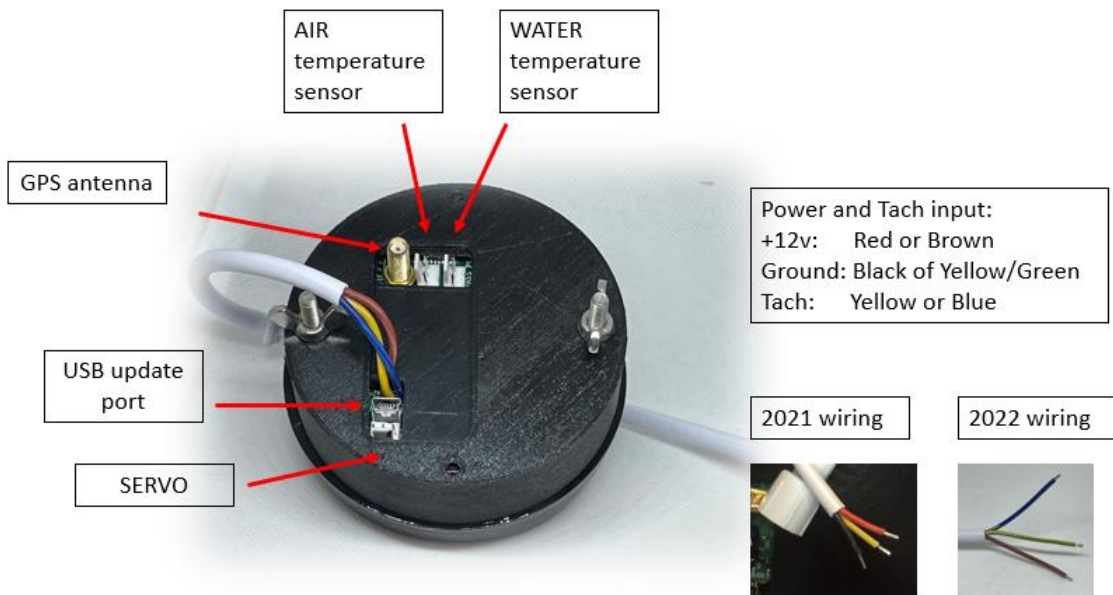


# STEADYPASS

THE BOAT SPEED CONTROL SYSTEM

Thank you for your purchase!

SteadyPass system is designed to control (decrease) boat's throttle to maintain preset speed per GPS. Starting April 2022 we are re-introducing RPM control and updated menu. As of Feb 2024 latest FW is 22-02

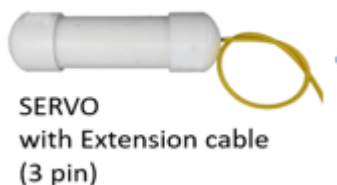


## What's in the box:

1. Head unit with wingnuts. Fits in opening with diameter 87-90mm.
2. Mating power cable (white). Use blue (yellow on older units) for tach input.
3. Short (1 meter) and long(6 meter) temperature sensors. Starting 2021 - with O-ring mount. It does not need to be connected, and is only for easy of mounting.



4. Servo assembly in white PVC tube (assemble before power up)



5. Adapter plate installed on cable: to connect servo cable to OEM throttle rod
6. Two nylon nuts to mount adapter plate: should fit OEM throttle rod
7. Allen wrench for servo fitting
8. 3-pin 6 meter extension cable for servo
9. GPS antenna

## Good To Know Facts:

- Kit body is not waterproof, but reasonably water resistant.
- Device power is provided by standard 12v boat power: kit comes assembled in 3.5" enclosure, with power leads (black(negative), red(12v) and yellow (tach input)).
- Power polarity is important!
- Tachometer: connect to signal lead on your tach, which would likely be grey (for older analog units). This signal typically comes off negative coil lead.
- Servo install: Fit cap firmly to PVC tube BEFORE power on (it is removed for shipment purposes)
- The servo assembly needs to be fixed in a place without direct heat, water, etc. exposure. The bowden cable will need to be adjusted to guarantee the correct idle position and smooth operation after installation.
- Servo connection: 3 wire lead, provides servo power, ground and PWM signal (standard for RC servo). The servo connects directly to the head unit with an extension 3-wire cable. Starting July 2019 – cable is included
- Temp sensors for air and water included. Early kits have one 4-pin connector for both sensors. Wiring diagram provided. August and later 2019 kits – have separate connectors for water/air.

Cable extension may be required depending on boat. 5meter cable is included. 10 meter is optional.

## Installation:

To be added drawing: MECHANICAL CONNECTION DIAGRAM

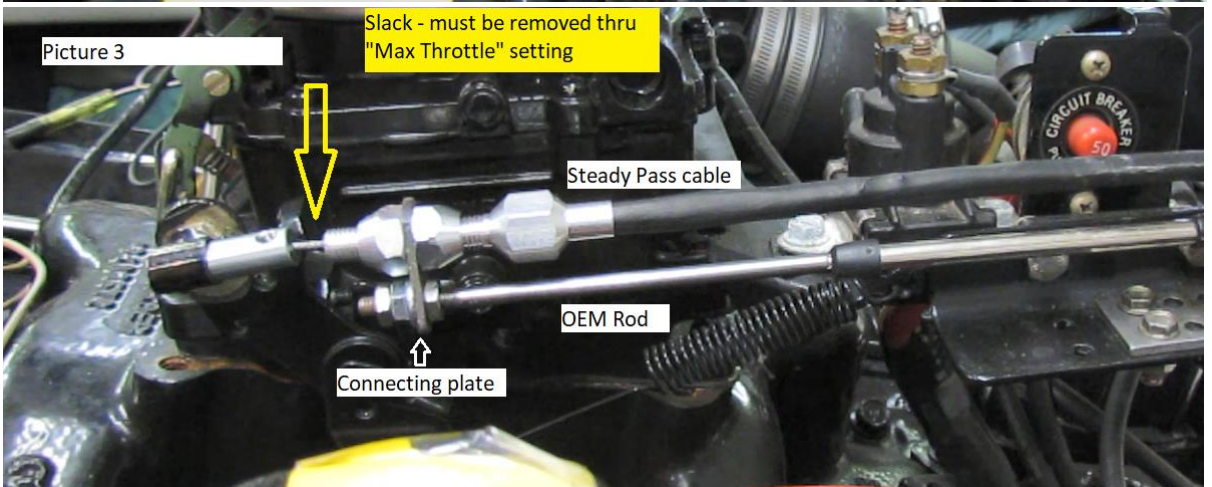
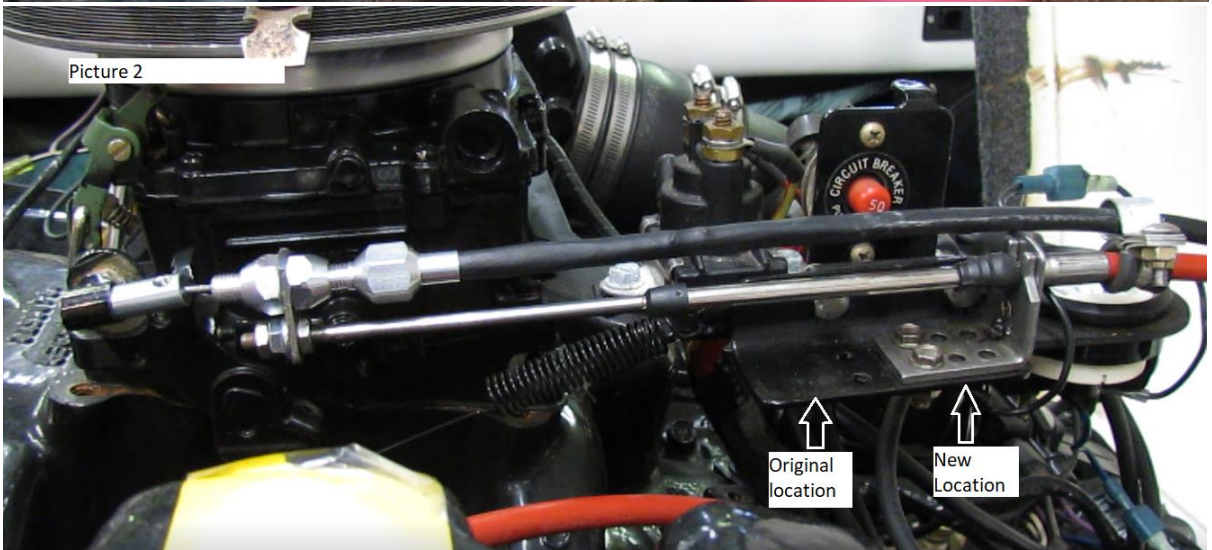
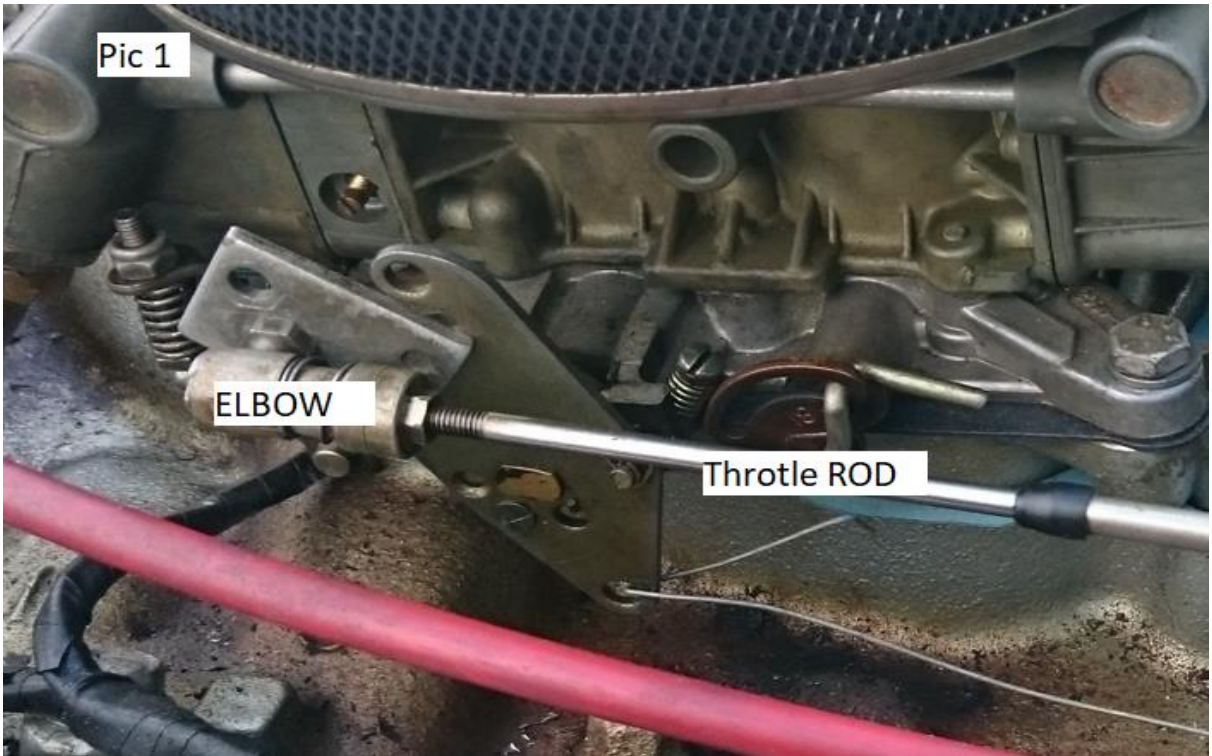
1. Unpack, inspect, and make sure all parts are present.
2. Connect all parts together and power up from any 12v DC power supply to confirm all is functioning as intended after shipping:
  - a. Connect GPS antenna to head unit
  - b. Connect servo with cable to head unit
  - c. Connect temperature sensors (optional)
  - d. Connect 12v DC power to the head unit – the screen should light up.
  - e. Enter menu, select “Test Servo” mode – verify servo is moving smoothly.
3. Work up a plan and connect Bowden cable to your throttle body: most challenging.
 

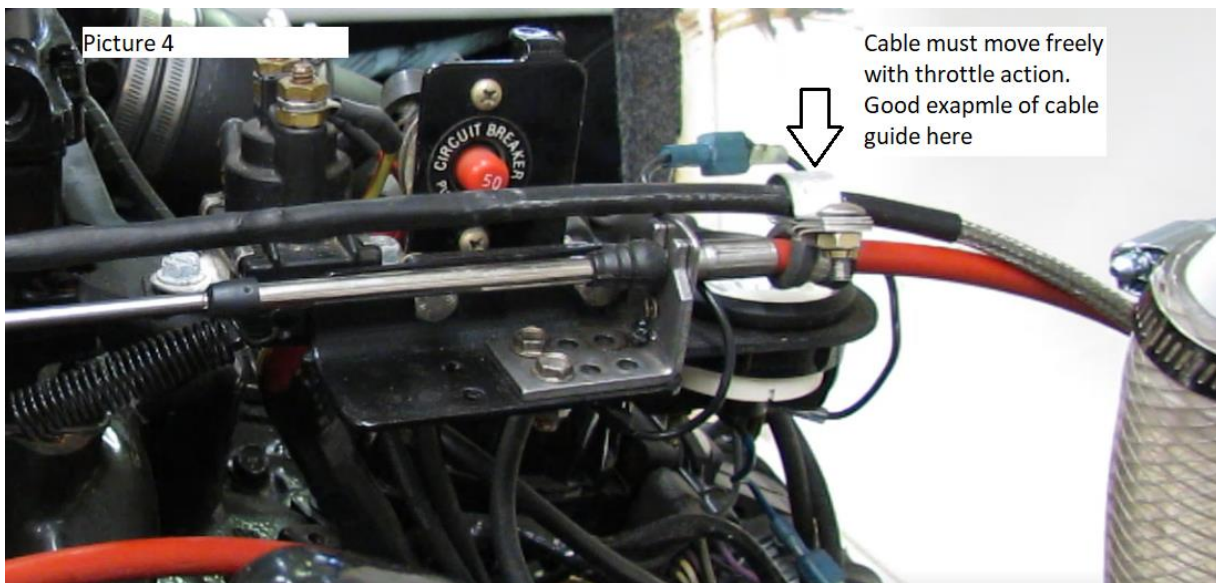
NOTE: The cable is connected IN SERIES, not in parallel to the factory throttle rod. Steady Pass is NOT supposed to move the throttle rod or throttle handle at the helm. It is designed to add “slack” - releasing the throttle body arm and decreasing speed to the target.

NOTE1: Some throttle bodies will have weak return spring, and require additional or a stronger spring.

NOTE2: Every boat is a bit unique in dimensions but the overall idea is outlined below

  - a. Disconnect the throttle rod from the throttle body and remote elbow assembly from the throttle rod – keep any removed parts. (See picture 1)
  - b. For most boats - OEM Throttle rod assembly mount (outer shell) needs to be moved back, to allow space for a SteadyPass throttle connection. Your boat approach may vary – examples below. (See picture 2)
  - c. Connect the tip of the original throttle rod through the plate adapter (connecting plate) to the outer shell of the Bowden cable, secure with nylon nuts on both sides of the plate. (See picture 3)
  - d. Connect tip (elbow assembly, on the core of Bowden cable) to throttle arm (where throttle rod was connected originally). (Also on picture 3)
  - e. A cable guide is needed. Not provided. It may be as simple as a cable tie looped loosely around the Bowden cable. Good example on Picture 4
  - f. With Steady Pass fully retracted (Bowden cable tip pressed against Bowden shell – can adjust in menu AND mechanically by repositioning cable tip) adjust position of throttle rod shell and Bowden cable to correct idle throttle configuration. When throttle control lever is in idle – your throttle body arm must be in idle. Verify with engine running in neutral.



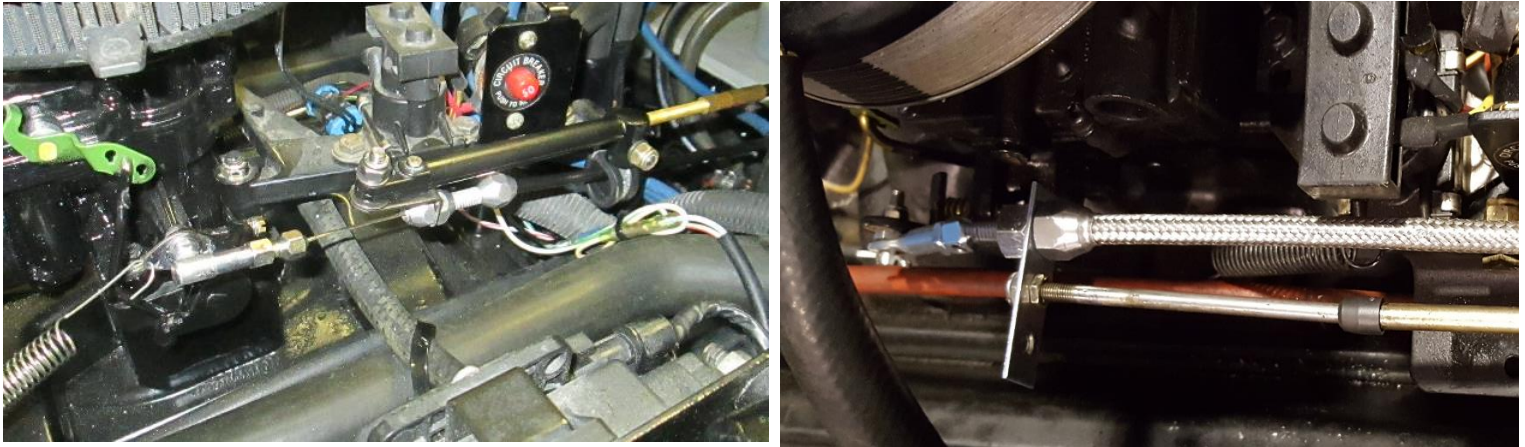


4. Place the head unit into a "3.5" standard opening on the dash
5. Connect 12v power to your preference – ignition-controlled ACC power or to a separate switch (unit does not shut down itself, and must be powered down to avoid battery drain when not in use)
6. Connect the Tachometer signal wire in parallel to your boat tachometer signal.
7. Run servo control wire from head unit to servo – 3 pin connector does not have orientation key, but will not cause any harm when plugged in wrong. If you don't see servo moving – simply rotate 3 pin connector 180 degrees.
8. Mount the GPS antenna and connect to the head unit. GPS will work ok even when mounted under non-metal dash surface, but is most accurate when mounted on the open space with clear sky view. Double sided tape works great for mounting.
9. Install optional temperature sensors
10. Adjust servo range (instructions later in this document) and verify correct operation of the servo:
  - a. Put helm throttle handle to  $\frac{3}{4}$  power, enter menu (long press) and enter option "Test Servo" on Steady Pass. Travel must be smooth and continuous.
  - b. Enter the menu "Max Throttle" setting – servo will retract and must apply light pressure to Bowden cable, very light intermittent buzzing is ok, cable connector tip needs to be pulled in firm against outer shell of Bowden cable, but must not cause servo stall. Rotate knob while in menu to change default servo position.
  - c. Enter the menu "Min Throttle" setting – servo is extended, and Bowden cable allows throttle body to close, decreasing throttle. Adjust to remove servo overextension: with Helm Throttle handle in FULL POWER – SteadyPass cable must extend but remain under tension

Pictures will best describe install, and we are continuously working on install aids

Pic1 Left: Bowden cable fitted with L-bracket to throttle cable and is in “Min Throttle” (de-throttle) position. The tip of the Bowden cable core is connected to the throttle body arm. The cable guide is on the right. Additional spring on the left. NOTE!! This is a Mercruiser setup, pretty rare, and shown spring + L-bracket are not provided in the kit.

Pic2 Right: Flat bracket used where throttle rod base had enough adjustment. Cable is in “non-activated” position (Note – early version of adapter plate is shown)

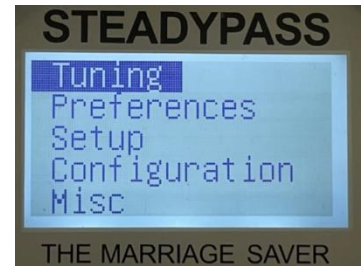


## Usage:

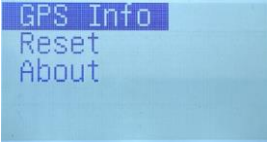
- Steady Pass starting with version 22 has 3 modes of operation: OFF, RPM control and GPS-based SPEED
- Steady Pass works by decreasing throttle within mechanical limits of installation. So it will NEVER go faster than you set by throttle lever.
- To change mode: Single short (but firm) press on knob.
- Mode – shown in upper right corner.
  - OFF mode: device does not perform any servo movements, only displays current speed and time.
  - SPEED modes – rotate knob to set desired SPEED control point.
  - RPM - rotate knob to set desired RPM control point.
- During correct operation – driver accelerates moderately above desired speed, to allow throttle range for Stead Pass to use. Once current speed exceeds target set – you will see “power” value decrease in upper left corner, which indicates servo movement to decrease throttle. This is helpful at BETA testing stage to confirm correct operation.
- Note – MPH and KPH speed options are available – change thru menu.
- Note – Current SPEED setting will be saved when entering menu. Upon next startup – unit will default to saved Speed value. There is also a separate line item in menu.

## Menu in FW v22:

Long press enters the main menu. Below you will find a visualization of the menu structure with descriptions:



Main Menu	2nd level	3rd level	Description
<b>Tuning</b>			PID coefficients, affecting GPS speed mode handling
	Target P		Target set of coefficients – used within 5mph of target speed
	Target I		
	Target D		
	Transition		Speed offset from target to transition from “Accel” to “Target” set
	Accel P		Set of PID coefficients used during acceleration. Initially – keep same as Target
	Accel I		
	Accel D		
<b>Preferences</b>			
	Start Speed		Boot up target speed.
	Start RPM		Boot up target RPM
	Volts warning		Voltage where readout will be highlighted on screen
	Plug warning		Splash screen drain plug message
	Menu Timeout		Time to self-exit out of menu. Typically 10sec
<b>Setup</b>			Misc setup items
	Engine Cyl		Number of engine cylinders – needed to show RPM correctly
	Clock Offset		Offset from GPS time – set to your time zone
	Hour Mode		24 or 12 hour time display
	Speed Units		MPH or KPH
	Temp Units		F or C
	Contrast		Typically 30. LCD contrast
<b>Configuration</b>			
	Servo		
		Min servo	Use at setup - verify Bowden tip lightly preset against cable. Fully retracted position of servo – corresponds to “no control” device mode.

		Max Servo	Use at setup - verify no cable slack at ~75% throttle handle position
		Test	Continuous cycle mode from min to max to verify linkage
	Display Items		
		Throttle	Hide/Show value from main screen
		Time	Hide/Show value from main screen
		Voltage	Hide/Show value from main screen
		Course	Hide/Show value from main screen
		Water	Hide/Show value from main screen
		Air Temp	Hide/Show value from main screen
		RPM	Hide/Show value from main screen
	Limits		
		RPM	On/off. Extra functionality to limit RPM (Alpha feature)
		Speed	On/off. Extra functionality to limit Speed regardless of operation mode (Alpha feature)
		Max RPM	Max RPM setting.
		Max Speed	Max Speed setting.
	River Mode		
		Enabled	Alpha level feature - automatically offset target speed to compensate for river flow
		Heading	River heading
		Heading Offset	Approximate river direction deviation
		Spd Offset	Offset target speed value
		Delay	Delay to apply
<b>Misc</b>			
	GPS info		GPS output
	Reset		Reset all settings or PID setting to factory preset
	About		Credits.



## Servo range setting verify before each season.

It is very important to verify/set servo range before operation. It is done by entering menu (long press knob) and adjusting MAX/MIN throttle settings so that servo is not pressing against mechanical limits and does not stall at end points.

- Start by setting correct min/max limits in menu while servo is in your hands, before installing into the boat.
- Typical values for linear servo are 950 in “max throttle”, 1950 in “min throttle”. Servo min/max limits are slightly different for every servo.
- Menu has 3 lines for setup: Min throttle, Max throttle, TEST.
  - When in menu for one of the values – servo will position itself to the current number shown on screen.
- Set up “Min Throttle” (max servo value position) : This is position of maximum de-throttle.
  - Put help throttle handle to FULL power.
  - Enter menu by long press, then enter “min throttle” menu – servo will move to extended position
  - When in menu – rotate knob to find optimal position.
  - Bowden cable must allow throttle body to close, decreasing throttle. Adjust to remove servo over-extension: SteadyPass cable must remain under tension
  - Note, depending on your throttle body – it may not fully close. It is ok.
- Set Up default position – “Max Throttle” (min servo value)
  - Put Help Throttle Handle to IDLE
  - Enter “Max Throttle” menu
  - Servo is retracted fully but must not stall.
  - This is done AFTER installation, because setting depends on bend radius of Bowden cable
  - Rotate knob to remove ALL cable slack, with LIGHT pressure of cable tip against cable outer shell
- Verify setting by entering “TEST MODE” in device menu – servo should continuously cycle without stops.

## TUNING/SETUP

- Although the device is built to work out of the box, it may be REQUIRED to adjust coefficients for specific boats – different power, torque, and throttle response curves force that.
- As of v21 FW, we have two sets of coefficients—one for the initial phase of reaching target speed and the other for the phase of maintaining speed.
- RPM mode does NOT use PID. It's a simple “more/less throttle” control loop.

The Steadypass control algorithm is based on an industry-standard PID controller (proportional–integral–derivative). PID algorithm is a control loop mechanism employing feedback that is widely used in industrial control systems and a variety of other applications requiring continuously modulated control. A PID controller continuously calculates an error value “E” as the difference between a desired setpoint speed (SP) and a measured GPS speed (V) and applies a correction based on proportional, integral, and derivative terms (denoted P, I, and D respectively), hence the name

The 3 coefficients are the magic secret of smooth operation, and for some – may need adjustment.

Below is the logic and approach to adjusting coefficients while we are working on a “magic button.”

### WHAT THESE COEFFICIENTS DO:

**P (Proportional):** Throttle input is linear to delta of current speed (V) from target speed (SP). Kp coefficient – increases weight (importance) of this ingredient. Pure P controller will be achieved if you set coefficients to 1,0,0.

**I (Integral):** An integral term increases action in relation not only to the error but also the time for which it has persisted. So, if the applied throttle is not enough to bring the speed to target, throttle adder will be increased as time passes. A pure "I" controller (Coeffs 0,1,0) will bring the speed to target, but it would be both slow reacting at the start and brutal at the end (the action increases as long as the V speed is below target SP).

This will lead to overshoot. After overshooting, the pure “I” controller will take “long” time to start applying correct throttle input, which will lead to continuous oscillation around the SP setpoint.

**D (Derivative):** This is the magic coefficient, designed to predict the future by calculating acceleration (hence the name). Pure D controller (0,0,1) does not consider the difference between V and SP, meaning it can not bring boat to the target speed. It only considers rate of change, and is providing input to decrease change of speed. Simply said – it fights the oscillations.

Another set of wisdom rules for tuning in PID from zero:

### **PID control loop rules of thumb**

Start from 0;0;0. Work on only one adjustment at a time. If you start making changes to all three controls at the same time, you can easily get disoriented.

Proportional gain first - controls how quickly the process races toward the setpoint. If you set a very high gain, expect to reach your setpoint quickly but be prepared for the possibility of drastic overshoot and oscillations. If you set a very low gain, you can prevent the overshoot, but it may take a long time to reach your setpoint. Increase the proportional gain value in small increments until oscillations occur, and then reduce the setting.

The integral time acts like an error eater. It can help reduce the oscillation time and remove the offset, but improper adjustment can cause an increase in overshoot as well as lead to the system having oscillations. Increase the integral time value in small increments until the oscillations and the offset have been eliminated.

The derivative time provides a braking action to the control loop and is not required in most applications where a little overshoot is allowable. If it is needed, derivative control can reduce overshoots but could also lead to a lack of responsiveness. Increase the derivative time value until the response to process changes is optimized.

### **Proper usage of Steadypass.**

Firstly – it takes both the operator and the algorithm to make happy. At least initially. Throttling to 100% on start up does not help. Instead try to follow to typical “Pull out of the water” sequence: give boat enough power to pull the rider up, and then decrease throttle to about 120% of what you would expect at your target speed. That 20% extra – is all the SteadyPass needs to work with. It also serves as a common sense maximum power setting.

Also, Steady pass won't be able to work within 2mph of planning speed.

### **Initial setup**

Default coefficients are programmed to latest configuration believed to be successful.

#### **Menu->Tuning**

Keep set of “ACCEL” coefficients at zero initially – these only control the “Launch sequence”

We are continuing to accumulate data from Beta users and will share what we know

Usable range for coefficients:

P: from 0 to 1; I: from 0 to 0.5; D: from 0 to 0.08

Higher values for coefficients are very unlikely to provide usable configuration but you are welcome to try.

Default shipped in ver22 are early in 2022 were:

P: 0.25 I: 0.25 D: 0.03

Unfortunately for most – these did not work.

Recent successful configuration #1 tested in June'22:

P: 0.12 I: 0.06 D: 0.03

Another configuration – with less PI to lessen overshoot:

P: 0.06 I: 0.03 D: 0.03

### **Please read and agree:**

The SteadyPass Boat Speed Control system is designed solely for use with water ski and wakeboard boats operating under calm conditions with supervision, with driver in full control at all times, also utilizing a spotter and all other safety crew and requirements applicable to water sports and general boating. Steadypass Boat Speed Control system should not be used for any other purpose or under any other conditions. Your decision to proceed with installation is conditional upon you assuming all and any risk and losses related to use of this system.

Both purchaser and/or anyone utilizing the Steadypass Boat Speed Control system acknowledges that their purchase and or use of this device is conditional upon them releasing and forever discharging Opportunity LLC and Steadypass Boat Speed Control team from any and all liability for any injuries or losses or any other claims, demands, losses or causes of action, whether occurring prior to, during, or subsequent to or directly or indirectly connected with the use of the Steadypass Boat Speed Control System, and whether caused by any persons negligence or otherwise. In other words – while by mechanical design, Steadypass is not able to increase speed above what the boat operator sets by the mechanical handle – please proceed at your own risk.