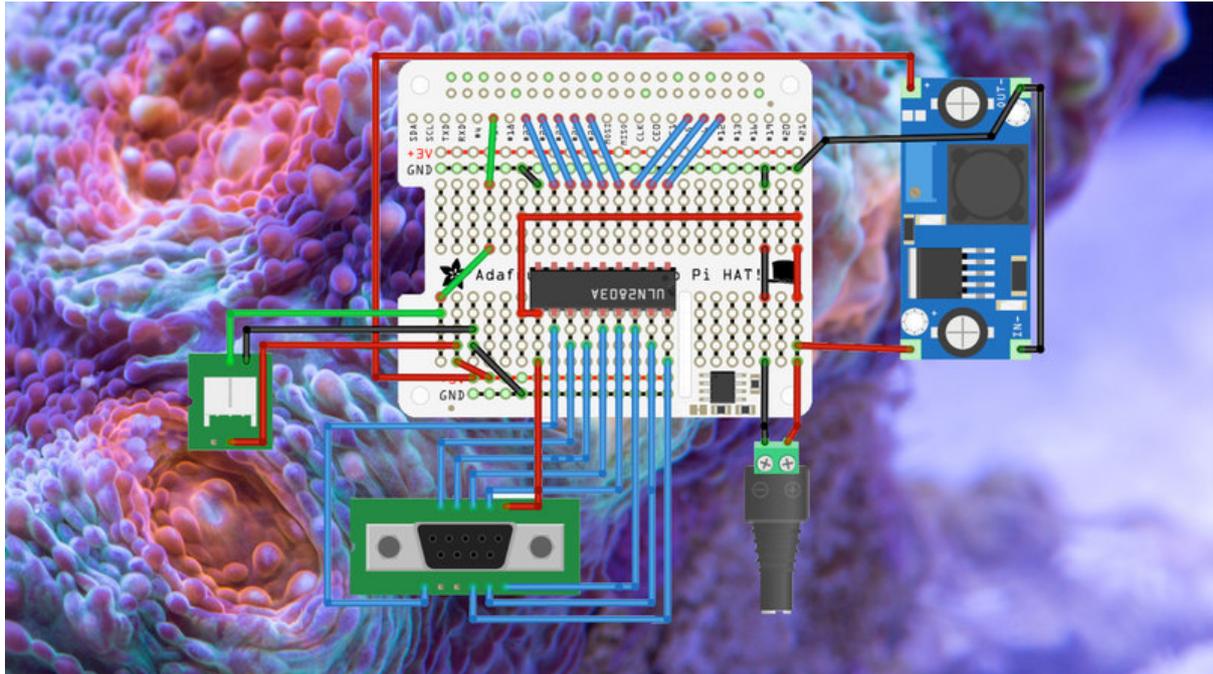




# reef-pi Guide 4: Water Level Controller

Created by Ranjib Dey



<https://learn.adafruit.com/reef-pi-water-level-controller>

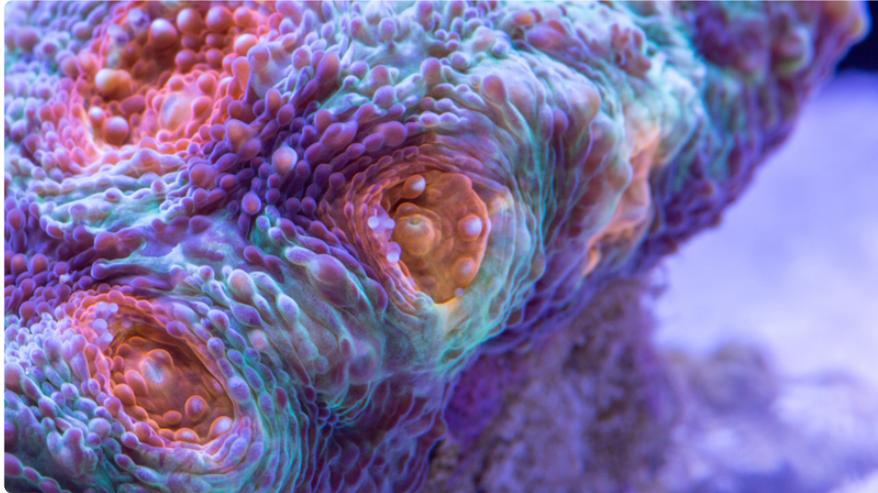
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# Overview



Welcome to the fourth guide in reef-pi series. In this guide, we'll be building a water level controller. In the home environment, reef aquariums lose water due to evaporation. The loss of water results in an increase in salinity since salt does not evaporate. Natural salt water has a fixed specific gravity (used to represent salinity) of 1.026. Corals are very sensitive to salinity and a small salinity fluctuation can cause significant stress to them. To address this, fresh water (filtered using reverse osmosis and de-ionized) is added to replenish the evaporated water, which in turn keep the overall water volume same, thus keeping the salinity fixed at 1.026. This is called top off.

While a reef hobbyist can manually top off, a water level controller automates the top off process by monitoring the reef aquarium water level and pouring fresh water by switching a pump. These types of controllers are popularly called as **Auto Top Off** or ATO. An ATO is critical for keeping salinity at exact 1.026 in smaller aquariums.



This guide assumes you have a working reef-pi setup along with the power controller module. [Follow the first two guides \(https://adafru.it/CyQ\)](https://adafru.it/CyQ) if you have not. We'll be extending our previous power controller build to add an optical water level sensor and a water pump (connected via the American DJ SR P8 power strip) to pour fresh RO/DI (reverse osmosis, de-ionized) water into the aquarium. Although in this guide we are extending our temperature & power controller, it is also possible to build a standalone ATO controller using reef-pi.

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## Parts

We are extending the [temperature controller \(https://adafru.it/CEp\)](https://adafru.it/CEp) that we have built in the course of last three guides. We'll extend the main circuit built on Perma-Proto HAT to provide three male jumper pins that will be connected with the optical sensor breakout board.

### 1 x [Water level sensor](#)

Infrared water level sensor with breakout board

<https://www.dfrobot.com/product-1470.html>

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We'll be using this optical water level sensor breakout board from dfrobot that simplifies the integration of optical sensor with GPIO pins of Raspberry Pi

**1 x ATO Water pump**

Water pump to pour RO/DI water from ATO container to reef tank

<https://www.amazon.com/dp/B0713T9PRP/>

**1 x Power adapter**

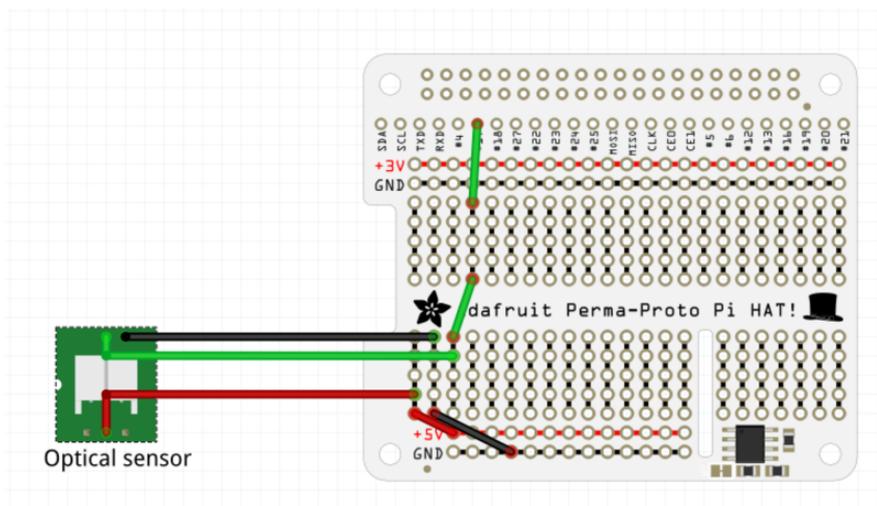
12V power adapter for ATO pump

<https://www.amazon.com/dp/B0713T89R1/>

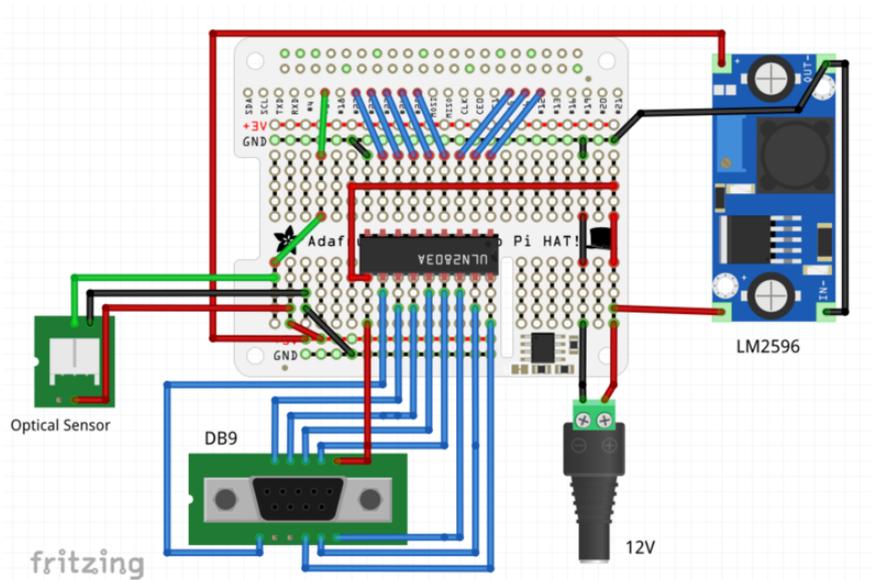
# Circuit Construction

The optical sensor breakout board requires a three pin connection using 5V, GND and any of the available GPIO on the Raspberry Pi.

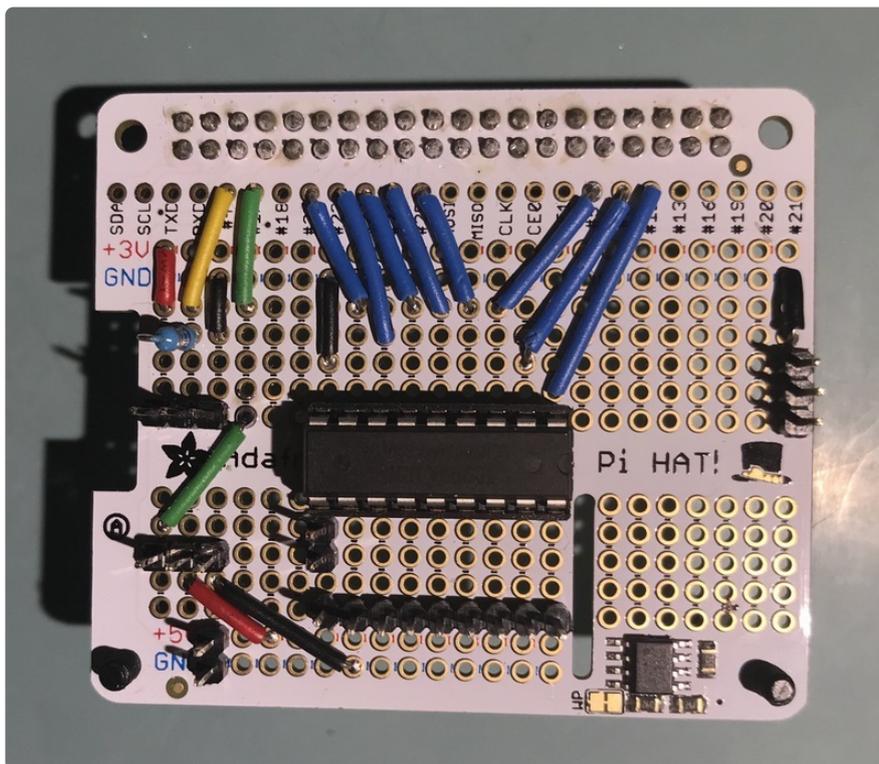
Following is the required circuit:



With power controller circuit:

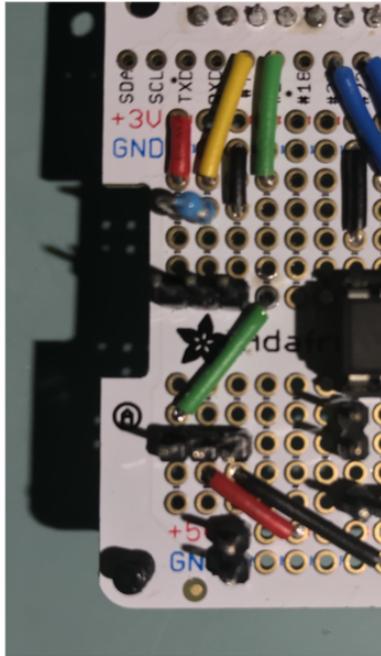


We'll solder three male header pins for connecting the breakout board. Notice the green colored solid core wire is connecting pin GPIO17 with one of the male header pins. The other two pins are connected to GND and the 5V rail.



Closeup photo of the ATO circuit. Notice the temperature circuit (for DS18B20 sensor) is located right above the ATO circuit.

It is perfectly fine to use a separate Perma-Proto board (my personal favorite is the [mint tin size](http://adafru.it/723) (<http://adafru.it/723>) Perma-Proto board) if you find the Perma Proto HAT is too crowded.



That's it. Like most of the reef-pi electronics, the ATO circuit is really simple. Next, we'll go ahead and mount it along with the optical sensor breakout board in the housing.

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## Building the Housing

Here we'll be mounting the optical sensor breakout board in addition to all the electronics that's already present in our reef-pi build. For this, start with locating the dfrobot breakout board at the bottom of the housing. I generally wall mount the reef-pi housing and prefer to keep all connectors (temperature sensor, pH sensor, power strip connector, etc.) at the bottom panel of the housing.

Draw the outline of the breakout board along with locations for standoffs, and then drill holes using a Dremel or drill driver. The optical sensor breakout board uses a 4 pin JST connector, hence we'll make a rectangular hole for it. I use a file to smooth out the edges after making the initial hole with a Dremel.

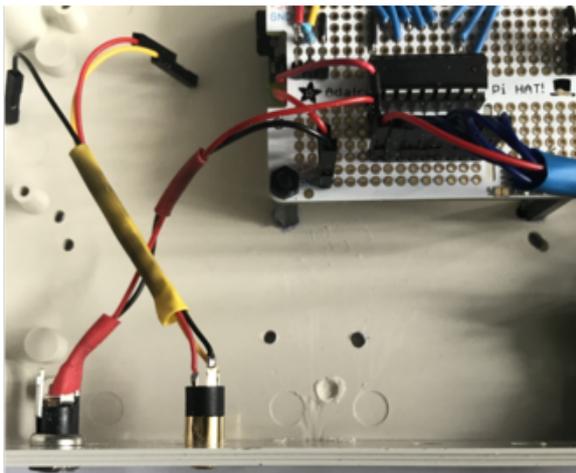


Ignore the other two round holes present on the right-hand side of the housing for the time being, they are made to accommodate an extra temperature sensor and light

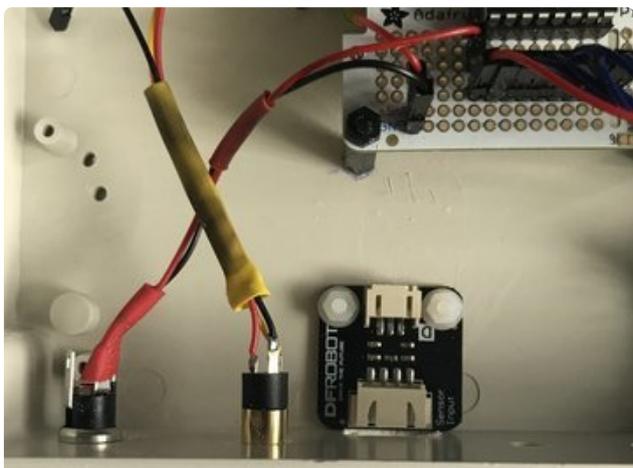
controller connector. They will be used in next build. I was lazy, so I did the drilling in one step :-)



In addition to the rectangular hole for the optical sensor's JST connector, drill holes for fixing the breakout board with nylon screws. The breakout board has two holes for mounting:



In addition to the rectangular hole for the optical sensor's JST connector, drill holes for fixing the breakout board with nylon screws.



The breakout board has two holes for mounting.

Once necessary holes are in made, fix the breakout board with nylon screws.



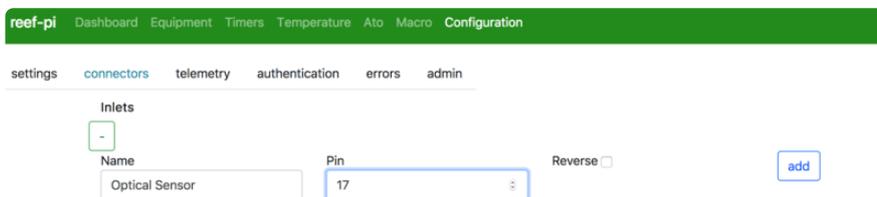
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# Configuration & Testing

Power up your reef-pi controller once all the sensors are connected alongside the power strip. Connect the reef-pi to your computer and go to the reef-pi user interface (UI) to configure the new ATO controller.

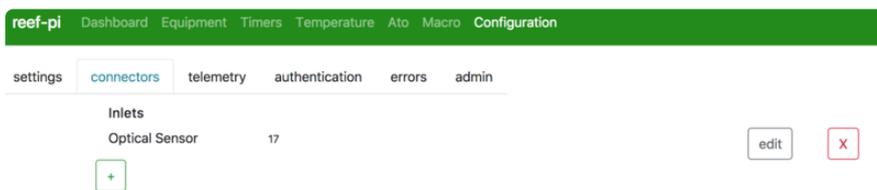
Digital inputs, such as optical sensors, are represented as **inlets** in reef-pi. Inlets are then associated with ATO controllers to monitor water level sensor and turn on or off ATO pump (a submersible or peristaltic pump, declared as an **equipment** in reef-pi).

To create an inlet, navigate to the **connectors** section under the **Configuration** tab. Create a new inlet by clicking on the "+" button. Specify a name and GPIO pin number. In our case the GPIO pin number is 17. I am naming the inlet as "Optical Sensor".

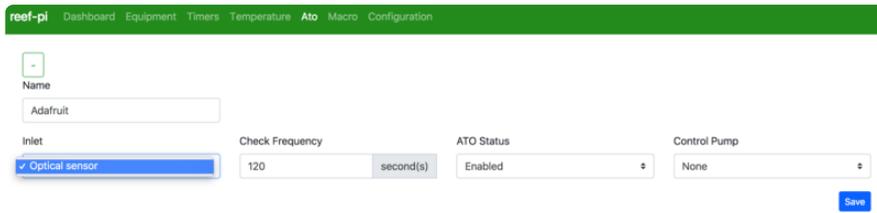


Inlets and Outlets in reef-pi are always associated with GPIO pin numbers. These are not serial numbers of the pins (for example GPIO 17 pin is the 11th pin)

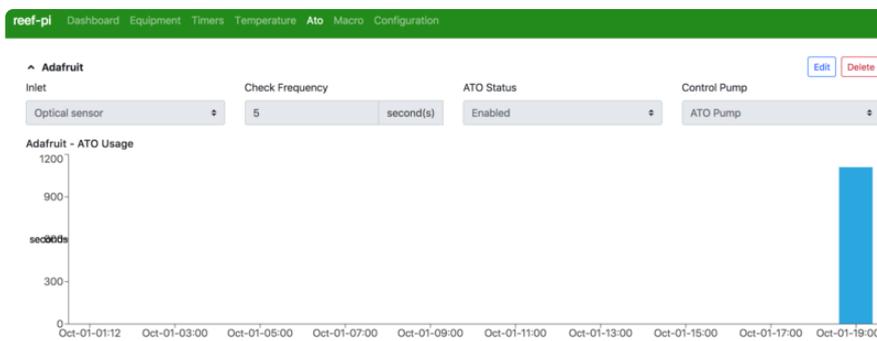
Once created the new inlet will be visible in the UI.



Next, head over to the **ATO** tab. Create a new ATO by clicking one "+" button. Associate the newly created inlet with it. We'll name it as **Adafruit**. Notice default check frequency is set to 120 seconds. This means reef-pi will check the inlet (the optical sensor in this case) every 120 seconds and switch on or off the control pump if specified. The **ATO Status** drop-down menu controls whether the ATO will be enabled or disabled.



Once created, the ATO controller will start monitoring the inlet. Since the optical water level sensor is out of water, the ATO control pump will be turned on. We can expand the ATO controller to see the usage chart which shows hourly ATO control pump usage in seconds.



For more comprehensive physical testing, use a table lamp or any other suitable AC device to simulate turning on a control pump and a cup of water to simulate the water level changes. Reduce the ATO control frequency to a smaller check interval (for example 2 seconds). Now, if you submerge the optical water level sensor inside the cup of water, the table lamp should turn off within a couple of seconds and if the optical water level sensor is moved out of water reef-pi should turn on the table lamp.



ATO controller in reef-pi is built by connecting an inlet item with an equipment item. Though it is built for water level control (and salinity indirectly) it can be used to automate a host of things, since mechanical switches, float switches, etc. can also be used as inlets.

A lower check interval will cause higher CPU usage in reef-pi. reef-pi allows charting CPU and memory usage (enable the **health check** feature in **configuration**). Keep a watch on those graphs to understand if your controller is loading your CPU.

Thank you for reading through the water level controller guide. We'll go through the lighting controller in the next reef-pi guide.