second warm-up. Do not engage the clutch until after the 10 second warm-up. Briefly turn the deadband to 5 or more to make clutch engagement/disengagement easier.

**Sensor does not match ship's compass when pilot is on course:**

- a. Sensor may not be aligned properly. See "Swinging the Sensor" in Part I, Section 7C on page 15.
- b. Rudder and deadband settings allow the vessel to range from the set course. NOTE: sensor heading will be 80-90 degrees off if the polarity of the power wires is reversed for your installation.
- c. Normally the vessel's binnacle compass is compensated and corrected with internal magnets, but the sensor compass is not; they may not always agree on certain course headings & some deviation is to be expected. Always use the ship's compass for navigation.

**HF Radios and Iron objects**

Winch handles, screw drivers, knives, and other objects with steel/iron parts can alter the sensor heading if placed next to the sensor. Be aware that SSB and Ham transmissions can also alter the sensor heading, as well as interfere with GPS, radar, and depth sounders. In testing, transmissions of 150 watts under 10 megs did not affect the CPT. At higher frequency, high power voice transmissions tended to generate enough RF to alter the heading, but every vessel HF system is different. It is probably best to turn off the CPT when transmitting. Recognizing that a winch handle or SSB is causing a heading change is not always readily apparent when it occurs. With steel vessels, iron or magnetic interference the pilot will usually operate fine on some headings but not others, usually when the heading orients the sensor compass towards the interfering object. Some older steering systems may have magnetized parts in the pedestal.

**Basic circuit function test:**

To check basic circuit function, remove belt & engage clutch. Set sensor dial to boat's heading, set rudder control to 5 and deadband to 3. Turn the pilot on and gradually rotate the sensor dial 360-degrees while watching the movement of the clutch pulley. If operating properly the motor will turn the drive pulley clockwise or counter-clockwise in pulsing movements, and reverse the direction about every 80-90 degrees as the dial is rotated.

**Reversed Power Wires:**

The motor will reverse it's direction of rotation if the polarity of the power wires are reversed. If the sensor heading is 80-90 degrees off from the ship's compass it is an indication the power wires are reversed. Review the dockside check-out procedure. (White wire goes to 12v+ for standard installations)

*If it is necessary to return the CPT for service, **return both the drive and the sensor units. Do not cut any wires!** You must contact us before returning the CPT. We may be able to solve your problem over the phone. We must charge for checkout during warranty if the returned CPT functions properly and the problem is in the boat.*

## **Part IV Technical Specifications**

### **Compass Sensor**

Fluid-dampened, gimbaled optical compass, up to 45 degree tilt

### **Power Requirements**

12 Volts DC

0.013 amp standby current

0.3 amp average current drain, varies with load & settings

### **Torque/rpm at Wheel**

97 ft-lbs (131 Nm) – 14" Wheel Adaptor

86 ft-lbs (116 Nm) – 12" Wheel Adaptor

Up to 7rpm at the wheel

### **Dimensions**

#### **Drive Unit**

7" wide x 5" high x 4" deep

#### **Sensor Unit**

4" cube

### **Wheel Pulley**

12-5/8" or 14-1/4" diameter, One inch deep

## **Part V Warranty**

CPT Autopilot, Inc. is the manufacturer of the CPT autopilot. A card showing the limited warranty is included with each new unit in the back of this manual, along with a warranty registration card. The warranty set forth in the express limited warranty is the exclusive warranty of the product and is in lieu of any other warranty whether implied or statutory, including warranties of merchantability and fitness for a particular purpose. The remedies available to the purchaser are limited to the remedies described in the express limited warranty card.

CPT Autopilot, Inc reserves the right to make changes in the design or material of the CPT at any time and without notice.

The attached Warranty Registration Card should be returned, together with a requested installation photograph. Please take a photo that shows the installation of the motor box, wheel, and the sensor box.. The photo can be emailed to us separately along with your name and the unit's serial number in lieu of mailing the card. The purpose of the photo is to help make sure the pilot is correctly installed, and to enable us to give advise and tips if we see anything wrong. If you run into a problem, the pictures will help us to help you.

### **Weight**

11lbs

### **Truly-Water Resistant**

The sensor, drive box, and remote are designed and built to withstand immersion. We prefer to call the CPT truly water resistant, as the term "waterproof" is often misunderstood. Storing the unit improperly in standing water or flooded conditions can eventually exceed the rating of the watertight seals.

### **Materials**

#### **Drive & Sensor Units**

Powder coated aluminum w/ anodized face plates

Delrin drive gear on 316 stainless shaft.

#### **Wheel Pulley**

Machined black nylon

316 Stainless fasteners

#### **Drive Belt**

Fiberglass reinforced neoprene