DIY Nutrient Doser (2 Part and pH Control)

3/23/2011 v.1.1 **Part 1: Controllers and Pumps** **by RMCG@THCFarmer**

Cautions and Warnings:

Do NOT use these pumps for full nutrient solution change outs. They will burn out from extended use. These are meant to be used to monitor and maintain a solution, with a few minutes of run time a day, not pump continuously for hours on end.

Do NOT blame me if something malfunctions and you over/under dose your plants or you electrocute yourself.

If you do not feel comfortable using power and/or hand tools, wiring, following directions and double checking your and my work, stop right now. You will waste a lot of money by purchasing pumps and controllers if you cannot follow every step in this guide.

Read through the entire guide twice BEFORE purchasing ANY of the items in the parts list. There are several opportunities to customize for YOUR particular situation. This guide is for a simple 2 part nutrient dosing unit with pH control.

You can scale this up or down, based on your needs. The basics are here, further refinement/customization is possible with some practical thinking. I would urge

AGAINST having too many inputs, making it too complex, etc., but you will begin to see the possibilities as we go through this.

I am utilizing this unit with the Under Current system, dosing directly in to the epicenter, so I wanted SLOW input rates to allow for accurate readings while nutrients are being circulated so as not to overshoot my desired pH/TDS levels.

My auto-topoff water is filtered tap, direct from a main, but it is not pH balanced (comes out ~7.7/100ppms or so), so even with nutrients, I require pH down. Your situation may be different; ie R/O system, 55g drum gravity feed, Ebb and Flow table reservoir, drain to waste tank, etc. affording you increased volume/flow rates, or requiring pH UP, CalMag, 3 part nutrients, additives, etc.

Note: If you are using this in a non-recirculating system, I would incorporate a small powerhead-type pump in your reservoir to mix the nutrients for the most accurate reading.

Bottom Line:

This is a complex, yet simple DIY guide. It is not a 'step by step' guide, more of a 'How I did it' guide. Use your own judgment, think about what you want/need, improvise, customize and make it your own.

Do some planning/research to determine what works best for you and your situation.

For this unit, I am utilizing a 2 part nutrient and a single input for pH control.

- The pH controller can utilize pH UP with a simple jumper wire change during wiring/installation.

Parts List:

HANNA BL 983319	TDS mini HAN-BL983319-1 controller 0-1999ppm	120v	1	$131
HANNA BL 981411	pH mini Han-BL981411-1 controller 0.0-14.0	120v	1	$131
HANNA HI 7634-00	EC/TDS probe for mini controllers	HAN-HI7634-00	1	$41
HANNA HI 1286	Spare pH Electrode	HAN-HI1286	1	$43

I got these items from http://www.eseasongear.com. They also sell 'satchets' of calibration solutions, if you don't already own them. You will also need a small calibration screwdriver to calibrate AND change the settings on these controllers. If you already own a pH/TDS meter, you have one already.

Pumps: http://www.aptinstruments.com

SP100FO (Fixed Output) (30rpm 115v 5.6ml/min using 3.0mm) 3 $67/$201 (Norprene Hose)

To simplify, you could just purchase a DUAL hose 1.1ml/min pump, prewired, in its own housing, similar to this:

Note: I've built a stand-alone (no pH) TDS doser using one of these for my 35g E&F table reservoir for 2 part nutrient. pH control is done via a DIY 130$ 5g bucket pH dosing unit.

For this project, I needed a slightly higher flow rate, so I went with different pumps from APT. Determine YOUR needs before blindly purchasing anything.

Home Depot:

Husky 8ft Medium Duty Tool Replacement Cord (16/2)	2	$8/$16
Husky 9ft Medium Duty Tool Replacement Cord (16/3)	1	$8
6' of 18/3 wire	1	$5
1/2" Cord Connectors (Non-Metallic)	3	$1.50/4.50
PVC Outlet Box w/ ½" conduit hole	1	$3
120v Outlet Receptacle	1	$2
PVC Outlet Face Plate	1	$2
6"x6"x4" PVC Conduit Box (to house controllers)	1	$10
½" PVC Conduit connector (top hat)	1	$1
Project Box from Radio Shack (dependent on # and size of pumps)	1	$8

Other items:
Small calibration screw driver
Calibration Solutions (pH and TDS)

The right tools make every job easier. Can't be a DIY'er without tools!

Tools:
Screw drivers
Drill and Misc Bits (Forstner and Regular)
Scroll Saw or keyhole saw
Wire Cutter/Stripper
Needlenose Pliers

Blue Wire Nuts
PVC Cement

Customizations:
If you want to get fancy, you can mix and match pump sizes, tubing, models, RPM's, etc. to properly dose a 1, 2 or 3 part nutrient, pH control AND additive(s). For example, when the TDS controller activates its relay, you could pump 15ml of A & B nutrient AND 1.5mls of an additive in a minute by using (2) SP200FO 30RPM pumps and a single SP100FO 8RPM pump. That could be extended to as many additives in whatever volume you wanted; as long as you understand it will always be dosed in a constant ratio (Think Lucas Formula).

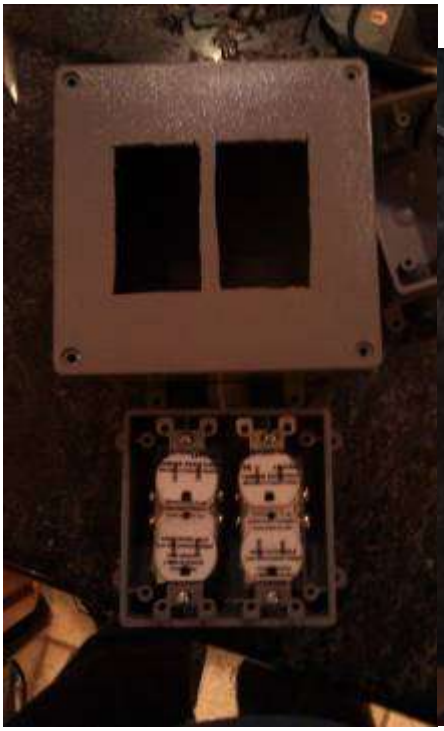
You could also utilize a constant power/timed outlet for controlled delivery of a given additive. I prefer to dose Silica at 20ml every other day(based on my res size). I could hook that pump up to a digital timer that has a schedule set for 3 minutes of run time, every other day on a SP100FO 30RPM (5.6ml/min) pump.

While these customizations are outside of the scope of this guide, the options are endless, but you need to decide what/how you plan on dosing prior to ANY pump purchases or wiring. Once you see it put together, I think it will 'click'.

See the pump charts at the end of the guide to determine the proper pump model and RPM ratings for pumps that will best suit your needs.

Again, Do NOT use these pumps for full nutrient solution change outs. They can burn out from extended use. These are meant to be used to <u>monitor and maintain</u> a solution, with a few minutes (60-240) of run time per day, not pump continuously for hours on end. Used in this fashion, the pumps will last for years, not weeks or months. Exception: If you utilize SP2/300's or have a very small reservoir. Again, DIY is all about customizing to suit your needs and not being 'stuck' with one way of using a product.

Here are a couple of layouts:



Dual outlet gangbox

Dual single outlet boxes

Pumps hardwired in (not remote)

I chose to use a single outlet box with a ‘split’ circuit. The pumps are in separate box, that can be located elsewhere on a wall. A set of pumps for nutrients are wired to one cord and plugged in to an outlet, the pH pump is wired to another cord and plugged in to the pH outlet. This also allows me to quickly and easily change out the pump box with different pumps, as explained above.

The outlet box has TWO ½” conduit holes, top and bottom. I will use the bottom hole for the pH and TDS probes to come out of. You can also have them come out of the controller box itself.

We need to drill some holes for the outlet box and the power cord connector to power the controllers and the outlet box. I wanted the ‘ears’ to be vertical for easier mounting on my wall. Line up the outlet box on the bottom of the controller box, offset it from the bottom to allow for the ‘lip’ that is on the inside of the controller box.

Mark it with a marker and drill the hole with a 7/8” forstner bit. This will take a ½” fitting.

Once through, I drilled another 7/8” hole in the corner for the power cord connector. Leaving room on both sides for the nut on the inside of the box. Choose which side you want the power coming in to the controllers. I chose the left side, but I could have also come in from the bottom (if not blocked by outlet boxes).

Cutouts for controllers:

Lay out the controllers on the 6x6 box faceplate which is turned upside down.

Trace around the controllers with your marker. Try to keep them closer to the middle of the box as you need some clearance for the power cord connectors inside the box.

Far from perfect tracing job…

If you are a perfectionist, use a straight edge/ruler to get it lined up perfectly.

Mount the cover back on the box UPSIDE down, use all 4 screws, just turned in, don't need to torque them down, just enough to hold the cover in place.

Drill small starter holes in the corners to allow your scroll saw blade in to finish it up. I used a ½" forstner bit. Keep the circle INSIDE the corner of your tracing.

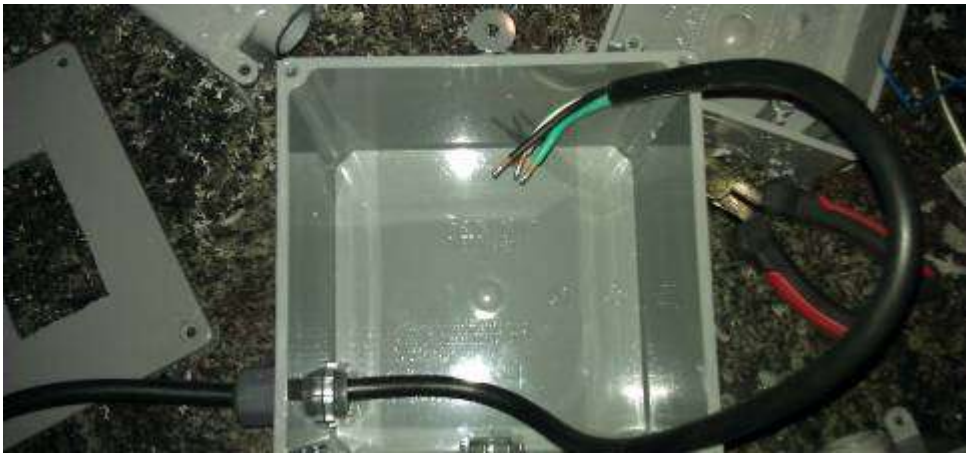
Use your scroll saw to cut out the spots for the controllers. I had to trim a few times to get them to slide in 'snugly'. You could also use your forstner bits and take out large chunks and file down the high spots. When cutting near the center piece, go VERY slow with the scroll saw, like 20RPM's as the cover will flex and you have the potential to break it, cut off a finger, etc. Let the saw do the work!

Power to the controllers:

Once the controller holes are made and cleaned up and you didn't break the cover requiring you to get another box, you can install the ½" cord connector for the power cable.

Run your power cord (16/3) cable into the connector. Feed the end cap parts on first.

Give yourself about a 16” of wiring through the box to allow you to wire the controllers comfortably. Slightly tighten the cord connector to hold the cable in place, we will pull out the excess cable from the box and tighten it up later.



Wiring the controllers:

This next step requires some pigtails for the power to the controllers.

I have lots of computer power supply cords around, so I cannibalized one of those.

Use your 6’ piece of 18/3 wire, cut (3) 12” sections and a (2) 6” sections.
From (2) 12” and the 6” sections, strip off the insulation jackets.
Leave the other (12”) section jacket on and take one 12” set of ‘stripped’ wires and set them aside.

Cut the 12” wires into (2) equal sections and strip ½” off of each end.
These are your ‘pigtails’.

Grab some wirenuts.

Wire the pigtails in to your power cord. Should be self explanatory…

Insert your controllers through the faceplate (the right way in).

The lower left of the controller is where the power feeds come in.

PE = Earth/Ground = GREEN
115V = White(neutral)/Black(hot)

With the other 6” section of wires, make (2) 1” ‘jumpers’.

These will go on the dosing relay.

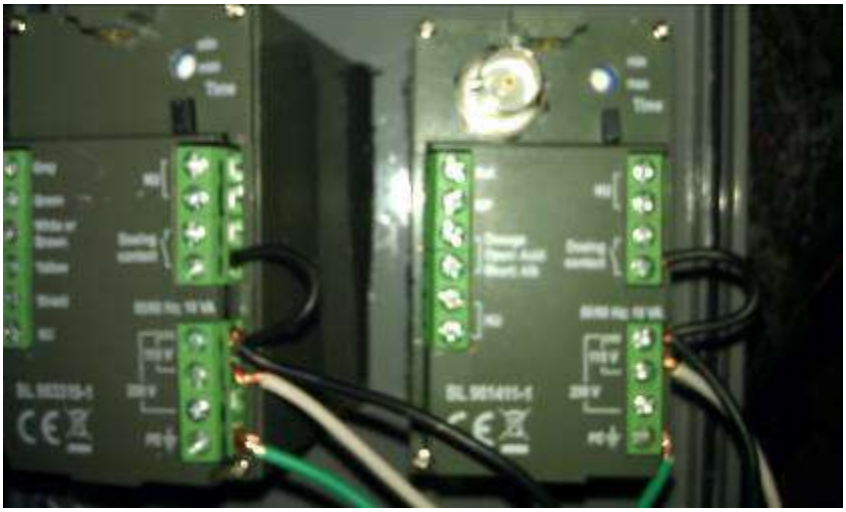
Note: If you are using the pH controller for pH UP, make a third jumper now.

Connect a pigtail to each controller, tighten retaining screw to hold Ground and Neutral. Do not overtighten!

Take the jumper wires and connect it to a ‘hot’ pigtail.

Insert the connected ends into the power block and tighten.

Insert the jumper wire into the dosing contact ‘hot’ side and tighten.



Now take the remaining insulated 12” wire that you set aside, strip off several inches of insulation on both sides. Take a single ‘stripped’ 12” black wire and tape it along side the insulated wire with electrical tape. This wire set will go to the outlets. For mine, I am creating a ‘split circuit’; each outlet will be powered/controlled individually. So I want 2 hots(black), and a shared neutral and ground.

Connect one hot to the other side of the dosing contact on one controller and the other hot to the other controller. Remember which ‘hot’ is to which controller. I used the ‘taped’ wire to go to the pH controller.

Undo your wire nuts at the pigtails on Ground (green) and Neutral (white), tie the wires in to them and put the wire nuts back on.