

Build Guide for Project BruteForce2 IONI based Wheel

Project BruteForce2 designed by Philip Jansen van Rensburg

Build Guide by Jason Sandlin

Thanks to Jason Jodarski for reviewing and providing feedback

v1.04

This is a guide on how to build on Project BruteForce2 Ioni based by Philip Jansen van Rensburg (aka Beano)

Like many folks, I got interested in direct drive wheels after watching Sim Racing Garage's Direct Drive FFB Wheel System Comparison video, where the OSW wheel won top marks: <https://youtu.be/fnugyXhVsZI>

After reading hundreds of pages of forum posts while taking lots of notes in OneNote, I realized there's a lot of complexity in trying to build a direct drive wheel and there isn't a good comprehensive guide that covers:

- All the choices you need to make
- Tips on how to actually build it
- How to setup the software

That's what I hope to cover in this guide. If you see anything wrong, please feel free to PM me on iRacing. Please post any questions you may have to the iRacing forum in the project page as I'm not an expert like the folks who designed it -- I'm just hoping this will save some folks time :)

Which model to build?

The first big decision is figure out which direct drive wheel model to build.

At the time of this writing, there seem to be 3 major DIY direct drive wheel projects:

- 1) A **true OSW wheel** as seen in the Sim Racing Garage. The OSW wheel was designed by Bernhard Berger. It uses the Bernhard's API custom driver and Argon controller.
- 2) **Project BruteForce based on the Argon controller**. This has the ability as I understand to use either software stack: Bernhard's API or the MMos driver.
- 3) **Project BruteForce2 based on the IONI controller**. This only run with the MMos driver, but the main advantage is that it is cheaper build.

I asked Bernhard Berger what his thoughts were comparing two different software stacks (MMos vs his API) as I was worried that the API would be far superior to MMos given that glowing comments about OSW in the youtube review. But Bernhard said that MMos is more up to date than the API and MMos has been working flawlessly. He has plans to improve his software but you can ask with him if interested in that path. So that is good news for builders of Project BruteForce2 which only can use the MMos driver as of right now. In addition, as I understand it, Bernhard's API is only designed to work with a few games such as iRacing whereas the MMos controller appears in Windows as a typical wheel so most racing games will work with it.

For option #2, the Argon can run either software stack to compared to option #3 which can only run the MMos stack. However when using MMos driver, both Argon and Ioni function pretty much identical. The Argon has it's HV DC power supply and servo control all built into one box making it a slightly smaller build, it is also capable of delivering slightly more power. However on the horizon is a new component called an Ionizer, which is an add-on for the Ioni which will increase it's power output surpassing what the Argon can do. The Ioni requires it's own separate power supply making a slightly larger footprint, but using the Ioni over the Argon is about \$100-150 cheaper.

So for me the best choice was #3, Project BruteForce2 based on the IONI controller using the MMos software stack. And that's the project I'll be focused on in this guide.

After landing which model to build, the project is described in detail on this forum thread:

<http://members.iracing.com/jforum/posts/list/3312320.page>

This is good reading but after reading the first 70 pages of posts, there's a lot of flexibility in how exactly to build this project.

Let's go through the options.

Which motor to use?

First there's a choice of which motor to use. This is a hotly debated topic.

Here are the popular options with my notes about each:

- 1) **Kollmorgen AKM53**. This motor was used Sim Racing Garage's review video in the OSW build. It is reported that the Lenze and AKM53 have similar power but the Kollmorgen is a touch smoother. It was highly rated, however it is hard to buy it, and it is expensive.
- 2) **Lenze MCS12H15L**. This motor can be found but it is expensive at around \$1600 for the motor alone. It is rated to be better than the MiGE, but overall the consensus seems to be that while better the price doesn't justify the cost.

- 3) **“Large” MiGE 130ST-M10015.** Beano said in a post that “something to note about small vs large vs middle MiGe (M10015) - at this point both Argon and IONI can drive the small MiGe to full 20NM potential, and beyond, but the large MiGe can only get to ~22NM because of its lower NM/A rating and hence higher current requirements.”
- 4) **“Small” MiGE 130ST-M10010.** This is as far as I can tell the most popular option. It is the cheapest and declared to be the best bang per dollar by folks who have compared these motors side by side.

Here's what Beano said in a [forum post](#):

“There is no doubt that my Lenze is a much higher quality motor than my MiGes, but, I enjoy running all three, with hardly a noticeable difference between small and big MiGe, whilst Lenze is certainly a better motor with faster and harder response, one has to ask if the difference is that big to justify spending that huge sum....

If you can afford it, go for it, but, if you can only afford the small MiGe, it is one hell of a good motor for this application.....”

Given this, the best choice for me was thankfully also the cheapest choice, the “Small” MiGE.

Which power supply to use?

The popular options seem to be:

- 1) MeanWell 48V 600W PSU
- 2) Antek 600W linear PSU, PS-6N50N24
- 3) Antek 800W linear PSU, PS-8N50N24

The Antek PSU seems to be the better option since as the project page says “this option is the preferred one, as Linear PSU's can provide high current for very short bursts”. Its not clear if Antek 800W is much better than Antek 600W, but if you can afford the extra \$10 then I would recommend the 800W version.

If you order from the Antek website, be sure to use the drop down and select “PS-8N50N24” because this model contains both a 50V and 24V power and both are needed.

Which design to use?

Even when using the IONI based build, there's still a lot of choice on which components to use. Here's the popular options at the time of this writing:

- 1) IONI 4x Cube + IONI Pro Drive + STM32 Discovery card
- 2) Sim-PLE board by Ollie Aina + IONI Pro Drive
- 3) IONI 1x Cube + IONI Pro Drive + STM32 Discovery card
- 4) IONI 1x Cube + IONI Pro Drive + STM32 Discovery card + Dennis adapter

There didn't seem to be any real upside to the 4x Cube, so I ignored option 1 as its a more expensive option. Note that the 4x cube is it doesn't require a braking resistor.

When I ordered my build, the Sim-PLE packages weren't available. If it is, then it definitely is worth looking into as it should simplify the wiring as it is an "All-in-one" board. Here is a good description of it: <http://members.iracing.com/jforum/posts/list/225/3312320.page#8956866>. Contact Ollie Aina for more details.

The different between option 3 & 4 is the Dennis adapter board. Dennis Reimer designed and built adapter boards for the Argon based project to help simplify the wiring and they also work on this IONI based project. But I don't believe it is worth it for this project as it boils down to only avoiding the need for 4 wires. I'll talk more about this later when we get to the wiring section.

So I recommend going either option 2 or 3.

Which rim to use?

There's a lot of choice here.

A popular rim seems to be the MOMO MOD 30:

<http://www.momousa.com/racing/steering-wheels/mod-30buttons.html>

It is a favorite of Barry as reviewed here <https://www.youtube.com/watch?v=CUJaqtrLOSI>, just ignore the custom buttons box by Sam Maxwell in this video.

But I'm not fond of suede in the MOD 30 as I don't wear racing gloves and suede tends to fade over time. I personally browsed MOMO's selection and chose to go with the MOMO RACE 320mm wheel as I like the feel of top grain leather. It's an expensive rim at \$270, but very nice. <http://www.momousa.com/tuning/steering-wheels/race.html>

I noticed a lot of folks order a rim on eBay. Just take care to order from a reputable source or you could end up with junk as seen here: <https://youtu.be/SMxB4RpCDzA>

A few more choices left

Some other things to consider:

- 1) **Do you want paddles or buttons on the wheel?** If you do, then you can go with a wireless system by ordering a Fanatec Universal hub, gutting it, and putting inside it inside a bluetooth card so it can send wireless button presses to your PC. This is described in detail in this post:

<http://members.iracing.com/jforum/posts/list/3325082.page>.

I did do this, but I won't go into detail on this in this guide as it's basically a separate project. If you're going to go with this option, you do need to keep in mind that the Fanatec hub requires a 50mm wheel side adapter (instead of the typical 70mm adapter). The Fanatec hub can then attach many different wheels including wheels with a 70mm pattern.

- 2) **Do you want a quick release?** You don't need one, but it makes the wheel easy to detach. It's a nice option but it is pricey at around \$150 extra. I did choose to do this as well.

- 3) **What shifter and pedals are you going to use?** Unlike some mass market wheels, these DIY wheels don't have pedals or H-shifters built in. So you may need to buy (or make) USB H-shifters and pedals. I'm personally right now leaving my old T500 wheel plugged in but unmounted in order to also to use the T500 pedals with my BruteForce2 wheel but a better option would be to buy a separate set. I personally like the Fanatec shifter & pedals as stand alone USB devices but they are pricey. There's lots of other options if you search around.

Parts List

Your parts list may differ if you made different choices, but here's what I bought with notes.

Note that a lot of these parts come from overseas if you're in the US and take a while to get in hand. However all the green highlighted items, I recommend talking to Joe Sullivan if you're in the US as he has a stockpile of these parts in the United States and his prices and shipping rates are very good. Here's his forum thread:

<http://members.iracing.com/jforum/posts/list/3325366.page>

Source	Name	Price	Link	Notes
Adafruit	Mounting Kit \$3 + \$4 shipping	\$7.00	https://www.adafruit.com/products/1116	
Amazon	Jumper Wires	\$9.00	http://smile.amazon.com/gp/product/B00JUKL4XI?psc=1&redirect=true&ref=oh_aui_detailpage_o09_s00	

Amazon	Ferrite Choke Cores	\$5.00	http://smile.amazon.com/gp/product/B007Q94DBK?psc=1&redirect=true&ref=oh_aui_detailpage_o01_s01	
Antekinc	PS-8N50N24	\$160.00	http://www.antekinc.com/ps-8n50-800w-50v-power-supply/	Talk to Joe Sullivan also
DigiKey	Brake resistor 6.8 OHM 100W	\$15.00	http://www.digikey.com/product-detail/en/0/A102366-ND	You can also use the 10 OHM 100W version. Don't go too low or too high here or you may end up with errors.
DigiKey	Fuse holder	\$3.70	http://www.digikey.com/product-detail/en/0/283-2851-ND	
DigiKey	5x fuses (4 extra)	\$4.60	http://www.digikey.com/product-detail/en/0/283-2607-ND	
DigiKey	USB converter	\$16.40	http://www.digikey.com/product-detail/en/0/SC1837-ND	
DigiKey	2x diode 1N4001 (1 extra)	\$1.00	http://www.digikey.com/product-detail/en/0/1N4001GP-E3%2f54GICT-ND	
DigiKey	Power filter 10A	\$8.00	http://www.digikey.com/product-detail/en/858-10%2F015/Q469-ND/1494934	
DigiKey	Main Power Switch	\$1.30	http://www.digikey.com/product-detail/en/CRE22F2BBRLE/CH809-ND/446075	
Digikey	USB Thru Connector	\$16.40	http://www.digikey.com/product-search/en?Keywords=sc1837-nd&WT.z_header=search_go	
eBay	D-SUB DB15 2Row 15Pin	\$6.30	http://www.ebay.com/itm/D-SUB-DB15-2-Row-15Pin-Male-Plug-Breakout-Board-Terminals-Connectors-/181569546620?hash=item2a4663697c	
eBay	Industrial EStop	\$15.00		I bought one used on eBay, but there's a bunch of styles on Amazon and Digikey also. You could even use a simple switch if you wanted a cheaper build.
eBay	STM32F4DISCOVERY	\$23.00	http://www.ebay.com/itm/ST-STM32F4-DISCOVERY-USB-Development-Tool-USA-S-TM32F4DISCOVERY-STM32-ARM-Board-/160731358953?pt=LH_DefaultDomain_0&hash=item256c55e6e9	Talk to Joe Sullivan also
eBay	Martin Asher Servo Mount	\$70.00	http://www.ascher-racing.com/shop/mige-mounting-bracket/	Talk to Joe Sullivan also
Granite	Ioni Pro Drive	\$196.00	http://shop.granitedevices.com/product/54/ioni-pro-servo--stepper-drive	Talk to Joe Sullivan also

Granite	Inoicube 1x	\$82.00	http://shop.granitedevices.com/product/64/ionicube-1x-single-axis-motherboard	Talk to Joe Sullivan also
Granite	Smv2 USB adapter	\$20.00	http://shop.granitedevices.com/product/32/simplemotion-v2-usb-adapter	Talk to Joe Sullivan also
Mige	Motor Small Mige	\$350.00	http://www.aliexpress.com/item/PM-Servo-Motor/267482883.html	Talk to Joe Sullivan also
Mige	Cables with wheel side connectors installed	\$30.00	Email Lisa Zhan @ MiGE at hzmgdjzhan@gmail.com, skype: lisazhan1	Talk to Joe Sullivan also
BeyondMonkey	OSW Adapter	\$37.50	http://beyondmonkey.com/pub/osw/osw.html	Talk to Joe Sullivan also
BeyondMonkey	Q1R 50mm wheel side adapter WARNING: Know what you're attaching this to. If you want to do the wireless button project then use 50mm, otherwise 70mm may be a better choice here for most rims	\$64.00	http://www.beyondmonkey.com/pub/q1r/q1r.html	Talk to Joe Sullivan also
BeyondMonkey	Q1R quick release plate	\$72.00	http://www.beyondmonkey.com/pub/q1r/q1r.html	Talk to Joe Sullivan also
Momo	Momo Race 320mm rim	\$272.00	http://www.momousa.com/tuning/steering-wheels/race.html	Choose the rim you like best
NewEgg	Coolmaster Elite 130	\$35.00	http://www.newegg.com/Product/Product.aspx?Item=N82E16811119286	
eBay	3 prong power supply cable	\$2.00	http://www.ebay.com/itm/New-3-Prong-A-C-Power-Supply-Cable-Adapter-Cord-LC-D-PC-Hot-/161606800906?pt=LH_DefaultDomain_0&hash=item25a084160a	You may already have one of these cables if you have spare computer parts
Amazon	22 gauge solid wire	\$15.00	http://smile.amazon.com/Hook-Up-Wire-Kit-Colors-WK-103/dp/B008L3UXO6/ref=sr_1_3?ie=UTF8&qid=1439349305&sr=8-3&keywords=22+gauge+solid+wire	Also can be found in local HW stores
	14 gauge stranded wire	\$20.00	Send me a link and I'll include it	Found this at a local HW store
Amazon	DB15 male to female cable	\$5.00	http://smile.amazon.com/Monoprice-6ft-D-B15-Molded-Cable/dp/B002LWJ7TA/ref=pd_sim_sbs_23_11?ie=UTF8&refRID=0YV77G7VMCVKKE52GPMZ	
Adafruit	Bluefruit EZ-Key - 12 Input Bluetooth HID Keyboard	\$20.00	https://www.adafruit.com/products/1535	Only needed for wireless button project

	Controller			
Adafruit	Bluetooth 4.0 USB Module	\$11.00	https://www.adafruit.com/products/1327	Only needed for wireless button project
Adafruit	Lithium Ion Polymer Battery - 3.7v 2500mAh WARNING: I haven't tested this battery will fit. Do research before ordering	\$15.00	https://www.adafruit.com/products/328	Only needed for wireless button project
Adafruit	USB Lilon/LiPoly charger	\$12.50	https://www.adafruit.com/products/259	Only needed for wireless button project
Adafruit	Switch for bluefruit power	\$1.00	http://www.digikey.com/product-detail/en/DA102J12S215HQF/401-1287-ND/566765	Only needed for wireless button project
Fanatec	ClubSport Steering Wheel Universal Hub US	\$186.00	http://www.fanatec.com/us-en/steering-wheels/clubsport-steering-wheel-universal-hub-us.html	Only needed for wireless button project
	Total without rim & wireless buttons	1,290		
	Total with rim & wireless buttons	1,807		

What tools do you need?

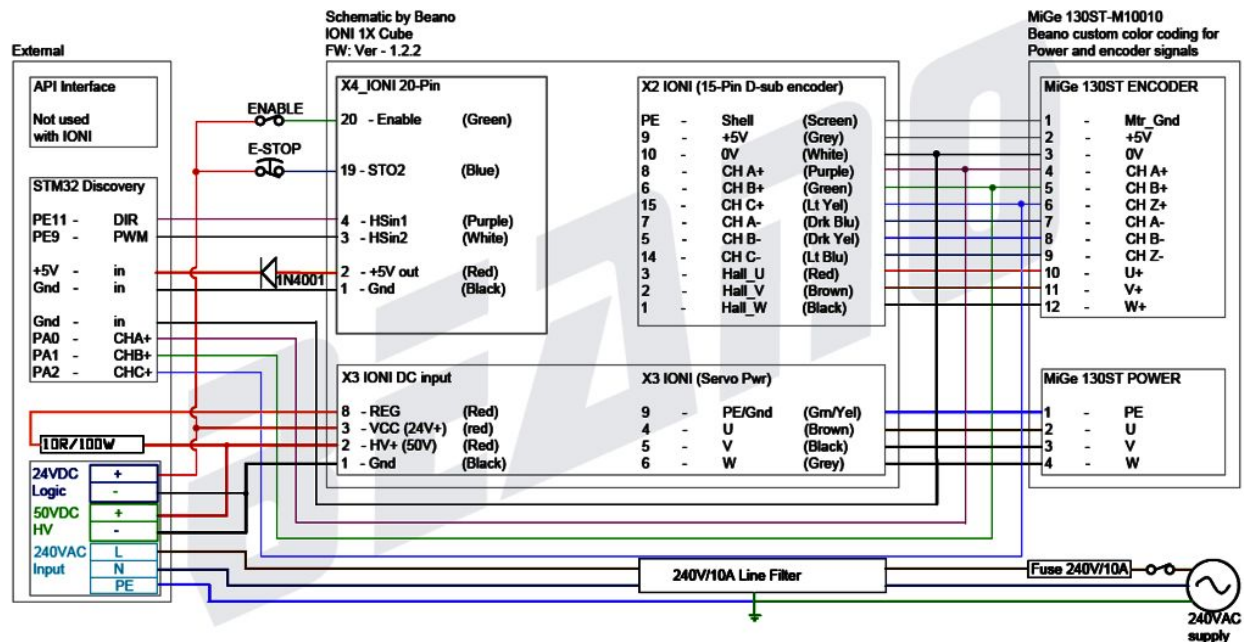
- 1) **Soldering iron.** You'll need a soldering iron. You don't need a fancy model for this project as most of what you'll be doing is soldering wires together and any cheap soldering iron can do this. If you don't solder often, at least watch 1 min of this video on how to properly solder and tin wire: <https://youtu.be/BLfXXRfRlZY?t=3m14s>.
- 2) **Helping hand.** Super useful when soldering. There's lots of choice here. Here's the one I use which has a nice built in ring light which is very useful: <http://smile.amazon.com/dp/B00IK4WHA4>
- 3) **Heat shrink.** Its also a good idea to have invest in heat shrink wrap for wires and a heat gun or torch: <https://youtu.be/LD9kBax1DDk>. Its a lot easier to use than electrical tape. Here's some links of what I use:
Wrap: <http://smile.amazon.com/dp/B00EXLPLTW>
Torch: <http://smile.amazon.com/dp/B005FN0ZCK>
- 4) **Wire strippers.** I personally recommend self-adjusting wire strippers. They are very nice. Here's one: <http://smile.amazon.com/dp/B000OQ21CA>

- 5) **Multimeter.** You don't need anything fancy for this project. Anything will do that has connectivity mode (beeps when the leds touch) and DC & AC voltage readouts. Here's a cheap one I use: <http://smile.amazon.com/dp/B00KHP6EIK>

Starting the build

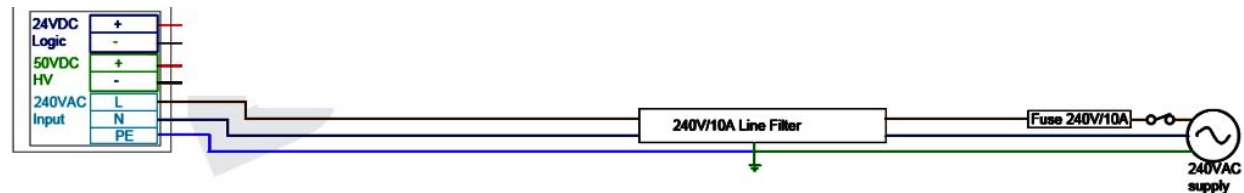
After you have all or most of the parts on hand, here's how to get started.
We're going to be using Beano's schematic as the guidepost through the build.

Note that I rotated some of the colors in this picture vs the original to make the yellow wires pop off of the white background more.



Step 1: Wire up the power supply

The first step is to focus on this part of the build:



Notice that this schematic says to use 240V, but in the United States household power is 120V and luckily the Antek power supply supports 120V. So we're going to wire these parts together:

DigiKey	Fuse holder	3.70	http://www.digikey.com/product-detail/en/0/283-2851-ND
DigiKey	5x fuses (4 extra)	4.60	http://www.digikey.com/product-detail/en/0/283-2607-ND

DigiKey	Power filter 10A	8.00	http://www.digikey.com/product-detail/en/858-10%2F015/Q469-ND/1494934
DigiKey	Main Power Switch	1.30	http://www.digikey.com/product-detail/en/CRE22F2BBRLE/CH809-ND/446075

Antekinc	PS-8N50N24	160.00	http://www.antekinc.com/ps-8n50-800w-50v-power-supply/
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eBay	3 prong power supply cable	2	http://www.ebay.com/itm/New-3-Prong-AC-Power-Supply-Cable-Adapter-Cord-LCD-PC-Hot-/161606800906?pt=LH_DefaultDomain_0&hash=item25a084160a
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I wired these parts up in slightly different order than the schematic.

Starting with the power filter "Line" plug, using the 16 gauge wire, I wired it to the fuse holder and then on to the switch. Be sure put a fuse inside the fuse holder. Obviously leave the power filter unplugged from the wall unless you are testing your build.



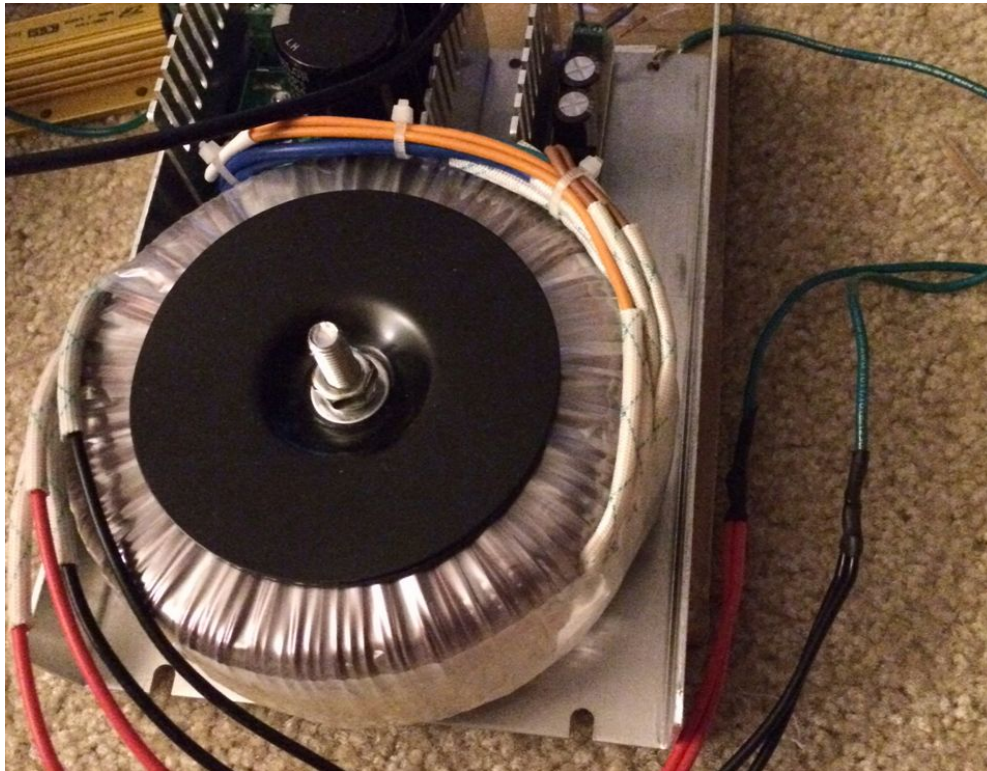
My switch has a LED to know when the power is on, so I also had to run a wire to it from the “load” side of the power filter. Once you have the line filter, fuse, and switch hooked up then carefully plug it in and use your multimeter on AC voltage mode to check that 120V is properly

flowing to the switch and stops when you flip it, and if you have an LED switch that the LED turns on properly.

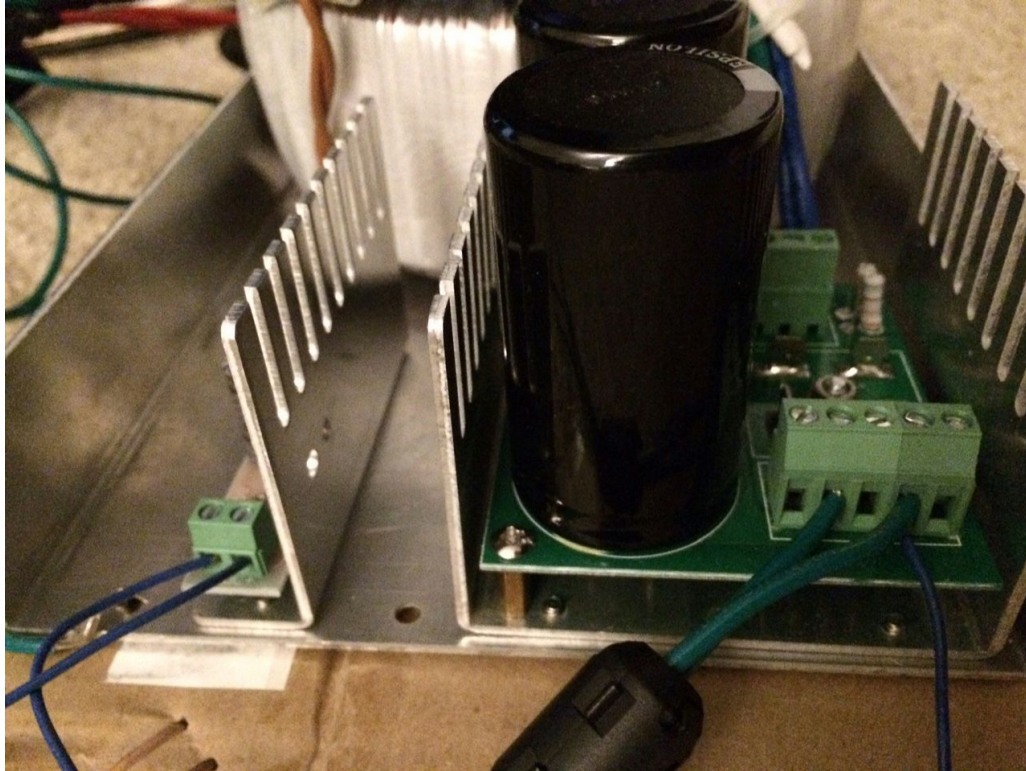
Now you'll need to wire the "load", "line", and ground wires to the Antek.

For the ground, I simply wrapped it around Antek metal shell.

For the Antek to accept 120V input, you simply merge the Antek's two reds lines together and solder it to the "load", and merge the Antek's two black lines together and solder them to the "line" (aka "hot").



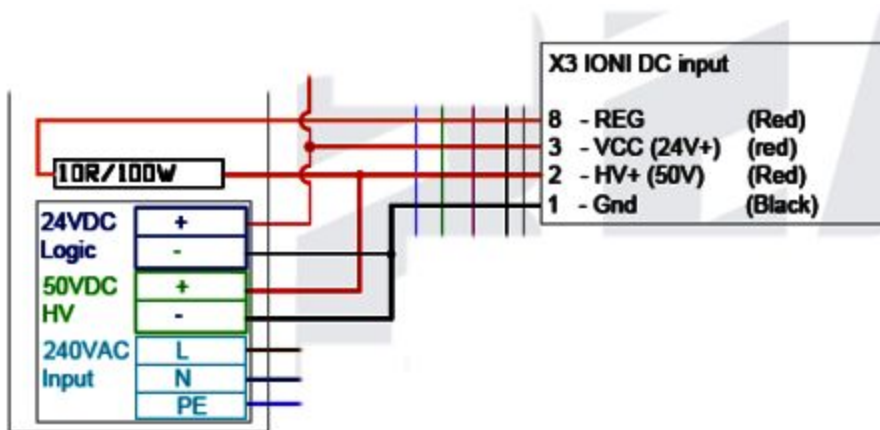
Now you should test the build so far, and hopefully it doesn't blow up. Use your multimeter and confirm your getting near 24V on the smaller outputs shown below on the left, and 49V near the larger outputs shown on the right. For some reason the Antek has 2 sets of 50V outputs and a center pole [if someone understands why there are 2 sets of 50V outputs, please provide info and I'll update]. I chose to hook up to the inner pair as shown:



If you got this far, hurray! You have power and are ready for the next step in the project

Step 2: Power up the IONI

Next, we'll focus on this part of the schematic:



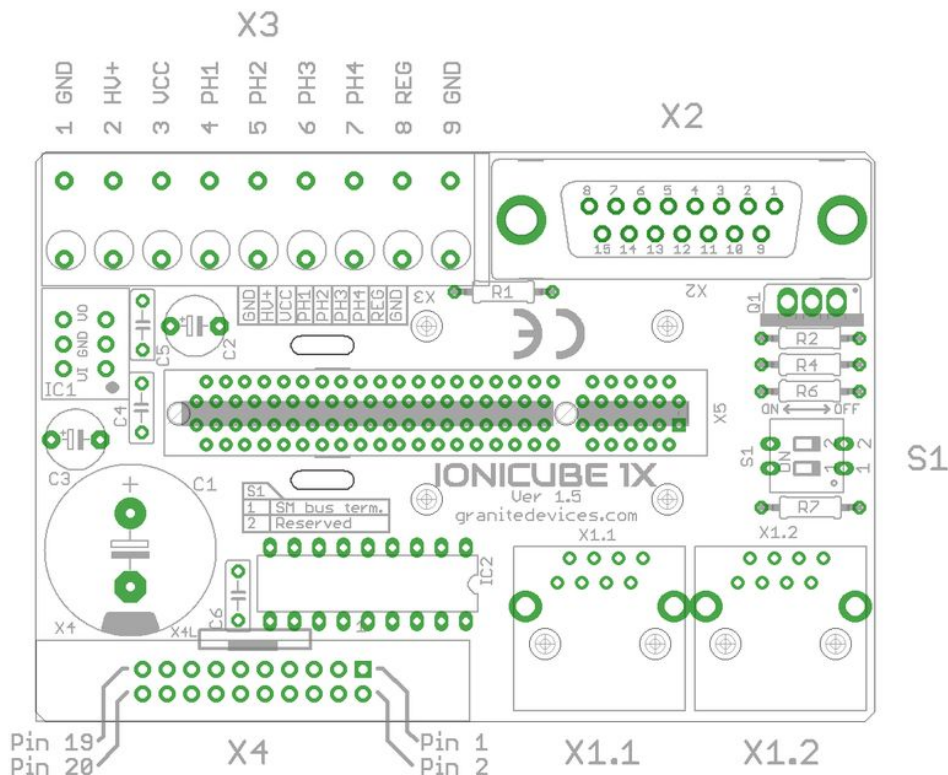
We'll be using these parts:

DigiKey	Brake resistor 6.8	15.00	http://www.digikey.com/product-d
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	OHM 100W		etail/en/0/A102366-ND
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Granite	Ioni Pro Drive	196.00	http://shop.granitedevices.com/product/54/ioni-pro-servo-stepper-drive
Granite	Inocube 1x	82.00	http://shop.granitedevices.com/product/64/ionicube-1x-single-axis-motherboard

This part is pretty straight forward. For the IONI cube, we'll be using the schematic from http://granitedevices.com/wiki/IONI_%26_IONICUBE_user_guide/Wiring_overview_with_IONICUBE_1X as our guide:



For this section, just wire it up like the schematic shows to the IONI cube into the ports of X3. They are spring loaded so all you need to do is tin the wire and push it in the holes. I used 14 gauge wire for the 50V and the 22 gauge wire for the 24V power lines. Be sure to double & triple check that you didn't miss wire this section. Running 50V into the wrong pin will fry the device.

That "10R/100W" in the schematic is the brake resistor. I don't think it matters which direction brake resistor is wired [if someone knows, let me know]. Also be aware that 50V high amps are

running through this resistor so be sure to cover the ends with heat shield or electrical tape so nothing accidentally touches it.

Also be sure to insert the Ioni Pro drive into the slot when the power is off. Take care there's no power to the IONI when inserting or removing the Ioni Pro or you will damage the drive according to the wiki.



Step 3: Wire up the E-Stop

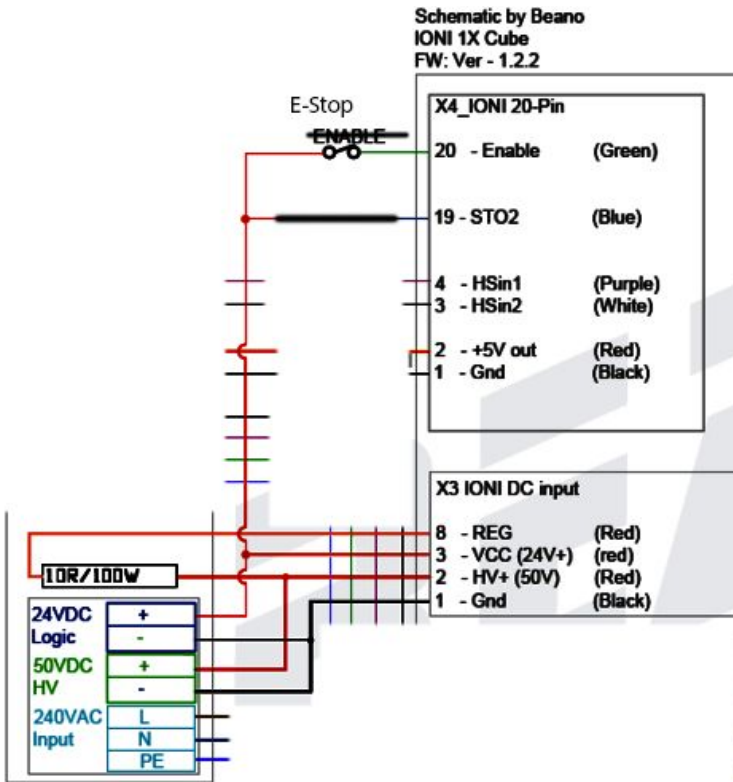
Here we'll be adding these parts:

Amazon	Jumper Wires	9.00	http://smile.amazon.com/gp/product/B00JUKL4XI?psc=1&redirect=true&ref=oh_aui_detailpage_o09_s00
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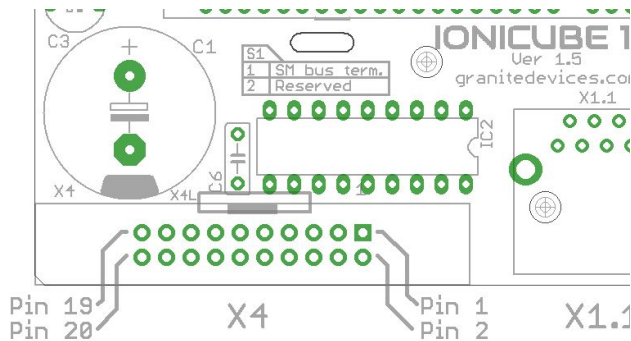
eBay	Industrial EStop	15.00	
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For this, I did something different than the original schematic based on advice from folks on the forums. If you wire up your E-Stop switch to pin 19's E-Stop switch then it causes the device to get a "fault" which means you have to Alt-Tab and load software to clear the faults.

So it is recommended that instead you hook up the E-Stop switch to the Enable button. This means no fault happens but it works just the same, like so:



Here we'll wire up to X4 on the IONI Cube. The schematic shows how the pins are numbered. I use the small jumper wires to easily connect wires to each of the pins



Step 4: Wire up the Discovery

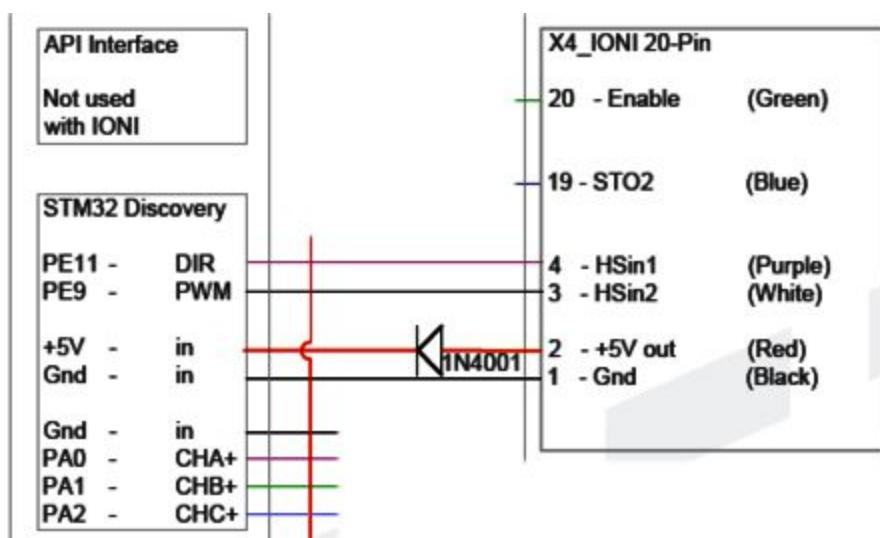
Here we will be adding these parts:

eBay	STM32F4DISCOVERY	23.00	http://www.ebay.com/itm/ST-STM32F4-Discovery-USB-Developme
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			nt-Tool-USA-STM32F4DISCOVERY-STM32-ARM-Board-/160731358953?pt=LH_DefaultDomain_0&hash=item256c55e6e9
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DigiKey	2x diode 1N4001 (1 extra)	1.00	http://www.digikey.com/product-detail/en/0/1N4001GP-E3%2f54G/CT-ND
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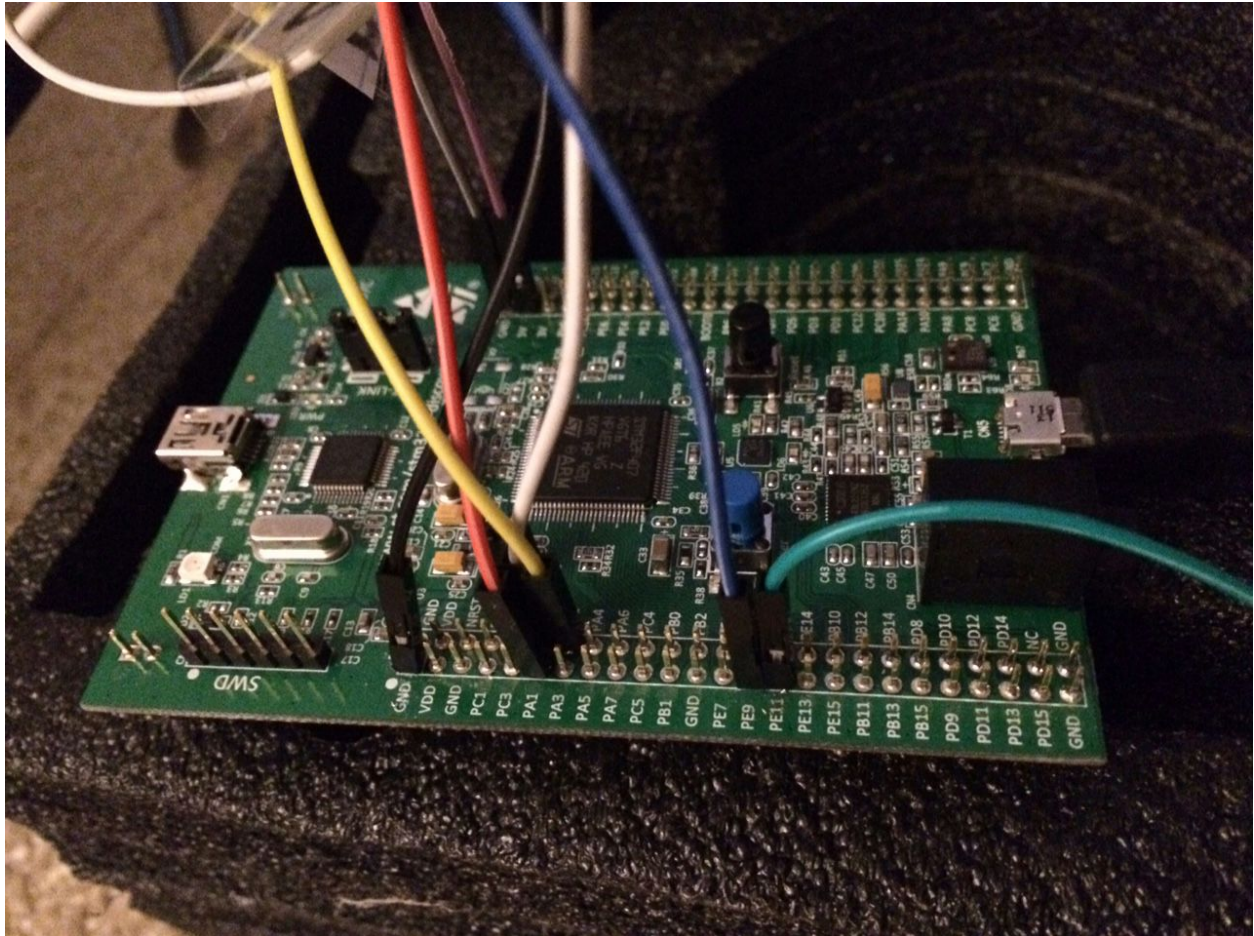
Here's the part of the schematic to focus on:



The Discovery board itself has clear labels of the various pins. Again I used the jump wires to make it easy. You can even add a tiny bit of solder to the pins to make the jumper wires stick to the pins if you want ensure they don't come loose.

For pin 2, wire in the diode using jumper wires. The painted line on the diode itself should be on the Discovery side. This allows power to flow IONI to the Discovery but not backwards.

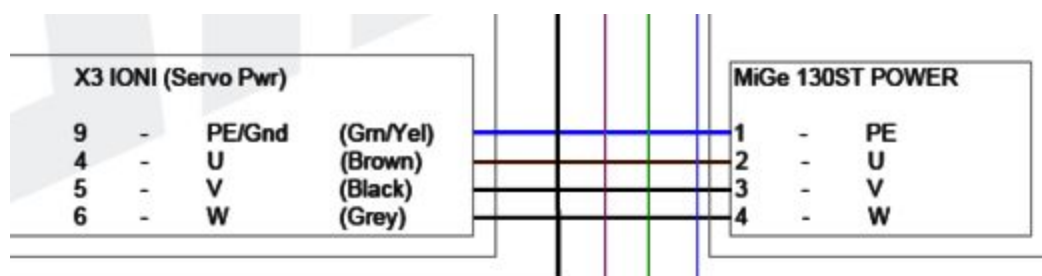
In the picture below, ignore the jumper wires in the picture labeled PA1-PA2 and since we haven't got there yet.



Now is a good time to stop and test the build so far with power. You don't yet have the motor connected, but you can turn it on and you should see both the IONI 1x and Discovery power on and flash their LEDs. [if anyone knows exactly which LEDs should be blinking at this point, please let me know and I'll add it here]

Step 5: Wire the motor power

We'll be focused on this part of the schematic now:



There's 2 cables that run to the motor that you should have.

One cable has with 4 wires and the other cable has a lot of tiny wires.
Here we'll be using the cable with 4 wires.

Map each of the wires in the pins using your multimeter using beep mode so if the leads touch it beeps. The numbers of each pin is written on the side of the cable that you plug into the motor. Ignore the colors in the schematic since the wire color won't match. Take great care again not to mess this up or you may damage the drive. I personally labelled each wire using simple clear tape and paper. Double check your labels and double where each wire runs into the IONI.

Step 6: Wire up the motor controller

You'll be using these parts:

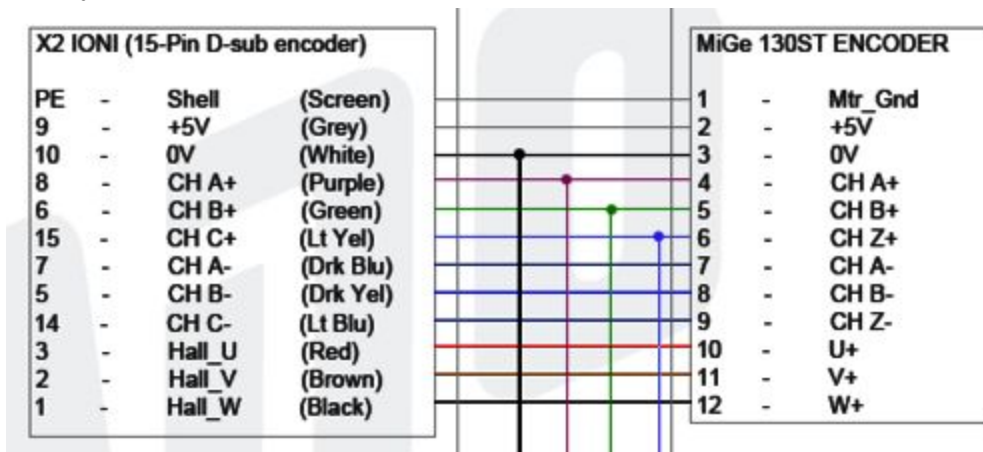
eBay	D-SUB DB15 2Row 15Pin	6.30	http://www.ebay.com/itm/D-SUB-DB15-2Row-15Pin-Male-Plug-Breakout-Board-Terminals-Connectors-/181569546620?hash=item2a4663697c
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Amazon	DB15 male to female cable	\$5	http://smile.amazon.com/Monoprice-6ft-DB15-Molded-Cable/dp/B002LWJ7TA/ref=pd_sim_sbs_23_11?ie=UTF8&refRID=0YV77G7VMCVKKE52GPMZ
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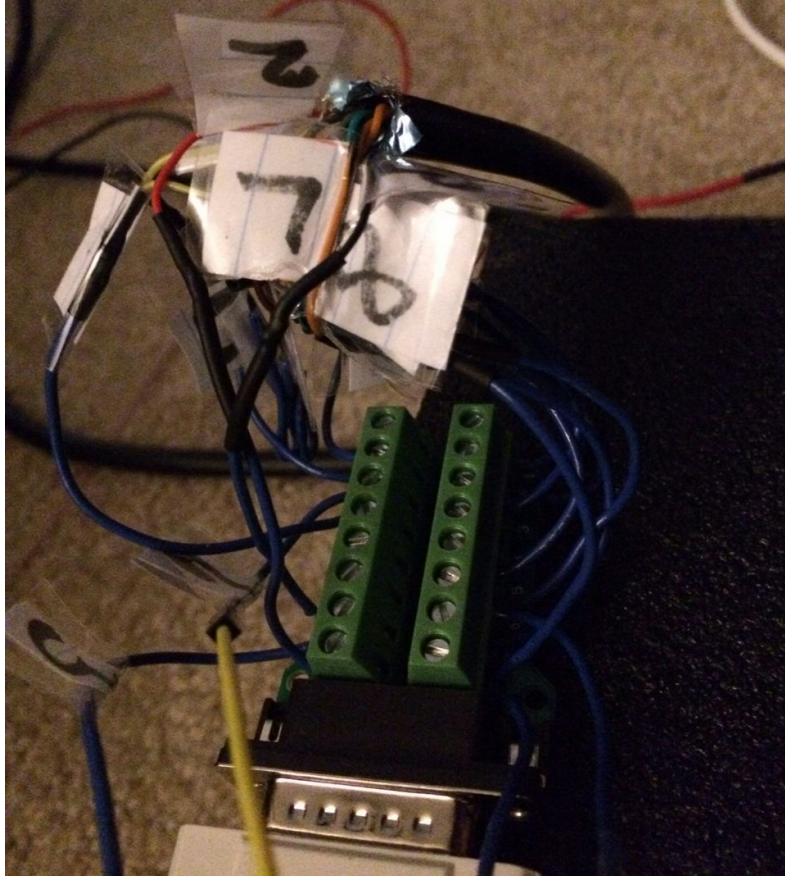
Now again map each of the wires in the pins using your multimeter using beep mode so if the leads touch it beeps. Here's a clear map of the pins. I labeled each wire. It gets pretty messy but at least its easier to verify



Once you've done that focus on this part of the schematic:

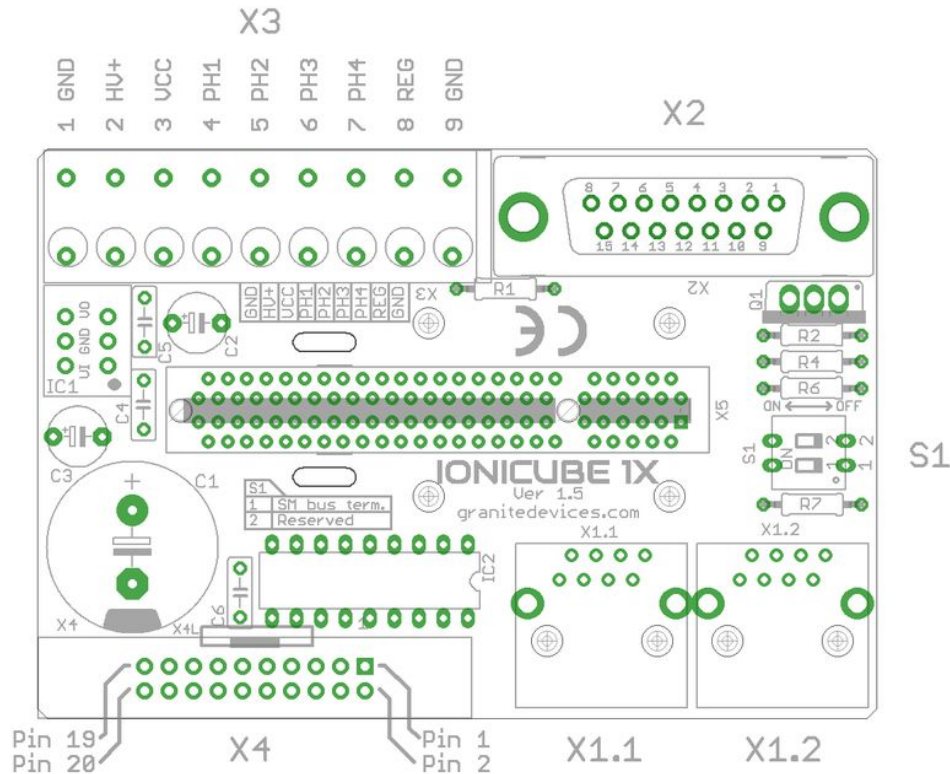


Now that for pins 3,4,5,6 you'll need to split those out to wire them into Discovery board later. Once each of the wires for the cable are label, wire them into the D-Sub DB15 breakout like so:



Once that's done, double check with the multimeter again to confirm each pin on this breakout board ends up in the right pin at the end of the motor cable.

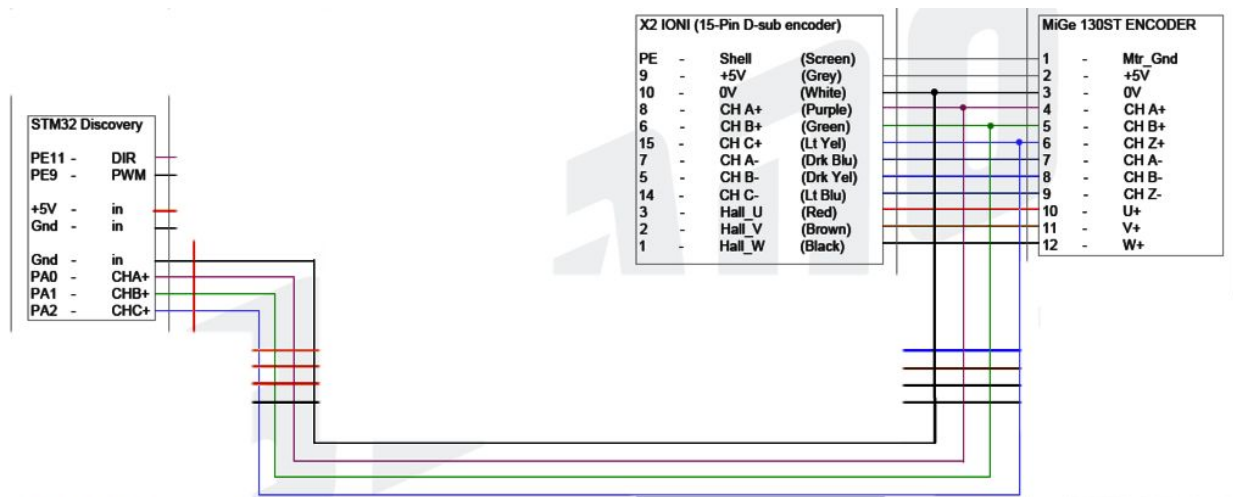
Now attach the DB15 male to female cable between this breakout board and the IONI. I'll fit right into the X2 slot:



Step 7: Wrap up the loose ends

1)

Now you'll have those 4 wires from the DB15 breakout board. Wire them up to the Discovery board using jumper cables like so:



Optional tangent about the Dennis board:

These 4 wires aren't needed if you using the Dennis adapter board but by now there's so much wiring already needed, a few extra wires won't be a big deal. To be more precise, you can also avoid any wiring to slot X4 also if you get the Dennis adapter board as well as another board that Dennis made called the "Dennis IONI 1X adapter board" which allows you to a run a flat 20 pin cable from the IONI 1x adapter board to the IONI. But this has its own complexity because you then you can't wire up an E-Stop easily, and you must use another part called the SMV2BRK which allows you hook the enable or e-stop. But to keep it simple and follow Beano's schematic more closely, I don't recommend any of these optional boards. If you want for less wiring, I recommend taking a look at the SIM-ple board by Ollie.

2)

Hook up the a micro usb to the Discovery board to the PC. This will be how the PC interacts with the wheel via a force feedback wheel device driver.

You'll need to hook the mini USB port of the Discovery board to the PC to flash the firmware. This is a temporary connection. Once your done flashing, you can disconnect this. We'll cover flashing in the next step.

3)

Hook up the ethernet port (either one) to the SMV2 USB adapter, and then connect that into the USB through connector.

Granite	Smv2 USB adapter	20.00	http://shop.granitedevices.com/product/32/simplemotion-v2-usb-adapter
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Digikey	USB Thru Connector	16.40	http://www.digikey.com/product-search/en?Keywords=sc1837-nd&WT.z_header=search_go
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4)

Now is a good time to put on those Ferrite Chokes as these prevent EMI interference.

Amazon	Ferriate Choke Cores	\$5.00	http://smile.amazon.com/gp/product/B007Q94DBK?psc=1&redirect=true&ref=oh_aui_detailpage_o01_s01
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This wiki page talks about good places to put them:

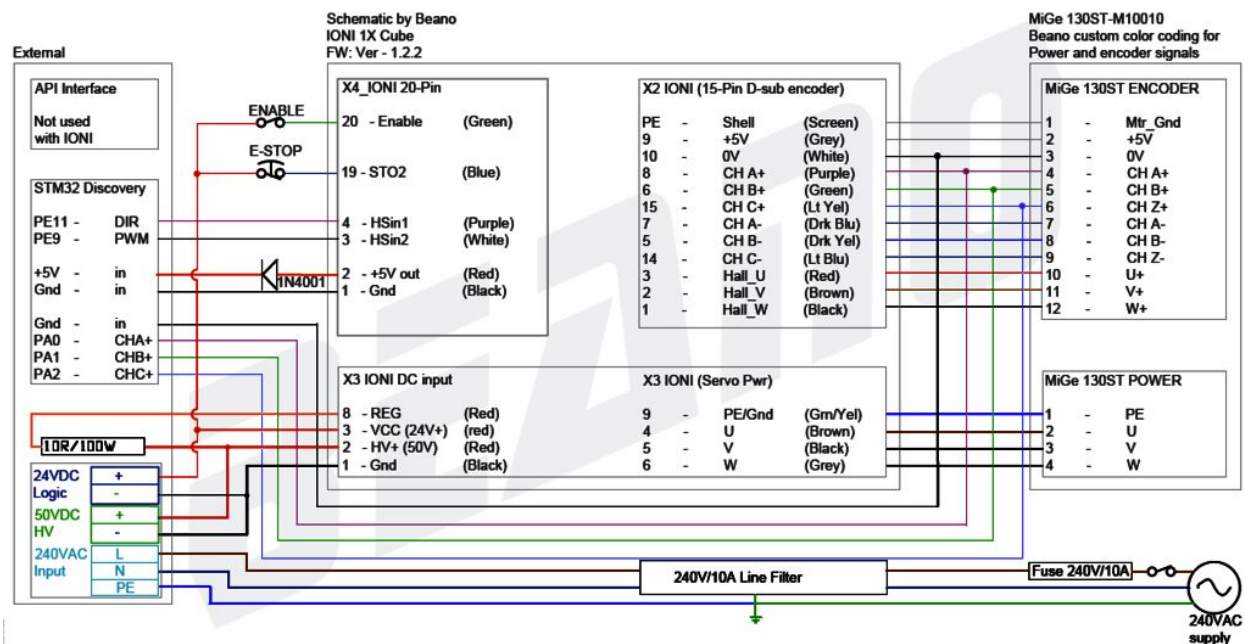
From http://granitedevices.com/wiki/EMI_suppression_cores

To solve an EMI problem its good to have selection of cores that can be tried on different cables. Most typical placement for cores:

- Motor output cable (all motor wires through core but **not** earth conductor).
However, if earth conductor is hard to separate, then feeding all wires through core is still better than nothing.
- High voltage power supply cable (+ and - leads through core)
- USB adapter or other communication cables
- Control I/O cables
- Encoder/feedback device cable

5)

By now you should be pretty familiar with the entire schematic. Look over it all again, and be sure you didn't miss anything. Double check your work. I recommend leaving the motor cables disconnected from the motor itself until the software is all updated just to be safe. We'll cover the software in the next step.



Step 8: Flash the Discovery firmware

Here's a good video walkthrough of the process:

<https://www.youtube.com/watch?v=bo5bae6Z9qo>

You'll need to hook the mini USB port of the Discovery board to the PC to flash the firmware. This is a temporary connection. Once your done flashing, you can disconnect this. We'll cover flashing in the next step.

Download the STSW-LINK004 software from

http://www.st.com/web/catalog/tools/FM147/SC1887/PF258168?s__searchtype=partnumber

Click the download button near the bottom of the page.

Download the 3 attached files from:

<http://forum.virtualracing.org/showthread.php/92420-DIY-USB-Force-Feedback-Controller>

Install & run the STSW-LINK004 software, click "Erase chip", and then click "Program & Verify" and choose the FFB2014-0.99.hex file you downloaded found inside the MMosFFB_FW_0.99.zip file.

Step 9: Flash and setup the IONI 1x

For this step, you'll be communicating to the IONI 1x via USB cable attached to the SMV2 adapter.

First, install the Granity for Windows software from:

<http://granitedevices.com/wiki/Granity>

And download the latest v1.2.3 firmware from:

http://granitedevices.com/wiki/IONI_firmware_releases

Run the Granity-IONI.exe after extracting the zip, and click "Connect" tab. It should show a "COM3: SimpleMotion v2 adapter" in the drop down and choose "Connect to drive". It should list the drive, and then you can click "Install firmware" on the bottom of this tab. Follow the instructions and choose the v1.2.3 firmware you downloaded.

Once that's done you can set very page to the same settings as seen on this project thread:

<http://members.iracing.com/jforum/posts/list/3312320.page#8922740>

I personally had good luck just loading the settings.drc attached in this post:

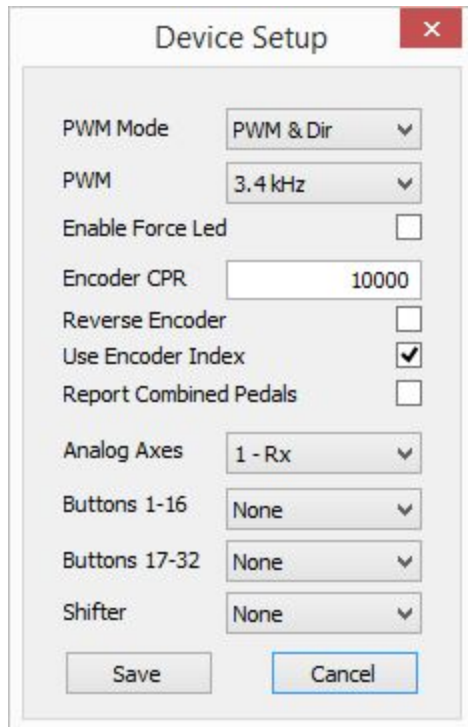
<http://members.iracing.com/jforum/posts/list/825/3312320.page#9042890>

Step 10: Configure MMos

Now run extract that MMosFFB_Tool_0.91.zip, and run the MMosForceFeedback2014.exe.

This lets you configure the wheel's force feedback behavior.

Click Setup, and fill it out like so:



Then click “Save”, but then **DON’T** click apply because it will reset MMos and not take the values.

Now click Cancel

Now under FFB Configuration on the main page,

choose “Default” and click “Save”

and then

choose “Eprom” and click “Save”

You can play with the settings on this page for various forceback settings. I’ll cover these in depth in the next step. One thing you may want to do now is physically center the wheel and click the button at the top corner called “Center Steering” so your axis is center.

Now you should be able to go into the Windows Control Panel, choose Devices and Printers, and you’ll see a device call the “MMos ForceFeedback 2014”. Right click on that and choose “Game controller settings”, and click on Properties of that device. Turn the wheel and you should see it update the X axis.

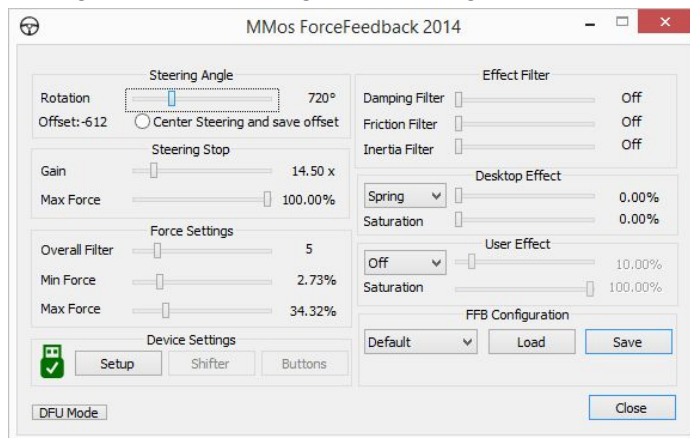
After configuring the MMos, the tutorial at <http://www.ascher-racing.com/OpenSimwheel/> reports that you must go back back now to Granity and changing the [CRI] setpoint factor from “Serial” to “Pulse Width Moduation” and saved. Otherwise you’ll may see the drive spin at full speed if the MMos isn’t connected.

Step 11: Play and configure MMos

Now you should be able to load iRacing or any racing game, and set it up according to use your new wheel. In iRacing, this involves going to the Config menu, and running the wheel wizard again.

The best way I've found to configure MMos forces is to run iRacing in windowed mode and put the MMos ForceFeedback tool on another screen. Then you can racing for a little and use the mouse to change the settings without getting out.

Let's go over the settings that I've figured out:



At the top corner is the how much rotations you want to allow your wheel. You can set this to anything from between 180 degrees up to 2160 degrees. The popular T500 wheel offers 1080 degrees for example.

Below that is a “Center Steering and save offset”. To use this, physically center the wheel and click this button.

Next is “Steering Stop” section. This controls what happens when you keep turning your wheel past the limit you just defined. For example, you can may only lightly push back on you by setting this to 1x gain with 15% force. On the other extreme, you can set this to 100x gain and 100% force. If you keep turning to the hit the edge, it'll be like a brick wall. It'll stop you and you won't be able to turn the wheel. btw, doing this will give you sense of just how strong the “small” mige is. You can easily get hurt if the wheel gets out of hand so be sure to keep the e-stop button close by.

Next is the “force settings”. This one controls how the force feedback feels in the game. Be very careful with the max force slider - going higher than 50% is very strong. It is reported by several experienced members it should be set to 100% then wheel strength should be tuned using the in game sliders. Also your amperage settings in Granity will greatly influence the

strength of the wheel. [I don't understand what "min force" means, if anyone knows let me know and I'll update].

The "overall filter" setting seems to smooth the feel of forces. Setting to "Off" makes the forces feel very gainy which people may like. Also try it on a setting like 5 to see if you like that. You'll just have to play with it and pick settings you like here.

[I didn't get a chance to play with the Effects Filter section yet.]

The "Desktop Effect" section are effects one can turn on/off at the desktop to experiment with what the filters feel like not in game. I think what kind of force gets applied to return the wheel to center. There's a bunch of options you can play with.

I far as I've read the proper way to set the forces is to modify your Documents\iRacing\app.ini, and change:

displayLinearInNm=0

to

displayLinearInNm=1

and then in MMosForceFeedback2014.exe, set the max force to 100%

Then in iRacing options, click on "Use linear mode". You'll see a nM scale, but setting it to a higher nM value will scale the actual forces you feel down and setting it lower nM will scale the forces you feel up. If you want to be a specific value, use this equation:

$(20 / Y) * 20$ where Y = nM you want

So for example, if you want to feel 15nM of force set it to 26.6 because:

$(20/15) * 20 = 26.6$

[If someone has some good settings on what they use here, please let me know and I'll update]

Step 12: Mount all the parts into the case after its working

You'll be putting the all the boards and the power supply into the case you bought.

I don't have any good experiance in this area. [If anyone wants to write this section, please let me know and I'll update]

Questions?

Please post questions to the official project thread at:

<http://members.iracing.com/jforum/posts/list/3312320.page>

Corrections to the guide?

PM "Jason Sandlin" on iRacing

