OPERATION MANUAL

- Operation
- Dockside Checkout
- Sea Trials
- Maintenance & Troubleshooting
- Specifications

MANUFACTURED AND SOLD DIRECT BY

CPT AUTOPILOT INC.

7960 B Soquel Drive, #114, Aptos, CA 95003 USA

www.cptautopilot.com email: info@cptautopilot.com

OPERATION OF THE CPT AUTOPILOT

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.

WARNING!

⚠ Always remember to maintain a proper look-out

⚠ 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.

⚠ Keep children and pets away from the autopilot belt

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.

Version: 29
Updated: November, 2024
Applies to autopilots manufactured after April, 2021
(Serial numbers 101193 and higher)

MANUFACTURED AND SOLD DIRECT BY

CPT AUTOPILOT INC.

7960 Soquel Drive, #B114, Aptos, CA 95003 USA
Website: www.cptautopilot.com
Email: info@cptautopilot.com

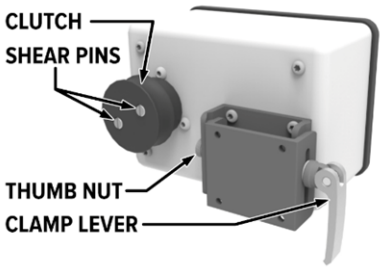
CPT Autopilot Operation

Turn power on with RUDDER control. Wait at least 1 minute for pilot to warm up before using.

To Steer with Autopilot:
Hold boat on desired heading 30 seconds. Engage Clutch.
Flip toggle-switch up to HOLD HEADING. Fine tune RUDDER and DEADBAND as needed.

To Hand Steer:
Flip toggle-switch down to STANDBY and Disengage Clutch

* In an emergency, the wheel can be forced to overpower the clutch and shear the shear-pins



Rudder: Sets autopilot Rudder Response
Determines proportionally how far to turn wheel for heading corrections.
High settings turn boat's rudder more; Low settings turn boat's rudder less
Turn to 5 at start, then increase or decrease as needed. Set as high as possible without causing over-steering

Deadband: Sets autopilot "Dead Range"
Determines sensitivity to vessel heading changes. Use to adjust for sea conditions.
Low settings hold boat to a tighter heading — Lowest setting allows approximately ±1° heading range
High settings allow the boat to steer within a wider heading range — Setting of "5" allows approximately ±10° heading range
Turn to minimum at start. Increase only after RUDDER control is set and autopilot is steering adequately

1°and 10° buttons: Push and release buttons to adjust heading; changes the autopilot target heading
Check boat headway and RUDDER/DEADBAND if boat is not responding (1° button response will not be immediately visible)

Tacking: Simultaneously hold down the 1° and 10° buttons for the direction you wish to tack. Keep both buttons pressed for five seconds. Release buttons to tack. Set DEADBAND low to keep the boat close to the new tack heading.

* Flip to Standby and disengage clutch if stuck in irons or no wind to prevent wheel hitting rudder-stops

Change Tack Angle: Hold both 10° PORT and 10° STARBOARD buttons down at the same time. Turn DEADBAND control to new tack angle and release buttons to set. Remember to return DEADBAND control to desired deadband setting afterwards.

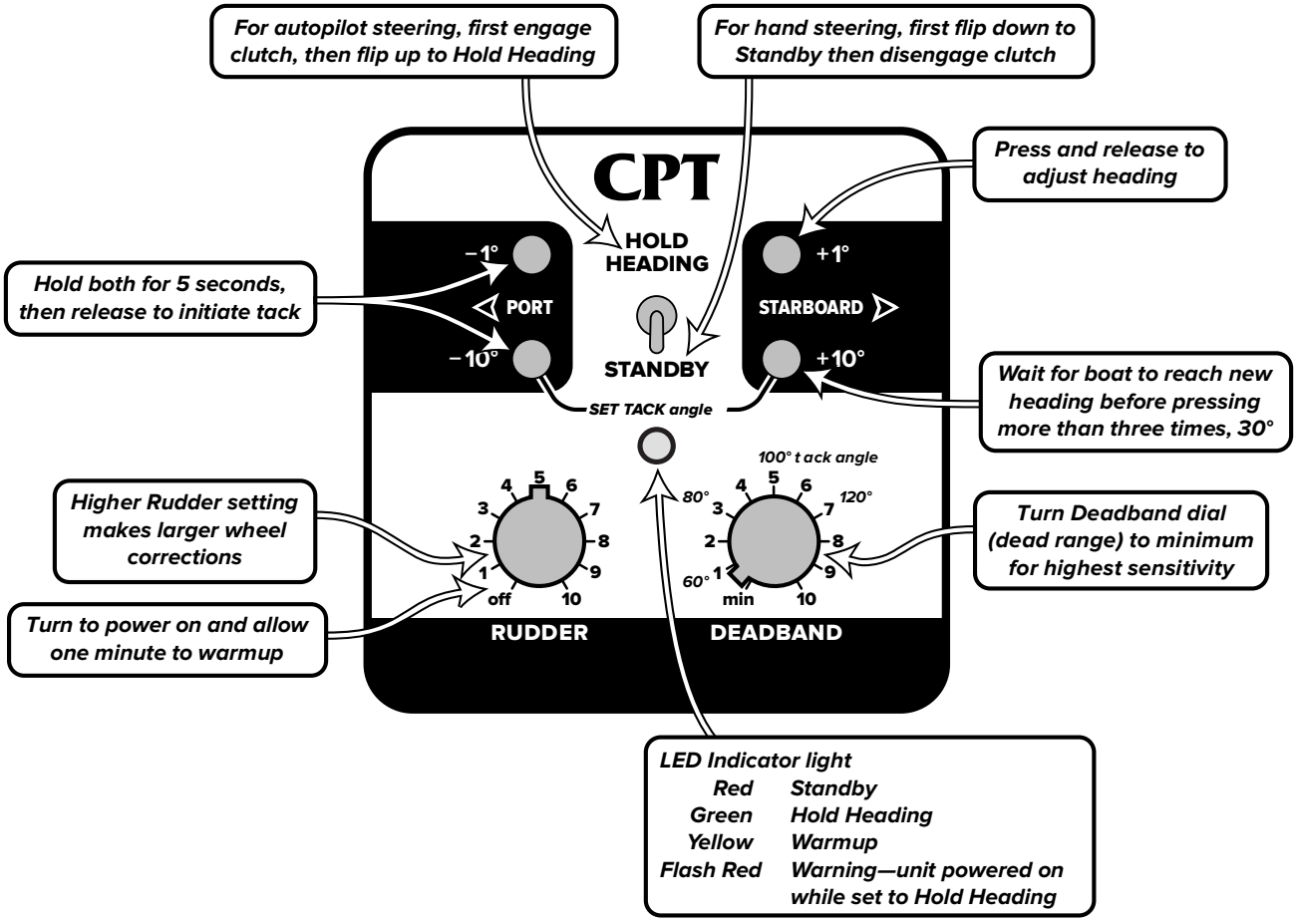


TABLE OF CONTENTS

OVERVIEW OF AUTOPILOT OPERATION

The RUDDER control and DEADBAND control must be set properly for the CPT to hold the boat on a heading. Tack angles are approximate and will vary from boat to boat based on the magnetic environment and deadband setting, you will have to see which angle works best for your boat.

Turning the Autopilot On and Off

Turn the autopilot ON by turning the RUDDER control clockwise from the OFF position past 1 to the desired setting (if unsure, set to 5). Turn the autopilot off by turning the RUDDER control counterclockwise to the OFF position. Do not use a circuit-breaker or external switch to power the unit ON or OFF: when starting the autopilot, first turn the circuit breaker or switch ON and then turn the RUDDER control ON (past 1).

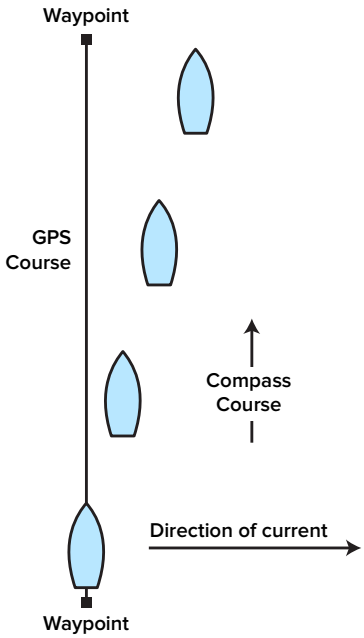
> ⚠ Be sure to remember to turn the CPT RUDDER control to OFF after getting into your berth or anchorage. It is easy to forget to turn the autopilot off during the activity of anchoring or berthing your vessel, dropping sails and putting the boat away after sailing. The CPT is very quiet, and will continue to operate after the clutch is disengaged.
>
> - If left in STANDBY mode the CPT will continue to draw current.
> - If left toggled to HOLD HEADING the CPT motor will continue running in an attempt to correct the boat's heading and you may not hear or observe it. The motor is quiet and will continue operating for weeks or months until you return to your boat.
>
> Always remember to turn the RUDDER control to OFF before leaving your vessel in its berth or anchorage.

Setting Rudder and Deadband controls

The RUDDER control should be set high enough so that when the boat falls off it is brought back to heading with just one or two "pulses" or wheel corrections. If the pilot makes repeated wheel corrections in one direction the RUDDER control is set too low; the setting needs to be raised. If the pilot oversteers, lower the setting a bit. High RUDDER settings provide larger rudder corrections, low RUDDER settings provide smaller rudder corrections. The boat must be balanced and respond to the rudder in a consistent manner: the RUDDER control sets the autopilot for one consistent response.

Start with the DEADBAND control (dead range) set to minimum, especially when first using the pilot. If the pilot is making port and starboard corrections too frequently, or reacting to swell, gradually raise the DEADBAND setting so that corrections are made when needed but are not constant. Low DEADBAND settings provides more sensitivity to heading changes, high DEADBAND settings provide less sensitivity when in swells and seas. A DEADBAND of 5 allows the boat to range approximately ±10° to port or starboard.

The CPT's performance can be improved by careful tuning but continously adjusting the controls is not necessary. Once you find the RUDDER and DEADBAND settings that work best for your boat, you'll use the same settings most of the time.



A Note About Magnetic Headings

The CPT keeps a vessel pointing to a magnetic heading; this is not the same as a GPS course. In keeping to a compass heading, your vessel will point the same direction but 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 easily keep the vessel on your waypoint course.

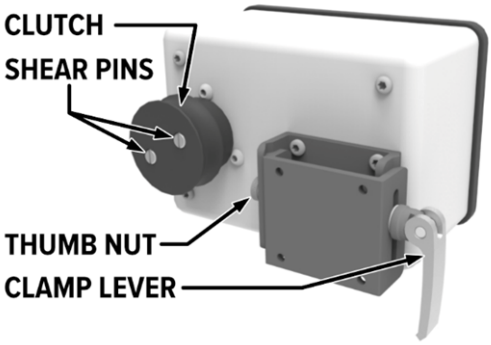
AUTOPILOT CONTROLS

Autopilot Steering

1. Disengage clutch, flip toggle to STANDBY. Turn power on with RUDDER control. Allow one minute to warmup.
2. Hold boat on heading for at least 30 seconds. Engage clutch. Flip toggle switch to HOLD HEADING**.**
3. Adjust RUDDER and DEADBAND controls to suit conditions

Hand Steering

1. Flip toggle switch to STANDBY.
2. Grip the wheel with one hand to relieve the pressure on the wheel. Disengage the clutch with the other hand.
   - Grasp the black disk on the clutch and pull outward ¼" to disengage the clutch



Hold Heading / Standby Toggle

After a 1 minute warm up, flipping the switch to HOLD HEADING sets the pilot to the boat's heading.

Hold the boat steady on desired heading about 30 seconds, engage clutch, then flip to HOLD HEADING. Keeping the boat on heading for a longer period before flipping to HOLD HEADING will allow the pilot to match your heading more closely.

When toggled to Standby, the pilot is on standby, and the motor will not turn. The clutch can now be disengaged for hand steering.

The indicator LED is yellow while the autopilot is warming up. After approximately one minute, the LED will change to red or green depending on the position of the toggle switch. Allow at least one minute for the pilot to warm-up before flipping to HOLD HEADING. The autopilot will still operate during the warmup period but the sensor heading may drift causing the autopilot to steer to the wrong heading.

The indicator LED will blink red if the autopilot is powered on while set to HOLD HEADING and autopilot will steer to the last known heading. The autopilot may steer the boat off course due to the sensor warming up. **If the autopilot is steering and the indicator LED begins blinking red, this indicates that power to the autopilot has been interrupted.**

1° and 10° Heading Adjustment Buttons

The pushbuttons allow you to alter the autopilot target heading in 1° and 10° increments. The heading is altered when the button is released. Pressing and releasing once alters the heading once, pressing and releasing twice alters the heading twice, etc. The DEADBAND setting determines how closely the autopilot holds the boat on the target heading. Due to differences between boats heading adjustments are not exact; check the ship's compass after settling on a new heading.

It is easy to lose track when pressing buttons multiple times, and you may overshoot the desired heading if the boat is slow to respond due to currents or conditions. In these cases, flip to STANDBY and then back to HOLD HEADING when the desired heading is reached or flip to STANDBY and steer to the new heading manually.

A NOTE ABOUT THE 1° BUTTON RESPONSE

When you release the 1° button, the target heading will change by one degree but you **will not** see an immediate motor response until the boat strays out of the deadband range. The tightest course-holding is when the DEADBAND is set to the lowest setting (min), which allows a "dead-range" of about 2°. At this setting when the bow of the boat strays more than about 1° port or starboard then the pilot may visibly respond to the 1° button; however, when the boat is within that range, there will be no immediate motor response to the 1° button.

Tacking

Tack angles are approximate and will vary from boat to boat based on the magnetic environment and rudder response. You will have to see which angle works best for your boat. In general, point as high as you can while keeping good boat speed before tacking. Set DEADBAND to lowest setting (MIN) for the most accurate tacking—this will keep the boat closest to the new heading after tacking.

Simultaneously hold down the 1° and 10° buttons for the direction you wish to tack. Keep both buttons pressed for five seconds. Release buttons to tack.

- Port Tack: Simultaneously press PORT 1° and 10° for five seconds and release.
- Starboard Tack: Simultaneously press STARBOARD 1° and 10° for five seconds and release

The RUDDER control must be set high enough and the boat must have adequate speed and rudder response for the tacking feature to work correctly. Keep an eye on boat response to avoid hitting the rudder stops; flip to STANDBY and hand steer if boat does not respond to the tack well or gets caught in irons. Making inadequate headway, pointing too high, or having unbalanced sails can cause the boat to lose speed and have poor response to the rudder—go to STANDBY and disengage the clutch to avoid hitting rudder-stops. If the boat is not tacking far enough, the tack angle can be increased; if tacking too far the tack angle can be decreased. Depending on the conditions and the boat's momentum, the boat may carry past the tack before correcting to the final heading.

Adjusting the Tack Angle

The autopilot comes manufactured with the TACK ANGLE set to 100°. The DEADBAND control shows TACK ANGLE settings from 60°-120° (the lighter colored numbers). Turn the DEADBAND control to the desired tack angle. Hold the 10° PORT and 10° STARBOARD buttons down simultaneously for two seconds then release them. Remember to return the DEADBAND control to desired deadband setting afterwards.

Rudder Control

The RUDDER control determines how far the pilot turns the wheel (and rudder) when a heading correction is needed. Low settings result in smaller wheel corrections, higher settings in larger wheel corrections. The corrections are proportional to the amount of heading change needed: If the boat is off-course by a small amount, the pilot will make a small correction. If the boat is off-course by a large amount, the pilot will make a large correction. **The ideal RUDDER setting is high enough to return the vessel to heading with just one or two corrections.**

The boat must be balanced for consistent steering and respond to the wheel consistently. The RUDDER control will not account for excessive play in a boat's steering system.

> ⓘ The RUDDER control also functions as the power switch for the autopilot: Turn the RUDDER control fully counter-clockwise (to OFF) to power off the autopilot; turn clockwise to power on the autopilot.

The RUDDER control is used to match the CPT's response to your boat's steering needs. Some vessels take many turns of the wheel to move the rudder, while others take only a few. The RUDDER control adjusts for this. Generally, full keel boats with more wheel turns lock-to-lock take a higher RUDDER setting. Lighter displacement boats with more responsive helms will need a lower RUDDER setting. Almost all boats require a RUDDER setting of 3 or higher.

- If the RUDDER control is set too high the pilot will turn the wheel too far and over-steer: lower the RUDDER setting.
- If the RUDDER control is too low, the autopilot will make many small repeated corrections in one direction that are too small. The boat may gradually fall off and the pilot will not keep the boat on heading. If the pilot is responding with many smaller repeated corrections in one direction, raise the RUDDER setting.

Either of these situations 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 lighter winds may have to be changed when winds increase.
- A boat may require a slightly higher RUDDER 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.
- Full Keel Boats: A full keel boat with 3-4 turns lock-to-lock will typically use a RUDDER setting of 5-6.
- Fin Keels and Spade Rudders: Response to the wheel may be more sensitive. The RUDDER setting will depend on the boat's response to the rudder, and you will need to see what setting works best. It may take more balancing and de-tuning to achieve steady steering and prevent the boat from reacting to every gust or slight condition change. With increased speed downwind, response to the rudder increases, and lowering the RUDDER setting slightly works well. If the boat is easily under-steered, over-steered, or has wheel play, the RUDDER setting may be a compromise between the two.

> ⚠ 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 stops.
> Avoid hitting the rudder stops; if it occurs a looser belt provides some give, and you will hear a warning thump as the belt jumps in its cogs. If the belt is over-tensioned or used with a tensioner there will not be much "give" in the system. The shear pins are designed to shear if the belt does not jump.

Deadband Control

The DEADBAND control determines how far the vessel can stray beyond the target heading before a correction is made. You may think of it as the autopilot "dead range". There is always some deadband range within which the pilot does not activate. If this deadband is small, 1°-2° for instance, the pilot motor will continuously run, making port and starboard corrections. In a seaway a vessel will yaw back and forth as it makes its way over the waves, but generally it will have enough directional stability to keep a good average heading. The deadband adjustment permits the boat to work its way through the waves without continuously using the rudder to try to fight the natural weaving and motion of the hull.

- Start out with the DEADBAND set to minimum when first using the CPT. Turning the control clockwise increases the DEADBAND.
- Most boats steer well at settings of 2-3 in swells, with lower settings in flat water.
- On long passages, turning the DEADBAND and RUDDER controls a bit higher can reduce battery use while still providing a good average course.
- A DEADBAND of "5" will allow the boat to range about 10° to port or starboard of the target heading; the pilot will make a correction if the boat strays more than 10° to port or starboard.

> ⓘ When the boat's heading is within the deadband range, small heading adjustments made with the 1° button will change the autopilot target heading but will not have visible effect until the boat's heading is outside the deadband range. The lowest DEADBAND setting allows the boat to range about 1° to port and starboard of the autopilot target heading, depending on the boat's response to the rudder.

Rhythmic CPT steering corrections, in time with the roll of the boat, indicate that the DEADBAND may be too low. Increase DEADBAND slightly to avoid constant correction. A low DEADBAND does not always mean that the boat will maintain a straighter course: the pilot may oversteer if the RUDDER setting is too high. In rougher seas, the DEADBAND can be set higher to avoid constant corrections. A lower DEADBAND setting is generally beneficial when sailing downwind or in flat water. Lower DEADBAND settings mean higher sensitivity to heading changes; higher DEADBAND settings mean lower sensitivity to heading changes.

Most of the CPT's steering action should be periodic corrections. Raise the DEADBAND a bit to avoid excessive battery drain and wear on the CPT.

Control Summary

The RUDDER control determines how far the autopilot turns the wheel when heading corrections are needed.

The DEADBAND control determines when a heading correction is needed—sensitivity to heading changes and seas or "dead range". The autopilot will attempt to hold the tightest course when the DEADBAND is set to the minimum.

Changing the Motor Rotation

The motor rotation is preset at the time of manufacture for your installation but can be easily changed and re-set.

Standard Rotation: Drive Pulley Facing Forward

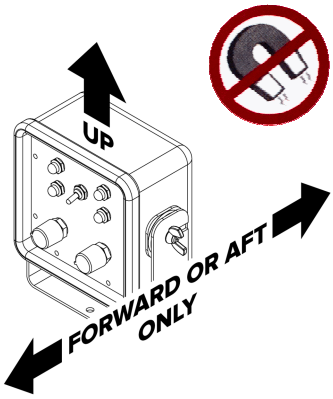
1. Turn the CPT OFF (turn the RUDDER control fully counterclockwise). While off, push and hold the STARBOARD 1° and 10° buttons and the PORT 10° button; hold all three buttons down at the same time.
2. Turn the pilot on while holding the three buttons down.
3. Release the buttons after five seconds.
4. If successful, the LED on the control box will blink red eight times.

Reverse Rotation: Drive Pulley Facing Aft

1. Turn the CPT OFF (turn the RUDDER control fully counterclockwise). While off, push and hold the PORT 1° and 10° buttons and the STARBOARD 10° button; hold all three buttons down at the same time.
2. Turn the pilot on while holding the three buttons down.
3. Release the buttons after five seconds.
4. If successful, the LED on the control box will blink red eight times.

Control Box Orientation Restrictions

The control box must be oriented level and facing either the bow or the stern of the boat. The cable exits the bottom side of the box. If the control box does not face the bow or stern, the autopilot heading will be affected by the boat pitching and heeling.



SAIL TRIM

Even the best autopilot can be crippled by poor boat trim, and the RUDDER and DEADBAND settings affect how accurately the boat holds the heading.

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

This means that through the skipper's selection of sails, trim and heading, the boat should tend to maintain a stable course without a significant amount of weather or lee helm. Reef and trim or head-off when wind and sea conditions increase. The RUDDER control manually sets the rudder response for one consistent response, the autopilot will not automatically adjust for changing conditions. The CPT is not recommended for racing.

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 and rudder efficiency.

> ⚠ 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, change heading or speed, reduce canvas, or put a competent helmsman at the wheel.

Because of the manual RUDDER and DEADBAND controls, the CPT performs best when the boat is balanced for consistent steering needs. If the wheel needs to be turned very little while going down the face of a swell, but then turned wildly at the bottom or in gusts, the boat is not balanced for the conditions, and the pilot will not anticipate the constantly changing steering needs.

Boat Balance

A balanced boat has very little or no helm, either weather or lee. A boat that is 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.

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 others with too much canvas spread, 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 the steering with every gust, to keep the steering needs consistent.

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 setting; higher speeds require a lower setting. Get to know your vessel's characteristics; there is usually an optimum vessel speed, course through seas, and amount of canvas that best balances the boat to meet the wind and sea conditions.

Reaching

Twin poled-out jibs or a main and a poled-out jib can be used up to 30° to 40° 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 a 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.

APPENDIX

Dockside Checkout

The direction of the autopilot motor rotation has been preset for your type of installation. 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

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. At the same time, inspect the system for chafing, frayed cables, or binding. Grease as appropriate.

Hydraulic systems must be free of trapped air, use the proper fluid, and cannot have excessive wear or leakage past the piston seals. Air bubbles, foaming, or leakage must be corrected if the CPT is to operate correctly. Excessive valve delay in some systems may be inherent in the design.

B. Performing the Dockside Checkout

1. Install the belt on both pulleys. Disengage clutch and center the boat's rudder. (Pull out on drive pulley).
2. Flip toggle switch to STANDBY on Control Box.
3. Check that 10-amp fuse or circuit-breaker is in place in the red-wire 12-volt (+) line and power is available to the CPT. The 12-volt supply wires to the autopilot should be a minimum of 14 AWG (2.5 mm^2).
4. For testing, turn the RUDDER control on and set it to '5'. Turn DEADBAND control to '1'. Allow a minimum of 60 seconds for the autopilot to warm up.
5. Engage clutch. Toggle to HOLD HEADING.

   The pilot should not respond very much and will make small wheel corrections about every 10 seconds. If corrections are made every second either inadequate warm-up time was allowed or there is magnetic interference in the mounting location; do not attempt sea trial until corrected.
6. Push the 10° PORT button once. The wheel should turn briefly to port, stop, and then begin short rotations to port about once per second. Push the 10° STARBOARD button once, and the wheel should turn back to starboard and stop. Toggle the control box back to STANDBY. If the autopilot responds differently without a smooth return to starboard, inadequate warm-up time was allowed or there is magnetic interference in the mounting location.

   *After a short time, the pilot will eventually make a small periodic correction about every 10 seconds—this is normal because the boat is not moving. Do not let the wheel turn so much that the rudder-stops are reached. Do not leave it unattended. **To stop the wheel from turning: TOGGLE TO STANDBY AND DISENGAGE CLUTCH, or TURN PILOT OFF.**

   If the wheel is turning the wrong direction when you push the 10° button, you can reverse the wheel direction by following the directions for Changing the Motor Rotation on page 7.

   If the wheel does not turn at all, check that the clutch is engaged, RUDDER at least '4', DEADBAND at '1', and red power wire connected to +12V. If the power wires are connected wrong, there will be no response from the controls and the pilot will not operate.

   When left on HOLD HEADING, it is normal for the pilot to make a small correction about every 10 seconds. More frequent corrections (once per second) usually indicate that the pilot was not allowed adequate warm-up time, the boat's heading is changing slightly, or there is magnetic interference near the control box.
7. Toggle to STANDBY. Turn the RUDDER control to OFF to turn off pilot. Disengage clutch by pulling outward on the clutch.

Warning: If left in HOLD-HEADING mode, the autopilot motor will continue to turn. Do not leave the autopilot unattended Always flip to STANDBY or turn autopilot OFF. Do not allow the wheel to rotate to its stops.

THIS COMPLETES THE DOCKSIDE CHECKOUT

Keeping Watch

The CPT Autopilot 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.

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

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.

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, clutch disengaged.

   Flip the toggle to STANDBY, RUDDER to 5, DEADBAND to lowest setting, allow 60 second warm-up.

   Steer the boat on a steady heading for 30 seconds, engage the clutch, toggle to HOLD HEADING. (You may have to turn the wheel slightly to engage the clutch.)

   The autopilot should make corrections to port and starboard to keep the boat on a straight heading. Do not use the 1° or 10° buttons during this initial test.

   The RUDDER control must be set high enough so that only one or two pulses or wheel corrections are needed to keep the boat on heading. If over-steering occurs with a RUDDER control of 5, slightly lower the setting, usually no lower than 4. If under-steering (3 or more small, repeated wheel corrections), raise the RUDDER control.

   Keep the DEADBAND control set low until you find the best rudder setting and only increase the deadband to reduce the pilot's sensitivity in seas; a low deadband setting provides high sensitivity to heading changes and heading adjustments from the 1° and 10° buttons.

3. **RUDDER/DEADBAND**: These must be set properly for the pilot to steer. The **RUDDER control** determines how much the vessel's rudder needs to turn to make a correction, the **DEADBAND control** determines how far the vessel can stray before a correction is made (dead range). Do not use the 1° or 10° buttons until the RUDDER and DEADBAND controls are properly set.

   * **RUDDER control too low**: If the CPT makes **repeated small corrections** in one direction, raise the RUDDER setting. The wheel will not turn enough to keep heading, and the boat may gradually fall off. Increase the RUDDER setting until the boat responds to both port and starboard heading changes **with only one or two corrections or pulses.**

   * **RUDDER control too high**: If the CPT steers too far to port and then too far to starboard, lower the RUDDER setting. If the wheel turns too far when the CPT makes corrections, the boat will over-steer; lower RUDDER just enough to prevent over steering. Set the RUDDER control as high as possible, but not so high that it over steers.

   (If the boat falls too far off while adjusting the rudder setting, toggle to STANDBY, disengage the clutch and return the vessel on heading before trying again**.)**

   * **DEADBAND control too low**: If the motor runs continuously back and forth, to port and then to starboard too frequently, or with each swell, **Raise the DEADBAND**. Gradually increase the DEADBAND setting so that corrections are made when needed but not constantly. This will reduce motor operation and the vessel will still maintain a good average heading. Gradually lower the DEADBAND setting if the CPT waits too long to make corrections.

Push the 10° PORT or STARBOARD button once. 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 back, lower the RUDDER setting and try again. If it approaches the new heading with a major correction and then additional smaller 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.

4. For the CPT to steer, the boat must make adequate speed and headway. At very slow speed in the water, when pointing too high, in irons, drifting, or when the wind dies, the boat's rudder will be ineffective. The boat will not respond to any autopilot corrections and the wheel will eventually hit the rudder stops. Disengage the CPT until you are making adequate headway.

5. The CPT will accept heading changes by pressing the 10° or 1° buttons. Push the 10° button two times for 20°, three times for 30°, etc. Due to differences between boats, heading adjustments are not exact; check your ship's compass after settling on the new heading. Adjust in increments until you are on the ship's compass heading you require. Rather than pressing buttons repeatedly and over-shooting the heading it is usually best to wait and allow the boat time to respond. The boat may be slow to respond due to wind, sail imbalance or sea conditions. You can also toggle to STANDBY and then back to HOLD HEADING to avoid over-shooting a heading, or simply go to STANDBY and hand steer to make major heading changes.

6. Tacking
   Tack angles are approximate and will vary from boat to boat based on the magnetic environment and rudder response. You will have to see which angle works best for your boat. In general, point as high as you can while keeping good boat speed before tacking. Set DEADBAND low to keep the boat close to the new tack heading.
   - Simultaneously hold down the 1° and 10° buttons for the direction you wish to tack. Keep both buttons pressed for five seconds.
   - Release buttons to tack.

   The pilot will make the turn until the new heading is reached. Be sure the boat is making the tack with adequate headway; disengage if the boat stalls or gets stuck in irons to avoid hitting rudder stops. Depending on the conditions and the boat's momentum, the boat may carry slightly past the tack before correcting to the final heading.

   The autopilot comes preset with the TACK ANGLE set to 100°. To change, see "Adjusting the Tack Angle" on page 6.

THIS COMPLETES THE SEA TRIALS

Maintenance and Adjustments

General Maintenance and Storage

After use, rinse salt off; lightly spray with fresh water and lightly wipe the CPT down with a cloth and dry it. Do not use alcohol or solvents to clean the motor box or control box as they may remove the paint and graphics. 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. Each season apply a light coat of marine or automotive wax to the boxes to maintain the powder coated finish.

- Do not store the autopilot in a damp locker, or a location subject to flooding or damp conditions.
- Store control box and motor boxes on their sides, with the controls and clutch facing sideways, not facing up/down to prevent moisture collecting.
- Do not store the control box near anything magnetic—store 18" away from the autopilot motor.

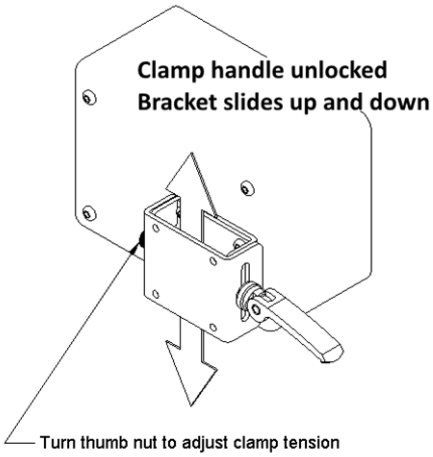
Control Box Buttons

The silicone rubber seals on the control box buttons and toggle switch are impervious to UV light and saltwater, however they are susceptible to physical damage from sharp objects and hard abrasion. Periodically inspect them for damage. If the seals show signs of damage, they should be replaced to prevent corrosion and water damage to the switches. New seals can be ordered from CPT Autopilot, or the control box may be shipped back to us for service.

Belt Tension

Unlock the clamp lever and slide the motor unit down on its mounting bracket slots with your hands to tension the belt. Pull the belt snug by putting downward pressure on the motor box with your hand and then locking the clamp lever. The clamp lever tightness can be adjusted by unlocking the lever and tightening or loosening the knurled thumb nut.

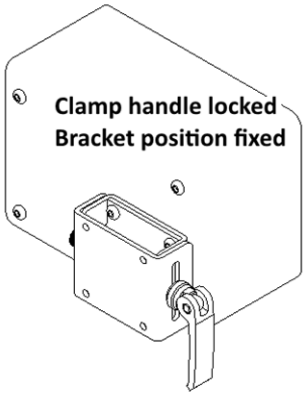
Do not over-tension the belt. Excessive tension causes clutch wear, makes the clutch difficult to operate and may damage the motor shaft. Over-tensioning also removes any beneficial "give" in the drive system. If the belt does not slip underway then it is tight enough. **An over-tightened belt will not allow any give**; a less tensioned belt will give warning of heavy loads or striking the rudder-stops with a skip and thump.



NOTES FOR PEDESTAL MOUNTED INSTALLATIONS

The hose-clamps on the pedestal bracket may need to be re-tightened after the foam padding compresses.

The pedestal bracket may need to be fastened directly to the pedestal with screws if the hose-clamps slip under heavier loads. This is especially the case with Reverse Vertical Pedestal Mounts due to the extra leverage.



Drive Pulley and Clutch Maintenance

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

Most clutch wear is caused when hand-steering under high belt tension without lubrication. Lubricate the drive pulley and shaft periodically. Salt water may leave salt crystal build-up in the detent. The drive pulley should be periodically removed from the drive plate and cleaned and greased—more often in severe or heavy use conditions.

If the autopilot will not be steering for a while, remove the belt from the drive pulley and hang it over the binnacle or wheel shaft. This will lessen wear and prolong the life of the clutch when hand steering.

Each season service and lubricate the clutch. You should not remove the drive plate unless the broken head of a shear-pin is stuck behind the drive plate.

1. Loosen tension on the drive belt and remove belt from the drive pulley.
2. Remove the two screws from the back of pulley cap; these are the shear pins. (The black disc used to engage and disengage the clutch is the pulley cap.) **Do not attempt to remove the shear-pins if the pin ends are bent. Reach and straighten them first using long-nosed pliers.**
3. Remove pulley cap.
4. Remove stainless steel retaining ring from its groove at the end of the shaft.
5. Remove drive pulley.
6. Rinse pulley in fresh water. Work the ball inside the shaft-hole in and out.
7. Clean, dry, and lubricate the shaft. Work lubrication into the ball inside the shaft-hole.
8. Replace drive pulley, retaining ring, and pulley cap.
9. Replace the two shear pins. Do not over-tighten: threads can strip or the drive pulley may distort causing stiff operation. Rotate the pulley on the shaft and observe the pin ends of the shear pins.

Shear Pin Clearance Adjustment

There should be an even gap of about $\frac{1}{16}$" (5mm) between the end of the shear pins and stainless steel drive plate. If one of the pins is too close to shaft-plate, it may tend to catch in the plate holes when the wheel is turned. If the pulley does not turn freely, the pins are not even, or the pins are too close to the shaft-plate: back off one or both screws slightly.

Detent Adjustment

If the clutch does not stay engaged the detent may need adjustment. Never overtighten the detent—the detent housing can mar the drive shaft if screwed all the way in. There is a slotted set-screw in the gear teeth to adjust the ball spring detent.

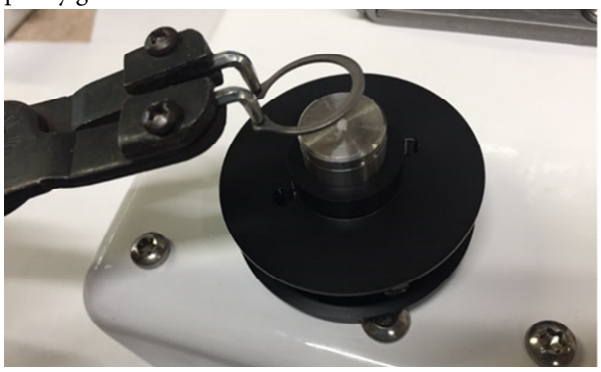
1. Carefully tighten or loosen the detent screw about ⅛ turn.
2. Test the operation of the clutch.
   - The clutch gear should stay engaged. If the detent is too loose, the clutch may inadvertently disengage
   - When disengaged clutch gear should spin freely without friction on the detent ball

Drive Plate Removal Instructions

The Drive Plate does not need to be removed as part of normal maintenance. It may need to be removed if a broken shear pin head becomes trapped behind it. (If you hear a screeching or scraping sound, this may be the cause.)

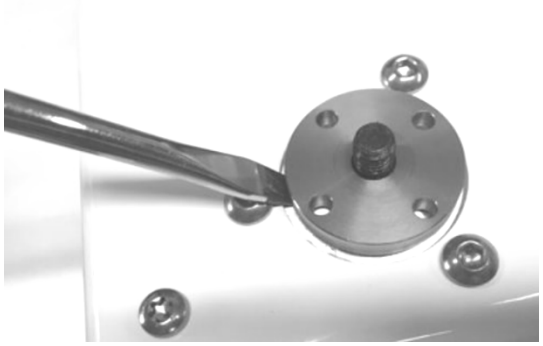
1. Make sure the ends of the two shear pins are not bent, then remove them from the back of the clutch by unscrewing.

2. Remove the retaining ring, then remove the drive pulley gear from the drive shaft.



3. Remove the drive shaft. There is a hole in the shaft. To remove the drive shaft, insert a screw-driver (3⁄16" or 4.75mm diameter rod) and unscrew the stainless shaft from the motor shaft. It has normal threads—rotate the shaft counter-clockwise to loosen.

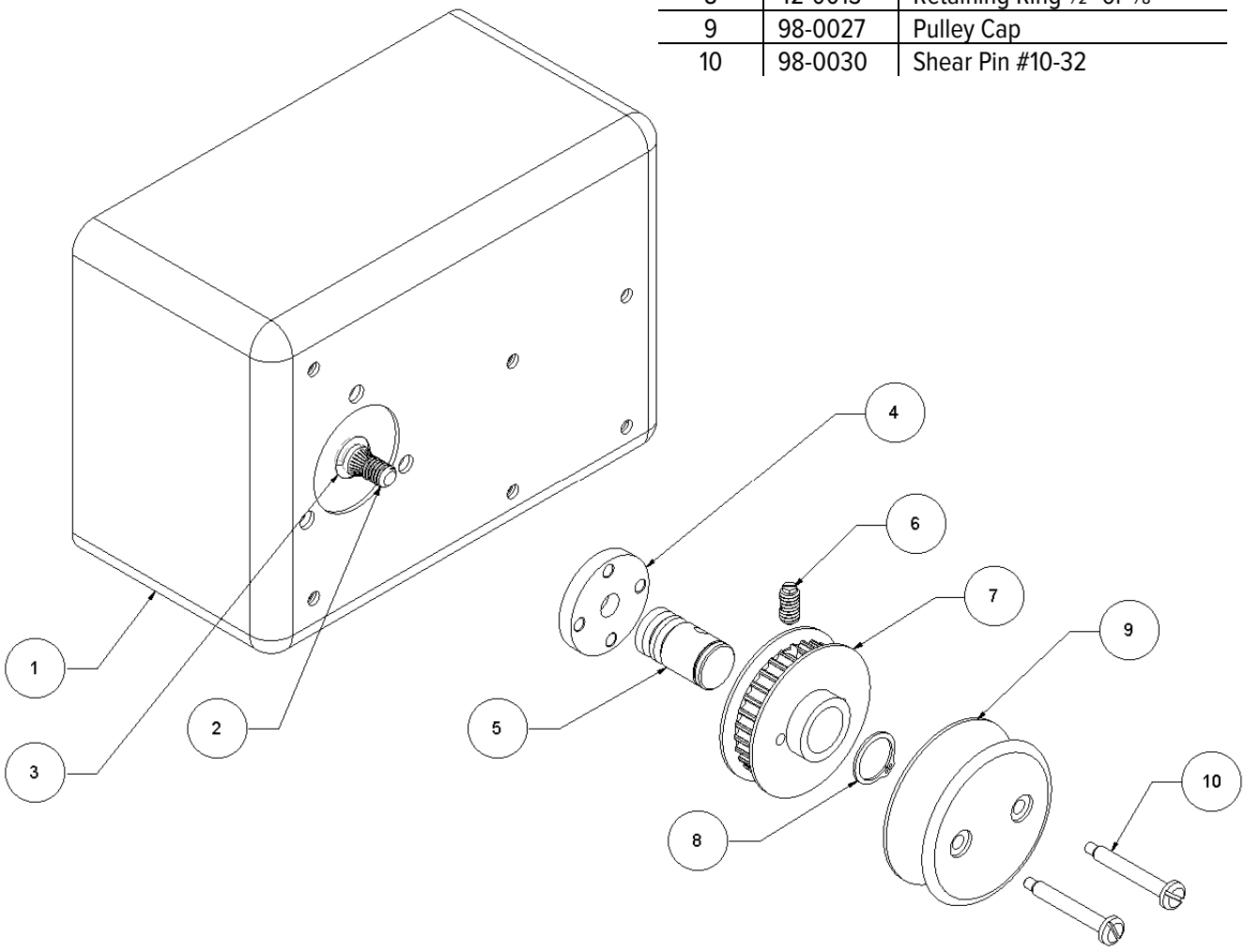
4. Gently pry the circular plate off the knurled motor shaft; gently pry all around the plate, force is not needed. Avoid prying against the aluminum box—use one of the bolt heads instead (as shown in photo). Do not remove or lose the black rubber O-ring found under the plate (size 110)—this is the watertight motor shaft seal.



5. Clean the drive plate, shaft, and hub of the drive pulley gear. Oil or grease the parts before reassembly. Be sure to work some oil into the detent ball that protrudes into the hole of the drive pulley gear.
6. Reassemble clutch. Adjust belt tension.

Clutch Assembly Diagram

Item #	Part #	Part Name
1		Motor Box
2		Motor Shaft
3	37-0004	Motor Shaft O-Ring, size 110
4	53-0009	Drive Plate
5	53-0012	Drive Shaft ½" or ⅝"
6	98-0039	Ball Spring Detent ¼"-20
7	53-0007	Drive Pulley Gear
8	42-0013	Retaining Ring ½" or ⅝"
9	98-0027	Pulley Cap
10	98-0030	Shear Pin #10-32



Connector Maintenance

Connectors for the power cable and control cable, if installed, should be maintained by applying silicone dielectric grease to both plug and socket contacts each season. Caps should be in place and tight if plugs are not fitted together. Connectors are a liability if not maintained and kept greased. The cable jacket should be kept sealed and not open or exposed. **Do not use corrosion inhibitor, Boeshield T-9 or similar lubricants on electrical contacts. They can leave an insulating film which inhibits electrical connections and is difficult to remove.**

> ⚠ No cables are detachable from their boxes. The black cable fittings on the control box and motor box are not plugs—do not loosen them. Attempting to remove them will void the warranty and may cause damage. The control box cable wires and power cable wires attach directly to circuit boards inside their respective box.

> ⓘ An extension cable is available to easily extend the length of the control cable without cutting the cable. Do not cut or splice the control cable: the original factory control cable with its connectors is required for factory servicing if ever required.

Wheel Pulley

After a season or two, check to make sure the wheel pulley is still centered on the steering wheel and adjust if needed**. Do not over-tighten J-bolts or the pulley will warp and distort over time. Tighten each J-bolt until it makes contact and grips the spoke, then tighten the nut only another ¼ turn.**

Factory Service

It is recommended that the autopilot be returned for service to have the watertight seals replaced every 5 years depending on weather exposure and amount of use. This is also worthwhile if it has been used for many years and you are planning an extensive passage. There is a nominal charge, but if the seals become worn or brittle and salt water enters the unit, repairs may be extensive. The motor box and control box should be securely bubble-wrapped with ½" bubble-wrap, then separated by cardboard and boxed, and boxed again with 1" of peanuts when shipping.

Troubleshooting

Specialized equipment is required to service the CPT; there is no internal fuse or other internal parts that are owner serviceable. For satisfactory and warranted repairs, repairs should be done only by the manufacturer.

UNAUTHORIZED REPAIR ATTEMPTS VOID THE WARRANTY REGARDLESS OF CIRCUMSTANCE

Light on Control Box Unlit

When the autopilot is turned on (RUDDER control turned to 5), the light on the control box will turn orange and then after 60 seconds turn red. If the light is unlit, the autopilot is not getting power. Make sure the red wire is connected to 12 volts positive and the black wire is connected to battery negative. If you have poor wiring, bad connections, or small gauge wires the voltage may read 12 volts but there will not be enough current for the motor to operate. In these cases, a voltmeter will usually show the voltage dropping when the motor attempts to run.

Light on Control Box Flashes Red During Normal Operation

This indicates power was interrupted to the autopilot while it was set to HOLD HEADING. This will also happen if the autopilot is turned on while the HOLD HEADING toggle switch is engaged. If this occurs during operation, check the autopilot power connection.

Motor Does Not Turn, Control Box Light is Green

The autopilot may be receiving enough power for the electronics to run but not enough to power the motor. Check the power connection.

Check the electrical connection by testing for motor torque and voltage drop: With the belt off and clutch engaged, set the RUDDER control to 10 and push a 10° button. Grip the clutch disk with your hand: the motor should show good torque and be difficult to slow. If the clutch is easily stopped there may be voltage drop and the pilot will not operate properly. When testing the connection, the supply voltage level must be measured when the motor is running.

Does Not Turn Wheel in Either Direction

Be sure shear pins are not damaged and that clutch is engaged.

Test that the autopilot has a good 12-volt power connection, with no oxidized connections. Check battery voltage (12 volts minimum), check the voltage at the power cable connection when the pilot motor runs or would normally attempt to run (turn RUDDER to 10 and set to TACK). A large voltage drop when the motor attempts to run indicates poor 12-volt connections and/or inadequate wire size. Trace the power circuit back to 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. The autopilot will compensate for voltage drop by drawing more current.

With the belt off and clutch engaged, turn the RUDDER control to 10 and TACK to port or starboard; if you grip the small clutch disk with your hand, you should feel good torque and not be able to stop the motor.

Motor: Engage the clutch after 1 minute warm-up, set RUDDER 5, DEADBAND 1, toggle to HOLD HEADING and press a 10° button: the autopilot motor should rotate to make a heading correction. If there is no response, try back-driving the motor briefly by turning the boat's wheel by hand; if this brings a response from the motor, it may be a sign of worn brushes or carbon build-up in the motor after seasonal storage. Back-driving the motor by hand may clear carbon build-up and restore brush contact.

Motor Turns the Wheel the Wrong Direction

The direction the motor rotates must be set for the wheel to turn the correct direction; it has been preset for your installation at the time of manufacture. See Changing the Motor Rotation on page 7.

Motor Runs but Drive Pulley Does Not Rotate

Check that shear screws are not broken or bent. See diagram on page 15 .

The motor will also turn very slow/weak if there is too much voltage drop in power wires.

Motor Turns One Direction Only

First check that the motor turns one direction only and never turns the opposite direction:

- Remove the belt from the drive pulley and engage the clutch so that you can see which direction the autopilot turns without the wheel hitting the stops.

- Hold the control box upright in hands, away from anything magnetic, about chest high. Set RUDDER to 5, DEADBAND to MIN.
- Toggle to HOLD HEADING.
- Turn the control box to starboard and observe drive pulley rotation. Turn the control box to port and pulley should rotate in opposite direction. Turn the control box as far as necessary to initiate a rotation.

If the motor truly turns one direction only, the problem may be a bad connection between the control box and motor box. Check the pins on the connector in the cable (control cable). There are 6 pins. If a pin is bent, the signal will not get through—carefully bend the pin straight with a small flathead/slot screwdriver. This may also be caused by corrosion inside the connector. Note that the connector pins were coated with dielectric grease when the autopilot was manufactured to prevent corrosion. If the problem is not in the connector there may be an internal problem and the autopilot may need to be returned for service.

Unit Will Steer/Turn in Only One Direction

Try turning the pilot off and restarting.

Be sure there is no magnetic interference.

During the warm-up period the sensor heading may drift. Allow one minute for warm-up after powering on. Keep the vessel on a consistent heading for 30 seconds before flipping to HOLD HEADING. If the pilot is toggled to HOLD HEADING without adequate warm-up time, it may turn and pulse frequently (once per second) in the same direction. At the dock, while the boat is stationary and unresponsive to the rudder, a small autopilot correction every 10 seconds is normal.

Continual turning one direction once per second while sailing or if the pilot steers on some headings but not others may be a sign of magnetic interference near the control box.

Under Steers, Boat Does Not Reach Heading or Does So Slowly, Eventually Falling Off-Heading

Small, repeated heading corrections in one direction indicate the RUDDER is too low—increase; set RUDDER as high as possible without over-steering. This may also indicate that the DEADBAND is too high—lower the DEADBAND. Make sure the boat is making adequate headway, set DEADBAND to the lowest setting and set RUDDER high enough so that one motor-pulse brings the boat back to the rhumb-line. Some spade rudders on racing-type hulls are easily understeered or oversteered, and the best RUDDER setting may be a compromise between the two.

Over steers, Passes Course, "S" Turns

RUDDER control set too high—use lower setting. DEADBAND may be too low—increase the setting.

Rhythmic Steering, Corrects as Boat Rolls with Swells

DEADBAND set too low—increase setting.

Frequent Corrections to Port/Starboard, Rudder and Deadband Controls Ineffective: Wheel Play

This is typically from too much play in the steering system, or air bubbles, foaming or valve delay in hydraulic systems. The boat's rudder will not center, and play will alternate between port and starboard sides. The pilot tends to only hold heading within 10°-20° or more, understeering on one side, oversteering on the other, and the best RUDDER setting will be a compromise between the oversteering and understeering. Adjusting the RUDDER and DEADBAND may seem to have little effect. To check for play in the steering system:

1. While having someone holding and locking the rudder quadrant to one side, measure how far the wheel turns.
2. Place 18" (450 mm) of tape on the outer rim of the wheel, centered at the top of the wheel, top-dead-center (TDC).
3. Slowly rotate the wheel to starboard until it will not turn further: mark the tape TDC.
4. Slowly rotate the wheel to port until it will not turn further: make a mark on the tape TDC.
5. Measure the distance between the two lines: _____ Circumference of Wheel:_____
6. Divide the circumference of your wheel by 360; the result is the distance for 1° of wheel play. Poor performance may occur if wheel play is more than 25°. Wheel play in hydraulic systems can be harder to measure and may only occur under heavier loads or intermittently, depending on the cause.

Belt Slips, Belt adjustment, Excess Torque

- The belt should be snug, but over-tensioning is unnecessary and will make it hard to operate the clutch. Increase the tension if the belt jumps in the cogs under load: unclamp the lever, push down on the motor box and re-clamp.
- The boat must be balanced to reduce weather-helm and provide consistent steering (See "Sail Trim" on page 8).
- Check the steering system for binding, bad control cable leads, damage, or lack of lubrication. Correct as necessary.
- Make sure the wheel pulley is centered on the wheel, and that the belt is aligned.
- Make sure hose-clamps and bracket are tight and have not slipped on pedestal. For pedestal diameters under 4", heavy loads, or reverse pedestal mounts: the pedestal bracket may need to be screwed directly to the pedestal.
- If heavy loads cause the mounting to flex causing the belt to slip, a belt tensioner may be used to prevent the belt from slipping.

> ⚠ Use of a belt tensioner will increase belt wear. In normal use without a tensioner the belt will periodically jump in the cogs to release sudden shock loads from the rudder (such as in cross seas). When using the tensioner in heavy seas there will be no release for rudder shock loads and the belt or shear pins are more likely to break.

Clutch Disengages

Motor unit may be 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 set-screw recessed into the drive pulley-gear adjusts the friction of the ball bearing detente 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 it has worked loose or there has been extensive wear. Use a small bit of thread locker if the screw has worked loose.

Shear Pin Breakage

> ⚠ The shear pins are a consumable wear-and-tear item and not a warranty issue. It is normal for the shear pins to get stressed and weakened, and then eventually break unexpectedly in mild conditions.

- Be sure all excess friction and play is removed from the steering system. A steering linkage with excessive play can transfer sudden shock loads from the rudder directly to the shear pins.
- Be sure the wheel pulley is centered on the steering wheel ±⅛" (3mm).
- A worn drive gear with excessive hub wear will no longer rotate on center and be wobbly, transferring belt tension to the shear pins instead of the hub and shortening shear pin life; contact us for a replacement drive gear. To prolong the life of the clutch and shear pins when hand steering, loosen tension or remove the belt from the drive gear and hang the belt over the binnacle or wheel shaft.
- Clean and lubricate the clutch on a regular basis.

Common Causes of Shear Pin Failure

1. Using a belt tensioner
2. Using the autopilot as a wheel brake
3. Engaging or disengaging clutch under load
4. Shear pins catching while hand steering
5. A broken shear pin head in a drive plate hole preventing the clutch from fully engaging after new shear pins installed

Belt Tensioners

A very common cause of shear pin breakage is from using a belt tensioner (which does not allow the belt to slip under rudder shock loads) or from engaging/disengaging the clutch while the wheel is turning or under load. It is best to relieve the wheel from any load by holding it with one hand while engaging or disengaging the clutch with the other.

In heavy weather, the belt must be allowed to periodically slip when there are shock loads from the rudder, especially when the stern gets tossed by seas. This provides a release from rudder shock loads that will otherwise stress and break shear pins, belts, and eventually damage the motor.

When the belt tensioner is used to stop the belt from slipping, the belt will often not slip at all and rudder shock loads transfer directly to the shear pins, the belt, and the motor, resulting in broken shear pins and belts. The shear pins are designed to shear by forcing the wheel when emergencies occur and to protect the motor from shock loads.

Our recommendation is to avoid using the belt tensioner and allow the belt to periodically slip under heavier wheel loads; it does not hurt the belts. Belt tensioners are usually used for installations where there is no other choice due to a short belt or mountings that flex. When they are used the shear pins and belt can be expected to wear faster.

Engaging/Disengaging Clutch Under Load

Engaging/disengaging the clutch while the wheel is turning or under load will put more force on the shear pins and weaken them. It is best to relieve the wheel from any load by holding it with one hand while engaging or disengaging the clutch with the other.

Autopilot Used as Wheel Brake

Sometimes people will keep the clutch engaged to use the CPT as a wheel brake at anchor, rather than use the actual wheel brake. Grabbing the wheel when getting off a cockpit seat will stress and weaken shear pins.

> ⚠ Do not use the autopilot as a wheel brake! This will cause the shear pins to wear and break prematurely.

Shear pins catching while hand steering

If the clutch is not fully disengaged, the shear pin ends can catch in the holes when hand steering. In some cases, a loose detent (ball spring detent) in the clutch will not keep the clutch firmly disengaged. The detent can be carefully adjusted–refer to the manual or contact us for instructions.

Broken pin ends causing problems

The broken head of the old pin may remain in the drive plate hole and cause problems when the new pins are installed. When the clutch is engaged, it will not engage all the way and the pin will break sooner. The old pin head will also get pushed through the drive plate and get caught behind. When replacing shear pins, make certain the old pin ends are not in the drive plate. You may have to remove the clutch and drive plate to check—see the diagram on page 15. If you hear a grinding, scraping, or screeching noise, a pin end is likely caught behind the drive plate.

> Temporary Emergency Fix for Broken Shear Pins
>
> In an emergency while on a passage it is possible to temporarily re-use a bent shear pin or file broken pins to fit. If the pin end is bent, carefully straighten it with a pliers.
>
> If the shear pin ends are broken:
>
> 1. File the ends by hand to fit into the holes of the drive plate
> 2. Install the pins into the drive gear without the black pulley cap.
>
> The shear pins will stick out from the drive gear, and the clutch may be a little more difficult to operate without the pulley cap, but it will get you through the passage. Just realize that the filed pins will not shear in an emergency or under heavy rudder shock loads and should be replaced as soon as possible.

CPT Steers ±10° or more in seas, worse in flat water

Be sure the DEADBAND is set to the lowest setting. Otherwise, this is usually a sign of excess play in the boat's steering system or some magnetic interference. Excess play at the wheel must be removed. Inspect and tighten cable systems. Air, foaming and valve delay in hydraulic steering systems must be removed. Try relocating the control box away from stereo speakers and any metallic equipment that may have a magnetic field; only 316 stainless fasteners should be used to mount the control box.

Poor Power Connections and Voltage Drop

To test the power connection, the supply voltage level must be measured when the motor is running. Just checking for 12V at the line is not adequate; voltage drop will only show when the pilot motor runs and draws current. If there is excessive voltage drop the small drive pulley may barely turn or vibrate. If the motor is receiving sufficient current, with the belt removed and RUDDER set to 10, you should not be able to stop the small drive pulley with your hand.

Loose power connections can cause the unit to intermittently turn off and power-up again. If the autopilot is steering and the indicator LED begins blinking red, this indicates that power to the autopilot has been interrupted. The autopilot will steer to the last known heading and may steer the boat off course due to the compass sensor warming up.

Magnetic Interference

Common Sources of Magnetism

⚠ Cell Phones · Tablets · LCD and Display Screens · Compasses · Screwdrivers · Winch Handles · Knives · Stereo Speakers · VHF Radios & Microphones · 304/18-8 stainless screws (magnetized) · Current carrying wires · Ferrite Beads

Magnetic objects will alter the sensor heading if placed too close to the control box. Ham radios and SSB radios should be properly choked and grounded and be used at 50% transmit power to limit effects and stress on all electronics onboard. Generally, SSB transmissions will not immediately affect the CPT, but long transmission times may gradually affect the heading and cause a noticeable magnetic field on the ship's compass. If SSB interference cannot be lessened, it is recommended that the CPT remain off or on STANDBY mode during SSB transmissions.

Magnetic interference may lengthen the warm-up time for the sensor, lengthen the time taken to settle on a new heading, or if strong enough, completely prevent it from holding some or all headings.

With steel vessels, the control box must be at least 6 feet from steel. With mild magnetic interference, the pilot may steer fine on some headings but not others, depending on the control box mounting location. Some steering systems in fiberglass or wood boats may have magnetized parts in the pedestal, worm-drive, or parts of the steering system or engine controls. Refer to the section "How to check for magnetic interference" on page 22.

Basic Circuit Function Test

To check basic circuit function, remove belt and engage clutch. Keep the vessel on a consistent heading during this test or at the dock. Flip control box to STANDBY, set RUDDER to 5 and DEADBAND to 1. After a minimum 60 second warm-up, toggle to HOLD HEADING. The small drive pulley should be stationary for a brief time, and will begin to make a small correction every 10 seconds. Push the 10° PORT button once and the clutch should turn to port and then make momentary corrections to port. Push the 10° STARBOARD button once and the clutch should rotate back to starboard and stop. Slightly rotating the control box box itself should bring the same results. When left on HOLD HEADING when the boat is stationary, it is normal for the pilot to make a small correction periodically once every 10 seconds; making corrections once every second after 60-second warm-up indicates a magnetic field too close to the control box.

Reversed Power Wire Polarity

The CPT will not operate at all if the polarity of the power wires are reversed. The red wire must connect to +12V, the black wire to ground / battery negative.

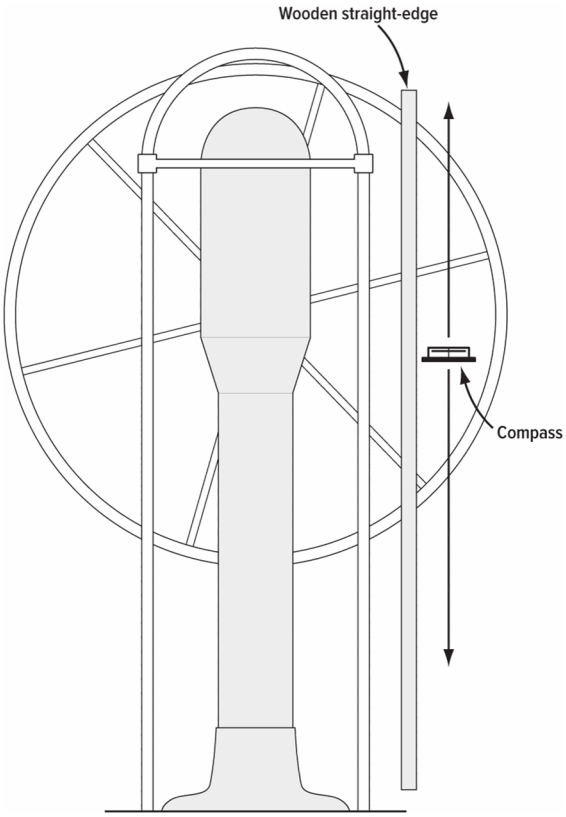
Cutting or Splicing the Control Cable

The control cable electrically connects the motor box to the control box. A 10ft (3 m) extension cable is available to easily extend the length of the control cable without cutting the cable.

ⓘ Do not cut or splice the control cable: the original factory control cable with its connectors is required for factory servicing if ever required.

⚠ Be sure the power wires are completely disconnected from the battery or 12-volt source before cutting the control cable or damage will result. Damage resulting from cross-connecting wires during splicing or routing is not covered under the warranty.

How To Check for Magnetic Interference



The autopilot heading sensor is built into the control box so the control box mounting area must be free from magnetic influences. The helm area of most boats will be free of magnetic fields, but this should be checked. Use a hand-held compass, preferably a needle-bearing compass, to check for magnetic fields near your pedestal. (Using magnets to see if they stick to something magnetic is not a suitable test for this purpose.) Stereo speakers, dive knives, and winch handles should not be located near the control box, as well as high current cables, radar or LCD screens and electronic devices such as phones and tablets. Stainless fittings that are not 316 stainless or have welds can be magnetic. Pedestal guardrails made from dodger/bimini fittings are often magnetic.

There is a short video on our website that demonstrates how to check for magnetic interference: www.cptautopilot.com/mag

A handheld compass that uses a needle (a simple hiking compass) is usually more accurate and easier to use than one that uses a floating card. A marine handheld compass with a floating card is harder to read in this situation and not recommended. A cell phone compass app may be used, and the rectangular phone shape can make it easier to hold the phone square but there are some limitations:

- If the phone has been exposed to strong magnetic fields the compass will not read accurately due to magnetized metal inside the phone.
- The phone compass may not be sensitive enough to show changes of less than 3°

Hiking compasses work well for observing small needle movements.

With your boat parallel to the dock, stand on the dock and check the dock's heading and the boat's heading with the magnetic compass. Step on the boat, hold the compass 3' above or away from the pedestal and take a reading. The two headings should be very similar. Keeping the compass oriented, approach the pedestal area and watch the needle to notice any deflection from magnetic fields. Next place a yardstick or a firm wooden straight-edge against the pedestal guardrail and rest it firmly on the deck. Hold the straight-edge steady, so it does not twist. While holding the compass firmly against the straight-edge to keep the compass from rotating at all, slowly slide it up and down the straight edge and notice the amount of needle movement or deflection. The needle must not be pulled or deflected more than 5° near the mounting area.

You may notice some needle deflection as you pass the area just next to the ship's compass (there are compensating magnets in the case) and near the engine control levers. There is usually no needle deflection 6-10″ below this area or 3″-4″ above the ship's compass card. If the needle deflects more than 5° a more suitable location will need to be found for the control box.

Some boats may have steel parts that have become magnetized over the years. Magnetism can come from steel in engine control cables and pins, steering cable fittings, any stainless bolts or dodger fittings that are not 316 SS, homemade guardrails, and fasteners used for pedestal tables. Welded joints or parts may also be magnetic. On a few boats, the boat's engine is located just inches under the pedestal which may cause a problem. Steel boats should do a careful magnetic survey and have a mounting location at least 6 ft from the nearest steel.

<u>If a suitable location is not available for the control box, use of the CPT is not recommended.</u>

INSTALLATION NOTES

Electrical Power Connection

Keep the autopilot OFF when making electrical connections. Turn the autopilot off by turning the RUDDER control counterclockwise to the OFF position. Turn the autopilot ON by turning the RUDDER control clockwise from the OFF position past 1. Do not use a circuit-breaker or external switch to power the unit ON or OFF: keep the RUDDER control in the OFF position when not using the autopilot.

Connect the autopilot power cable to a good 12-volt power source. The red wire connects to +12V.

Use a good quality 10-amp circuit breaker or use the included 10-amp inline fuse-holder. Do not install the fuse-holder in a place exposed to the weather: it is not waterproof.

- If possible, use a circuit breaker or switch for better separation from the boat's electrical system when not in use.
- Do not tie into the ignition side of any source.
- Use the shortest wire run possible and make good, solid connections.
- Apply dielectric grease to all connections to prevent oxidation.

A waterproof connector may be used on the power line, however, do not use a push-in or cigarette-lighter type connector. Use a connector with a screw-down cap and plug, and a compression fitting those seals the cable-jacket as it enters the connector housing. Tin the wire ends. Always keep the cable jacket sealed; an open or damaged jacket can allow water into in the autopilot and connector. Apply dielectric grease to the wire ends and connector pins/sockets to prevent corrosion.

Power Cable Extensions

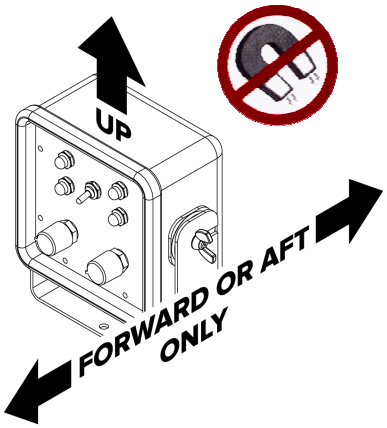
If necessary, the power cable can be extended using the appropriate wire gauge for the length of the extension:

- 12 AWG (4 mm^2) extension wire, up to 10 feet (3 m). Total length from motor box: 20 feet (6 m).
- 10 AWG (6 mm^2) extension wire, up to 15 feet (4.5 m). Total length from motor box: 25 feet (7.6 m).
- 8 AWG (10 mm^2) extension wire, up to 20 feet (6 m). Total length from motor box: 30 feet (9 m).

> ⚠ Using a wire gauge that is too small will cause voltage drop and increased motor wear.

Control Box Mounting Requirements

- The control box must be oriented level and facing either the bow or the stern of the boat. The cable exits the bottom side of the box. If the control box does not face the bow or stern of the boat, the autopilot heading will be affected by the boat pitching and heeling.
- The control box MUST be mounted away from anything magnetic that may influence it.
- The location should be checked with a handheld compass. See "How to check for magnetic interference" on page 22.
- Only use included 316 stainless fasteners for mounting the control box. Other fasteners and grades of stainless steel may be magnetic or become magnetized.
- Do not cut or splice the control box cable. If routing is preferred, complete sea trials BEFORE routing the cable to ensure the mounting location is free of magnetic interference.



Recommended Control Box Mounting Clearances*

**As measured on a typical helm—the magnetic environment of your helm may vary. At these distances there was less than 5° compass needle deflection; closer distances caused a 5° or higher needle deflection.*

Control Box Guardrail Mounting

The top of the control box should be at least 6" (150mm) under the ship's compass casing.

The bottom of the control box should be at least 1" (25mm) above the ship's compass bubble.

Control Box mounting on ship's compass shelf

At least 11" from the side of the ship's compass.

Stereo Speakers

The magnetic field from stereo speakers can extend 20" – 30" (500mm – 750mm) from the center of the speaker outward in a donut shape.

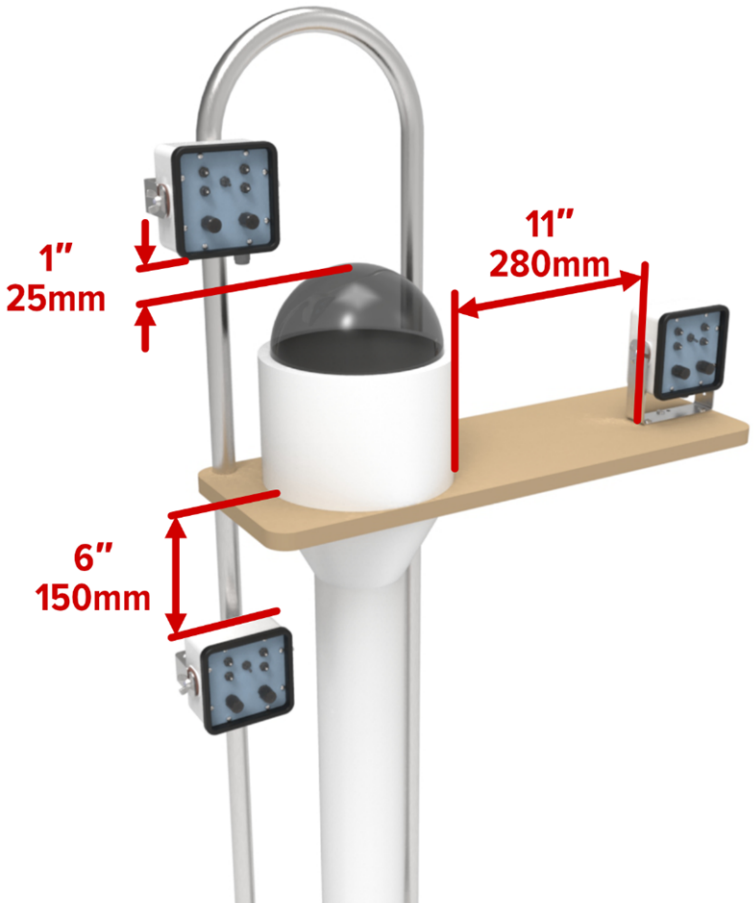
Autopilot Motor Box

Mount the control box a minimum 18 inches (450 mm) away from the motor box

Only use included 316 stainless fasteners for mounting the control box. Other fasteners and grades of stainless steel may be magnetic or become magnetized.

⚠ Possible sources of magnetism include:

- The autopilot motor
- 304/18-8 stainless steel screws (they can become magnetized)
- Ship's compass housing (contains declination compensation magnets)
- Current carrying wires including solar panels and related cables
- Chart plotters and nav screens (check "compass-safe" distance in manual)
- VHF Radio and handheld microphone



TECHNICAL SPECIFICATIONS

Compass Sensor

Electronic heading sensor built into control box

Power Requirements

12 Volts DC
0.1 A standby current
~0.75 A average current draw, varies with load and settings
0.05 µA (microamp) current draw when off
~1 A motor draw, no load
~3 - 5 A motor draw, medium loads

Torque/rpm at Wheel

Maximum 86 ft-lbs. (116 Nm) – 12" Wheel Pulley

Up to 6 ¼ RPM at the wheel

Dimensions

Motor Box

7" wide x 5" high x 3 ½" deep

178 mm wide x 127 mm high x 89 mm deep

(Not including drive pulley and mounting bracket)

Control Box

4" x 4" x 2 ½" deep

102 mm x 102 mm x 64 mm deep

Wheel Pulley

12 ¾" OD, 10 3⁄16" ID, 1 1⁄16" thick

324 mm OD, 259 mm ID, 27 mm thick

Mounting holes are ¼" (6 mm) dia. on 5 ⅝" (143mm) radius

Weight

10 lbs. (4.5 kg) motor and control box only

16 lbs. (7.25 kg) complete with all parts & brackets

Materials

Motor box and Control box

Powder coated aluminum with anodized face plates

Delrin drive gear on 303 stainless shaft

• Note that each box contains a packet of desiccant crystals/silica gel for moisture control.

Wheel Pulley

Black Urethane with 316 stainless J-bolts or screws

Drive Belt

Fiberglass reinforced neoprene

Standard Belt Sizes

Measured from wheel center to drive gear center

Belt Number (circumference in mm)	Center-to-Center inches	mm
1290	13	330
1350	14 ¼	362
1400	15 ¼	387
1420	15 ¾	400
1455	16 ⅜	416
1500	17 ⅜	441
1520	17 ⅞	454
1575	19	483
1595	19 ⅜	492
1635	20	508
1690	21 ¼	540
1720	21 ⅞	556
1790	23 ¼	591
1800	23 ½	597
1870	24 ⅞	632
1895	25 ⅜	645
1945	26 ⅜	670
2000	27 ½	699
2100	29 ½	749

Built for Immersion

The control box and motor box are designed and built to withstand immersion. Storing the unit improperly in standing water or flooded conditions can eventually exceed the rating of the watertight seals.

Designed & built in the USA

Please note that these specifications are subject to change without notice.

Motor Mounting Bracket

The motor mounting bracket is 3⁄16" (5 mm) thick with four mounting holes for #10 (5 mm) screws in a 2" square pattern.

LIMITED WARRANTY

The CPT is warranted for one year for defective parts and workmanship, provided the unit is installed and used in accordance with these instructions and common sense, as explained in the attached limited warranty card. You are cautioned to keep children, pets, and fingers away from the belt, that the CPT cannot see or hear danger, it must be supervised to ensure a safe course, and seamanship and watchfulness are required. A warranty card describing the limited one-year warranty is included with each new unit. Please contact us if this card was not included with your unit. 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 statuary (including warranties of merchantability and fitness for a particular purpose). The remedies available to the buyer are limited to the remedies described in the express limited warranty card.