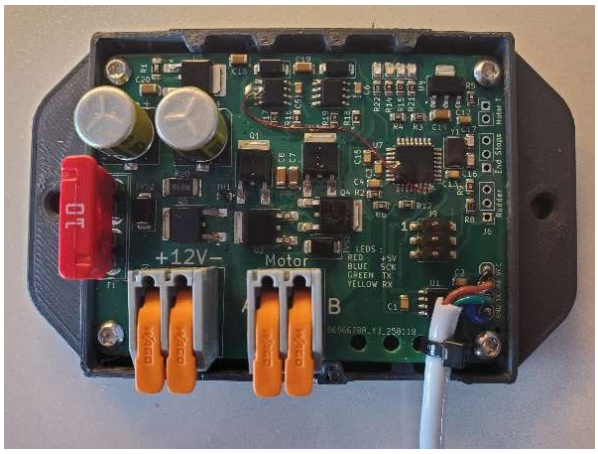
Pypilot* motor controller without clutch output 7A** continuous (15A peak)



* Pypilot was imagined and designed by Sean D'EPAGNIER. Thanks to him for this fantastic boat autopilot.

** Motor current is how many amps the motor draws at maximum speed moving the rudder freely, not stall current.

This motor controller needs to be paired with a suitable autopilot computer such as **Tinypilot** or **OpenPlotter** running pypilot.

- Can drive most existing autopilot drive units without electromagnetic clutch such as tillerpilot and wheel pilot.
- With pypilot, this controller allows you to adjust the acceleration/deceleration and speed of the motor.
- Voltage 12V DC (10.5 to 17V)
- Voltage, current, temperature monitoring.
- Connection to pypilot computer (tinypilot or openplotter) by serial communication with galvanic isolation, prevent ground loops and other electrical problems.
- Intrinsic consumption 10mA
- Internal resistance < 50mΩ
- Power and output with lever connection terminals Wago 32 amps for 4mm² conductors
- Over temperature, over current (stall) detection.
- Fuse 10A and reverse polarity protection.
- Tropicalized with Tropicoat acrylic varnish
- Pins to connect optional rudder feedback and/or port/starboard end of travel input switches
- Arduino based, open source software (ISP connector).
- Waterproof connector to serial communication

Dimensions

- PCB : 76 x 57 x 25 mm
- Enclosure : 105 x 69 x 32 mm

Power Connection

The 12V + and - wires connect to the + and - terminals of the Wago terminal block marked "12V".

Motor Connection

The motor connects to Wago terminals block marked "Motor". These may need to be reversed if the autopilot makes corrections in the wrong direction.

Serial Data Connection

Cable type 1	Cable type 2	Cable type 3	purpose	raspberry pin
Red	Brown	Black	+3.3v	1
Green	White	Brown	Rx to Tx	8
Blue	Blue	Green	Tx to Rx	10
Black	Black	Blue	0v, GND	6, 9

Note: wire colors of cable will be one of 3 possibilities depending on the controller.

End stops

With pypilot, rudder travel limiter switches are optional. They can be useful to reduce the forces applied to the rudder system if the current limiter does not limit the force, as with some hydraulic drives, or if the rudder feedback device becomes misaligned (rod bent or disconnected). When one of the switches closes, the controller prevents any further movement of the motor in that direction.

In all cases, care must always be taken to ensure that the limit switches remain electrically closed when the rudder is fully travelled, beyond the angle at which they are set to stop the actuator motor.

An optional cable with 3 wires can be used for optional end stops.

The connection on the motor controller PCB is labeled "End Stops". The square pin is GND, the middle pin is End A pin, and the last pin is End B pin.

Cable type 1	Cable type 2	Cable type 3	purpose
Red	Brown	Red	End A – Rudder travel limiter switch with boat to port (left)
Yellow	Blue	Black	End B – Rudder travel limiter switch with boat to starboard (right
Black	yellow	Blue	0v, GND

Rudder Feedback

First, with pypilot, the rudder feedback is optional. It can be disconnected while underway and pypilot will continue to steer. It is generally used to report the rudder angle on a display and avoid relying on end-of-travel stop by intensity limitation. It also may be used by certain pilot algorithms to enhance steering, but the basic pilot algorithm does not require it. To be clear, corrections needed in moderate conditions are 10 or more times that of the errors due to integration from not knowing the rudder position, so the potential improvement in steering performance from rudder feedback is not huge.

A potentiometer with 3 wires can be connected to the controller. The potentiometer should range from 1k ohms to 100k ohms. Recommend 10k. You can also connect a Hall effect sensor 5v with analog output to these 3 wires.

The connection on the motor controller PCB is labeled "Rudder". The square pin is GND, the middle pin is the measurement pin, and the last pin is the 5V power supply.

It is not critical that the voltage increases or decrease with rudder angle as the rudder feedback calibration takes care of the direction.

A potentiometer with only 2 wires can connect GND and measurement pins. A resistor should be added from 5V pin to measurement pin.

An optional waterproof connector with 3 wires for optional rudder feedback can have three wire color combinations depending on the controller

Cable type 1	Cable type 2	Cable type 3	purpose
Red	Brown	Red	+5v
Yellow	Blue	Black	voltage for angle
Black	yellow	Blue	0v, GND

When the rudder feedback sensor is installed, you can check the rudder calibration page to read the value and make sure it is working.

The rudder feedback must be calibrated. You must manually turn the rudder to port range, starboard range, and center and press each button for each position. The order is not important, but once all 3 operations are complete, the scale, offset, and nonlinearity must be calculated. The "Rudder Range" field must be manually set to indicate the actual angle at each range position and to limit the autopilot movement beyond that position. It is possible to set the "rudder range" to say 35 degrees and calibrate the rudder by moving it to 35 degrees in each direction and later set it to 30 degrees to further constrain the range the autopilot can move the rudder. So, to be clear, the "rudder range" is for calibration and whatever the value is when the button is pressed, but in operation it specifies the maximum angle the motor controller can move the rudder to.

Note: It should also always be remembered that using the rudder angle sensor to limit the actuator travel may disable the autopilot if the rod connecting the rudder is accidentally bent or disconnected. Properly installed limit switches or a good adjustment of the current limiter will often be more reliable in limiting the forces on the rudder system.

Motor Temperature Sensor

Optional 10k NTC (2 wires) for temperature of the electric motor.

This is generally not needed because most motors will not overheat unless stalled for prolonged periods. It can be used to prevent the motor from overheating and burning out.