UCI Rescue Robotics

2016-2017

Rover 5 Manual

Version V.2

Last Updated: June 2017

I. DO'S AND DON'TS

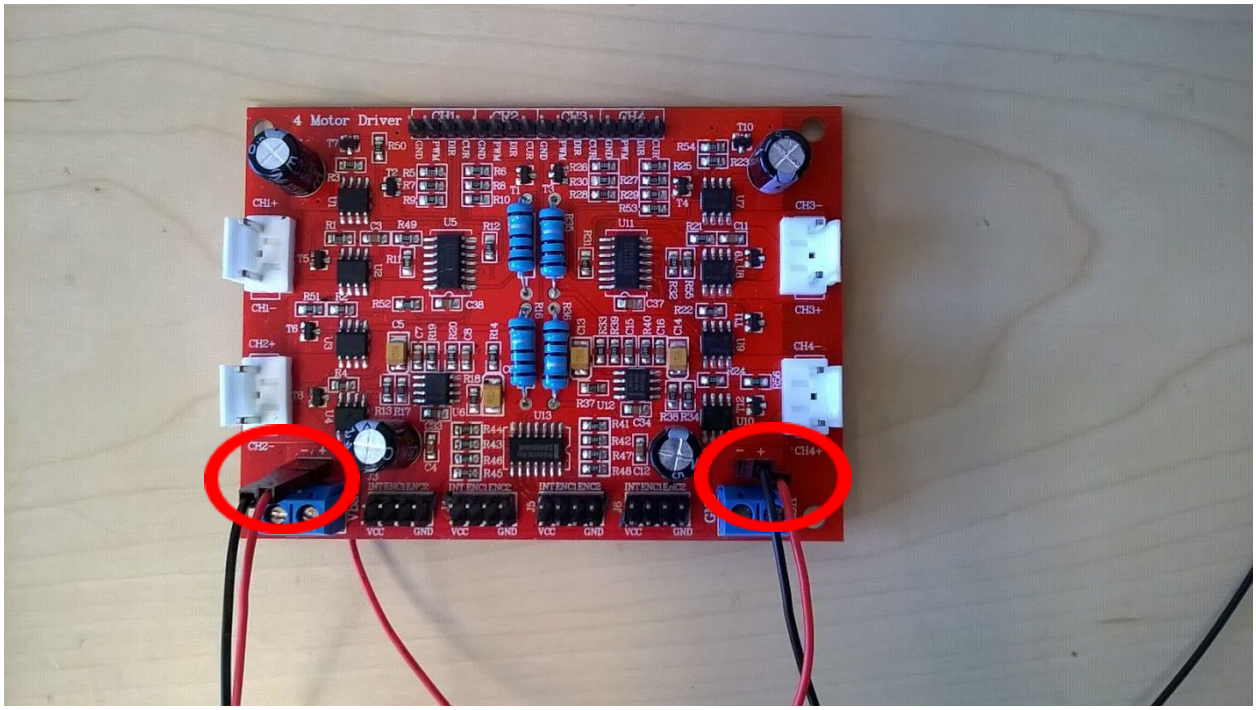
Do not:

- Block/hold the motors or servos when they are running/turning. This will damage the motors/servos and the electronics.
- Control the robot to move from full speed in one direction to full speed in the other. This will damage the motors and the electronics.

Do:

- Check the max (peak, stall…) current and operating voltage for each electronic device you use.
- Check all the wire connections before plugging the battery and powering the robot.
- Periodically check that power cord is properly attached to motor controller. If robot stops running, check the power connection.
- Make sure all GROUND wires are connected properly before connecting the battery. Failure to do so could lead to burned wires and components.
- **MAKE SURE TO CHECK THAT THESE FOUR WIRES ARE SECURELY CONNECTED BEFORE TURNING ON THE ROBOT or else it WILL CATCH ON FIRE!**

You can wrap electrical tape around the connector to better secure it, if you wish!



Read the manufacturer's warning for motor board here, (Page 2, first paragraph):

https://cdn.sparkfun.com/datasheets/Robotics/4%20Channel%20instruction%20manual.pdf

SAFETY FIRST!!!!

Always exercise caution when assembling and/or operating the robot.

SAFETY FIRST!!!

If you are unsure, STOP and ASK an adult mentor.

II. PREREQUISITE

Participants should have:

- Computer/laptop (Windows or Mac preferred)
- Android phone (with Android > 2.2 preferred)
- USB cable to connect phone to laptop

Participants should have downloaded on their computer:

1. Android SDK (Android Studio, no longer Eclipse)
   (http://developer.android.com/sdk/index.html)

2. All the Android tools and Android APIs (e.g. Android 4.4.2…). This might take a couple of hours Some packages might not get installed but that's ok.
   (http://developer.android.com/sdk/installing/adding-packages.html)

3. The latest IOIO libraries (Client Software, 5.06/5.05: App-IOIO0505.zip)
   https://github.com/ytai/ioio/wiki/Downloads

III. PARTS

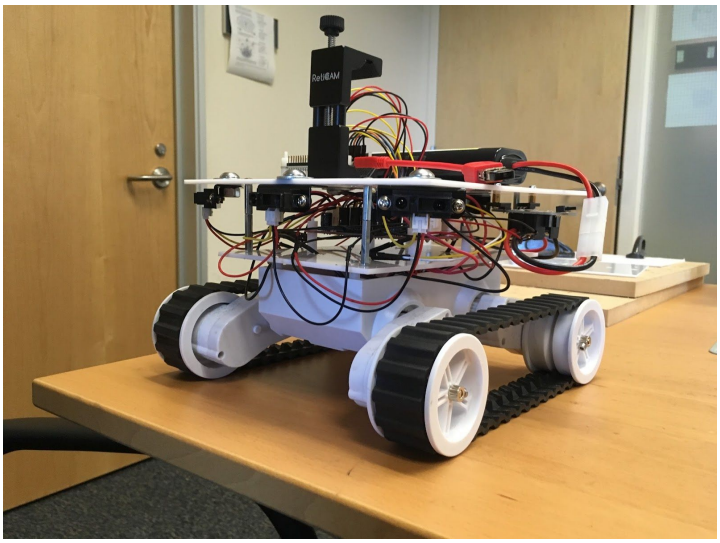
Part #	Robot Base:
1	Rover 5 Robot Platform with Tank Treads
2	Wheels (Recommended)
3	8” x 8” Polycarbonate Sheet
4	8” x 5” Polycarbonate Sheet
5	RetiCAM® Smartphone Tripod Mount
	Electronics:
6	DAGU Rover 5 tank motor driver board
7	IOIO-OTG V2.2
8	SMK-Link Nano Dongle Bluetooth v4.0 LE+EDR
9	TE Connectivity AMP Connectors 9-146285-0
10	TE Connectivity AMP Connectors 9-146252-0
11	Sharp Microelectronics IR Sensor
12	IR Bracket Mount
	Wiring:
13	Wires with Pre-crimped Terminals 50-Piece Rainbow Assortment M-F 6"
14	0.1" (2.54mm) Crimp Connector Housing: 1x1-Pin 25-Pack
15	Wires with Pre-crimped Terminals 10-Pack F-F 6" Red
16	Wires with Pre-crimped Terminals 10-Pack F-F 6" Black
17	Wires with Pre-crimped Terminals 10-Pack F-F 6" Yellow
18	Wires with Pre-crimped Terminals 50-Piece Rainbow Assortment F-F 6"
19	Wires with Pre-crimped Terminals 10-Pack M-F 12" Black
20	Wires with Pre-crimped Terminals 10-Pack M-F 12" Red
21	Thermosleeve Heat Shrink Tubing 3/32" "Black" - 100 FT
22	16 Gauge Primary Wire (25 feet) Black
23	16 Gauge Primary Wire (25 feet) Red
24	VELCRO Brand - Industrial Strength - 2" x 4' - Black
25	Infrared Sensor Jumper Wire - 3-Pin JST

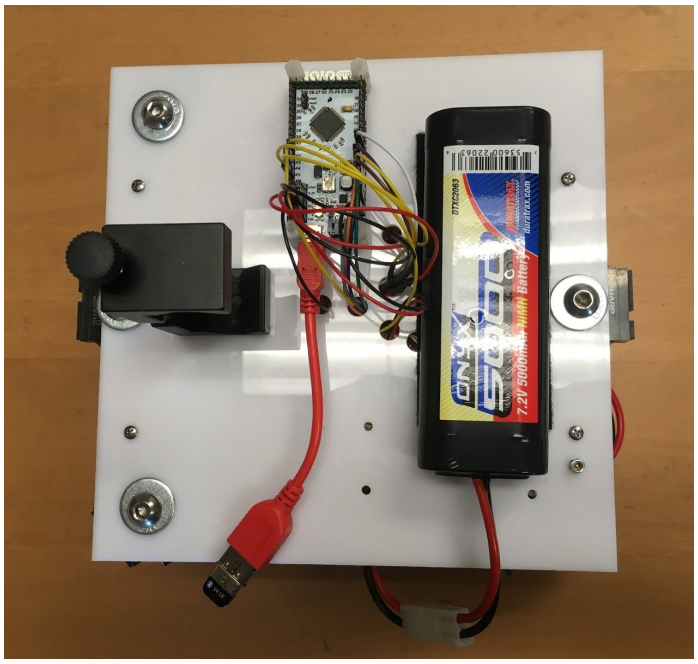
	Nuts and Bolts:
26	Phillips Oval Head Screws, M3 x 0.5 mm Thread, 8 mm Long
27	18-8 Stainless Steel Phillips Flat Head Screws 4-40 Thread Size, 3/8" Long
28	Nylon 6/6 Male-Female Threaded Hex Standoff, 1/4" Hex Size, 1/2" Length, 4-40 Thread Size

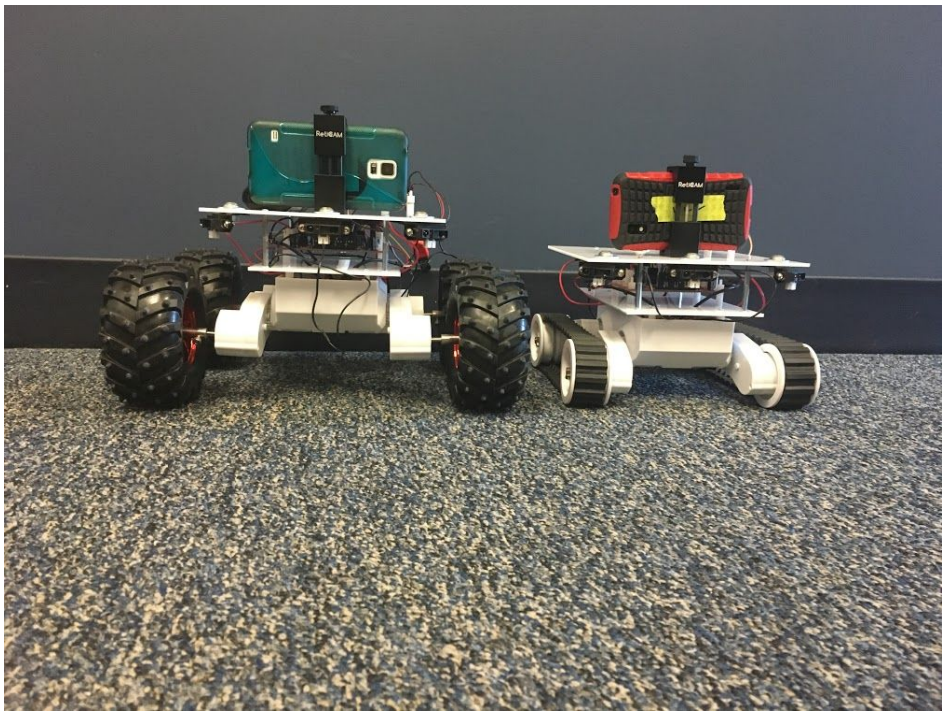
29	Nylon 6/6 Male-Female Threaded Hex Standoff, 1/4" Hex Size, 1/4" Length, 4-40 Thread Size
30	Male-Female Threaded Hex Standoff, Zinc-Plated Brass, 4.5 mm Hex Size, 25 mm Length, M3 Thread Size
31	Zinc-Plated Brass Female Threaded Hex Standoff 4.5 mm Hex Size, 19 mm Length, Fully Threaded
32	18-8 Stainless Steel Hex Drive Rounded Head Screw 5/16"-18 Thread Size
33	18-8 Stainless Steel MIL. Spec. Washer Passivated, 5/16" Screw Size, MS-16212-12
34	18-8 Stainless Steel Hex Nut, 5/16"-18 Thread Size
35	18-8 Stainless Steel MIL. Spec. Washer Passivated, 1/4" Screw Size, MS-16212-11
36	Hex Drive Rounded Head Screws, Zinc-Plated Alloy Steel, 1/4"-20 Thread Size, 1/2" Long
	Power:
37	DAGU - Wild Thumper High Power Switch
38	Tamiya Plug with 10cm Leads, Female (14AWG)
	Misc Tools and Battery
	Hex L-Key: 3/16" Size, 3" Overall Length
	Duratrax Onyx 200 AC/DC Sport Peak Charger
	Duratrax Onyx 7.2V 5000mAh NiMH Battery Stick Pack with Standard Connector

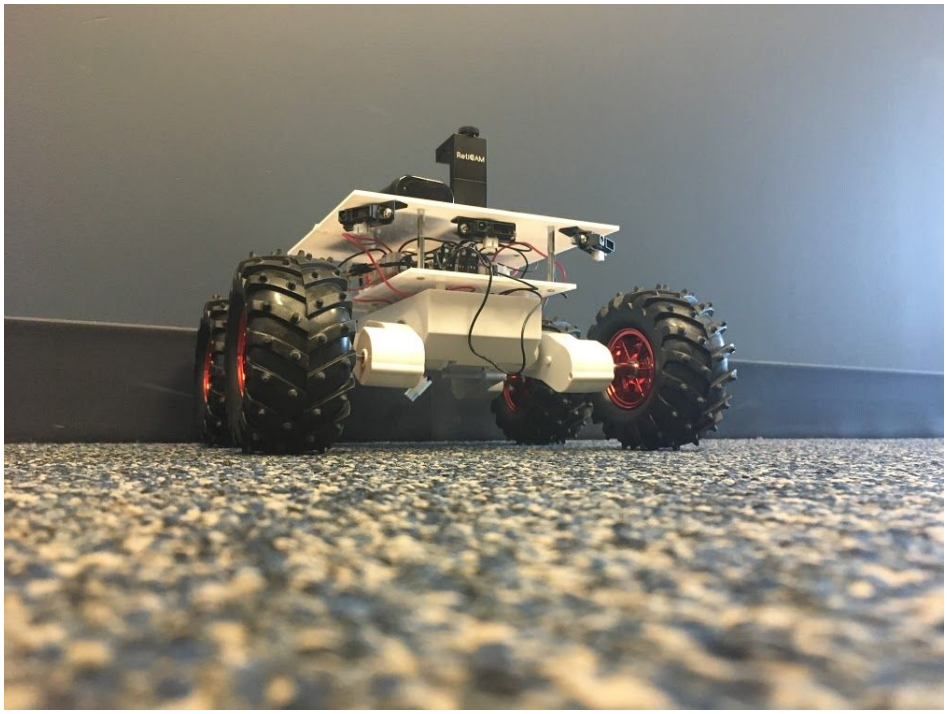
An extended list with sources is located at the end of this manual.

IV. GENERAL DESIGN



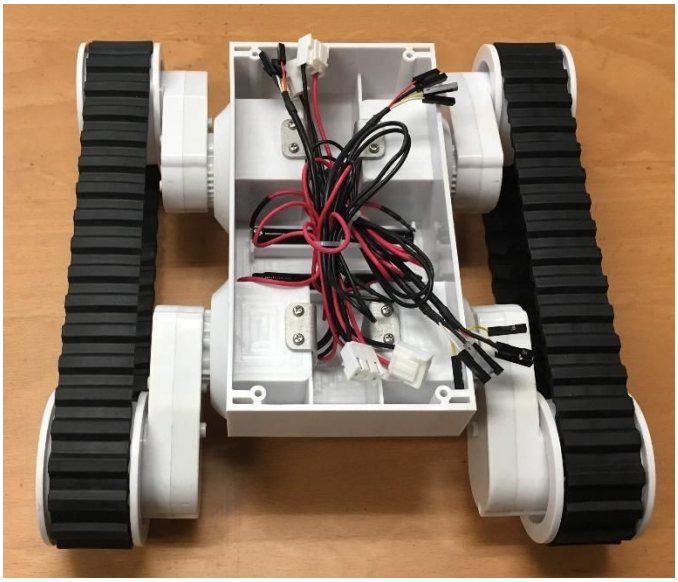




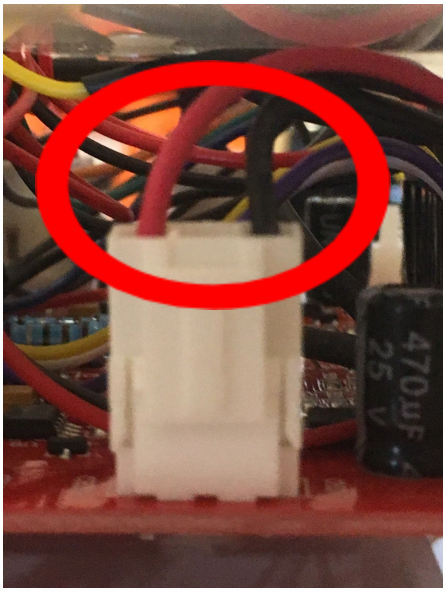


V. ASSEMBLY INSTRUCTIONS

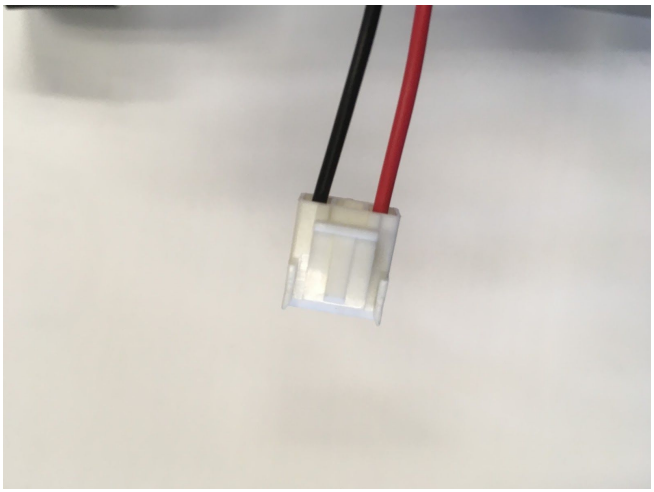
1) Take Rover 5 out of the box. Cut zip-ties restraining the power cords.



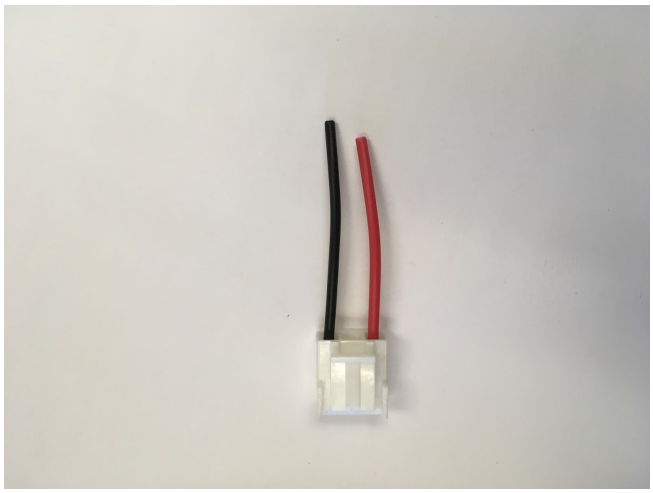
Check to see if all four of your robot's motor wires are configured in a red/black configuration, when viewed from the side with the snap facing you, as shown below. If so, you are good to go to Step #2. If not, keep reading.



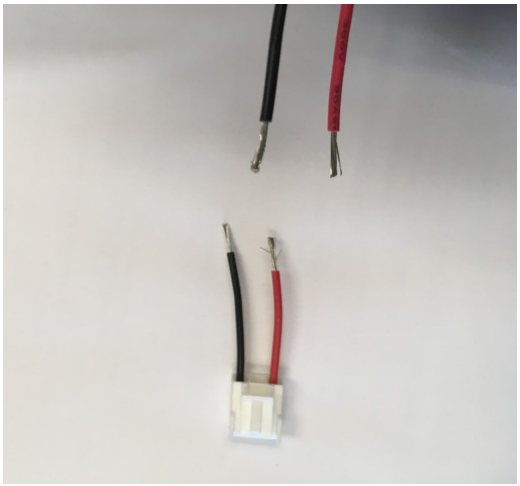
Sometimes, robots will be shipped with reversed motor connectors in a black/red configuration as shown below.



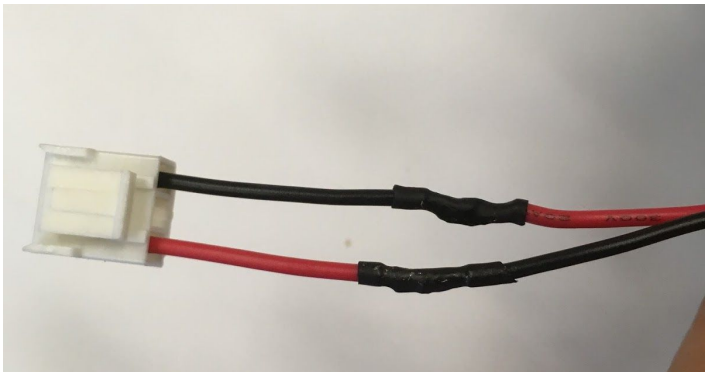
If so, you can fix it easily.
Cut both wires.



Be sure to leave enough room to strip the wires.



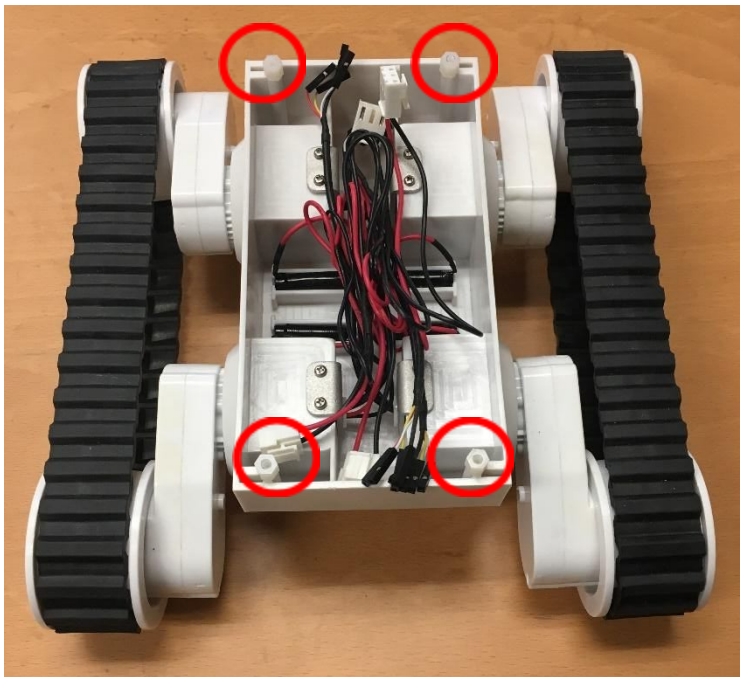
Strip both ends of the wires. Switch the black and red wires.



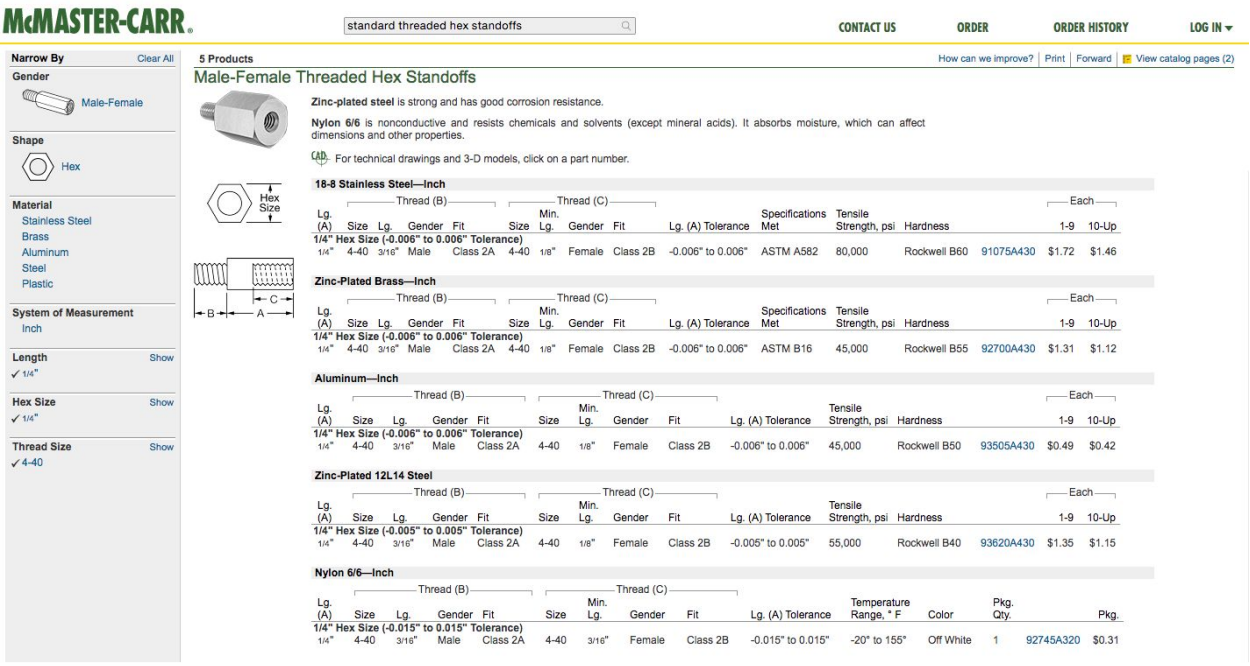
Place heat shrink tubing (**Part #21**) over the wires. Solder the switched wires and heat the heat shrink tubing. Be careful not to burn the wires!

2) Designate a front and back orientation on the robot. Note: the robot can run forwards and backwards, but the front and back must be designated prior to assembly.

3) Insert four ¼" plastic hex standoffs **(Part #29)** into the four base holes.



Note: Occasionally, the standoffs may fall off from the base after prolonged use, if this happens, just reattach it. If you wish for a permanent fix, you can order some steel standoffs and use Loctite to secure it permanently. A few suggestions from McMaster are shown in the following image.



McMASTER-CARR

standard threaded hex standoffs

CONTACT US ORDER ORDER HISTORY LOG IN

Narrow By Clear All

Gender
Male-Female

Shape
Hex

Material
Stainless Steel
Brass
Aluminum
Steel
Plastic

System of Measurement
Inch

Length Show
✓ 1/4"

Hex Size Show
✓ 1/4"

Thread Size Show
✓ 4-40

5 Products

How can we improve? | Print | Forward | View catalog pages (2)

Male-Female Threaded Hex Standoffs

Zinc-plated steel is strong and has good corrosion resistance.

Nylon 6/6 is nonconductive and resists chemicals and solvents (except mineral acids). It absorbs moisture, which can affect dimensions and other properties.

For technical drawings and 3-D models, click on a part number.

18-8 Stainless Steel—Inch

Lg. (A)	Thread (B) Size	Lg.	Gender	Fit	Thread (C) Size	Min. Lg.	Gender	Fit	Lg. (A) Tolerance	Specifications Met	Tensile Strength, psi	Hardness		Each 1-9	Each 10-Up
1/4" Hex Size (-0.006" to 0.006" Tolerance)															
1/4"	4-40	3/16"	Male	Class 2A	4-40	1/8"	Female	Class 2B	-0.006" to 0.006"	ASTM A582	80,000	Rockwell B60	91075A430	$1.72	$1.46

Zinc-Plated Brass—Inch

Lg. (A)	Thread (B) Size	Lg.	Gender	Fit	Thread (C) Size	Min. Lg.	Gender	Fit	Lg. (A) Tolerance	Specifications Met	Tensile Strength, psi	Hardness		Each 1-9	Each 10-Up
1/4" Hex Size (-0.006" to 0.006" Tolerance)															
1/4"	4-40	3/16"	Male	Class 2A	4-40	1/8"	Female	Class 2B	-0.006" to 0.006"	ASTM B16	45,000	Rockwell B55	92700A430	$1.31	$1.12

Aluminum—Inch

Lg. (A)	Thread (B) Size	Lg.	Gender	Fit	Thread (C) Size	Min. Lg.	Gender	Fit	Lg. (A) Tolerance	Tensile Strength, psi	Hardness		Each 1-9	Each 10-Up
1/4" Hex Size (-0.006" to 0.006" Tolerance)														
1/4"	4-40	3/16"	Male	Class 2A	4-40	1/8"	Female	Class 2B	-0.006" to 0.006"	45,000	Rockwell B50	93505A430	$0.49	$0.42

Zinc-Plated 12L14 Steel

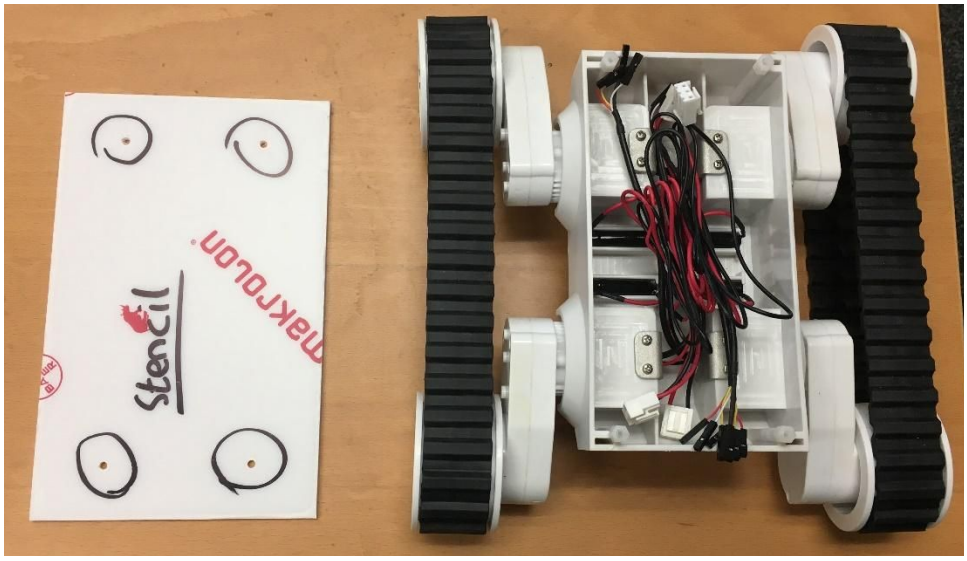
Lg. (A)	Thread (B) Size	Lg.	Gender	Fit	Thread (C) Size	Min. Lg.	Gender	Fit	Lg. (A) Tolerance	Tensile Strength, psi	Hardness		Each 1-9	Each 10-Up
1/4" Hex Size (-0.005" to 0.005" Tolerance)														
1/4"	4-40	3/16"	Male	Class 2A	4-40	1/8"	Female	Class 2B	-0.005" to 0.005"	55,000	Rockwell B40	93620A430	$1.35	$1.15

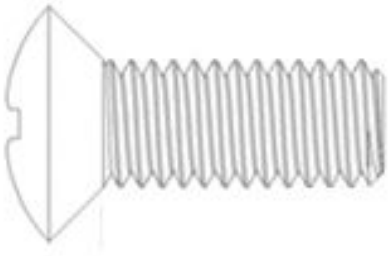
Nylon 6/6—Inch

Lg. (A)	Thread (B) Size	Lg.	Gender	Fit	Thread (C) Size	Min. Lg.	Gender	Fit	Lg. (A) Tolerance	Temperature Range, ° F	Color	Pkg. Qty.		Pkg.
1/4" Hex Size (-0.015" to 0.015" Tolerance)														
1/4"	4-40	3/16"	Male	Class 2A	4-40	3/16"	Female	Class 2B	-0.015" to 0.015"	-20° to 155°	Off White	1	92745A320	$0.31

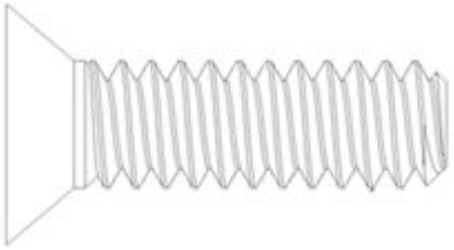
4) Drill four holes into the 8” x 5” Polycarbonate Sheet **(Part #4)** using a 9/64” drill bit. The holes should align the board to the 1/4" plastic hex standoffs **(Part #29)** on the Rover 5 base.

The board is attached to the standoffs using 4 Flat head screws **(Part #27).**





Oval Head Screw **(Part #26)**

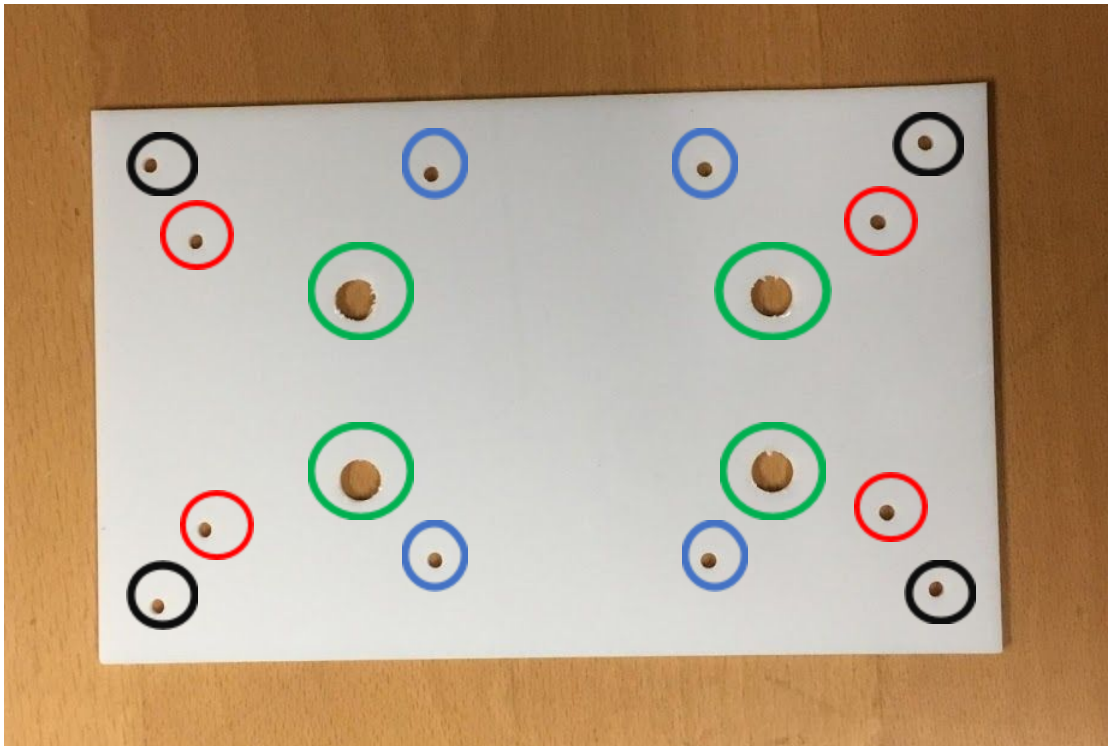


Flat Head Screw **(Part #27)**

PLEASE REMEMBER – SAFETY FIRST! Make sure to securely clamp the Polycarbonate sheet to a flat surface (with wood underneath it if necessary) and wear safety goggles while drilling.

Example: 8” x 8” board securely clamped as shown below.

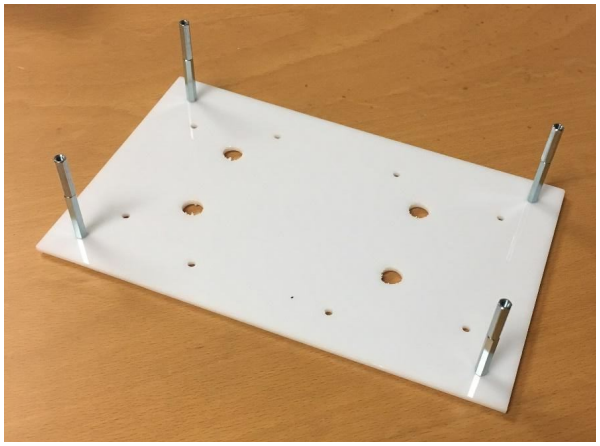
5) Drill the following holes into the Polycarbonate sheet:



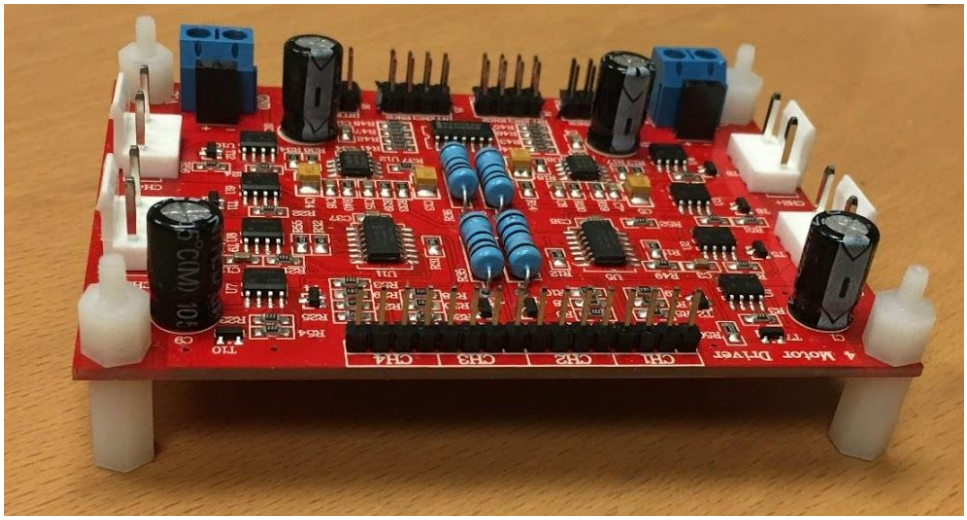
Red – holes drilled in step 4.
Green – drilled using a 3/8” drill bit (DRILL 1/4" PILOT HOLES BEFORE USING THE 3/8” DRILL BIT)
Blue – drilled using a 9/64” drill bit. Used to mount the motor board.
Black – drilled using 9/64” drill bit. Used to mount **(Part #30)**.

6) Attach the four Zinc Male-Female Standoffs **(Part #30)** to the 8” x 5” sheet using four Oval Head Screws **(Part #26)**

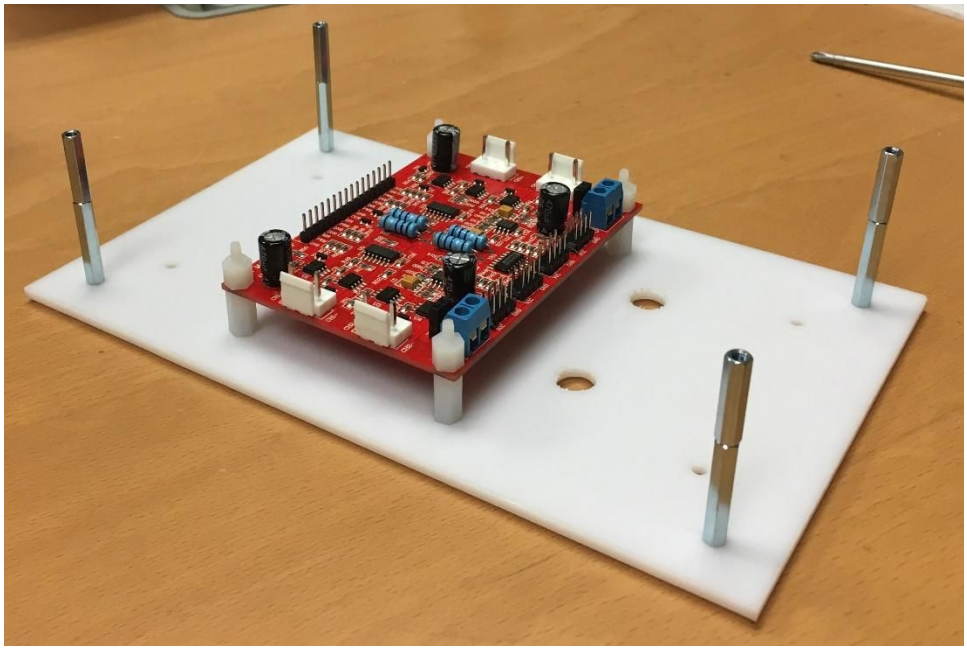
Attach four Zinc Female Standoffs **(Part #4)** to the four Male-Female Standoffs **(Part #30)**.

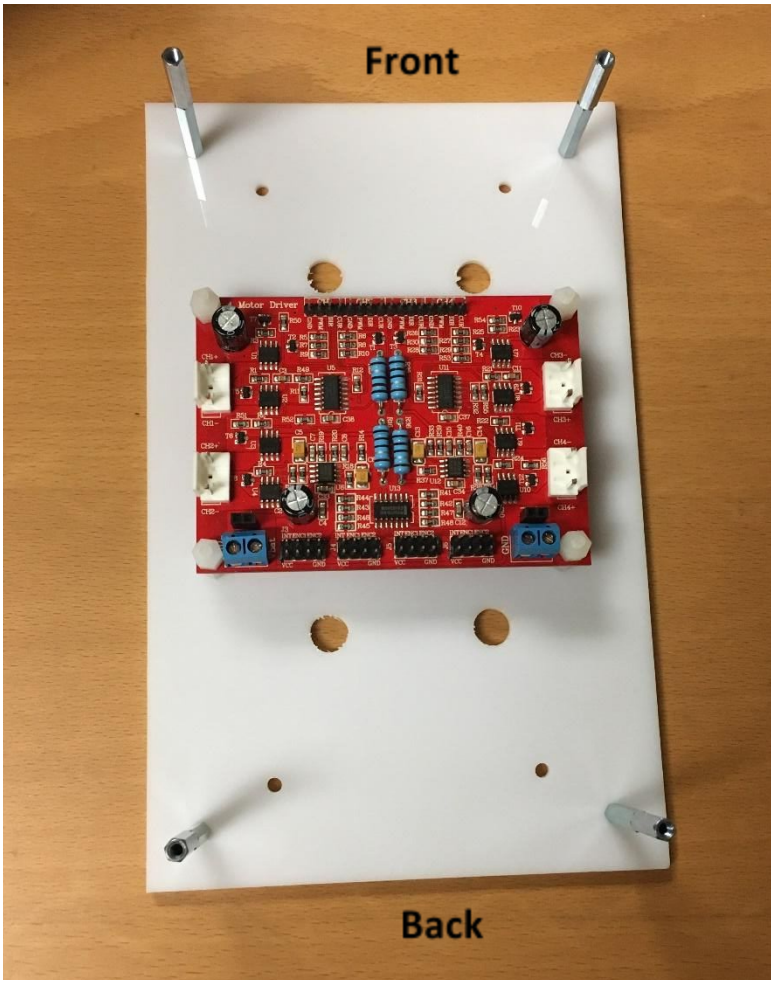


7) Attach four 1/2" Nylon Male-Female Standoffs **(Part #28)** to motor board and secure with four 1/4" Nylon Male-Female Standoffs **(Part #29)**, as shown in the image below.



8) Mount the motor board to the 8”x 5” sheet using four Flat Head Screws **(Part #27)** through the four blue holes drilled in Step 5.





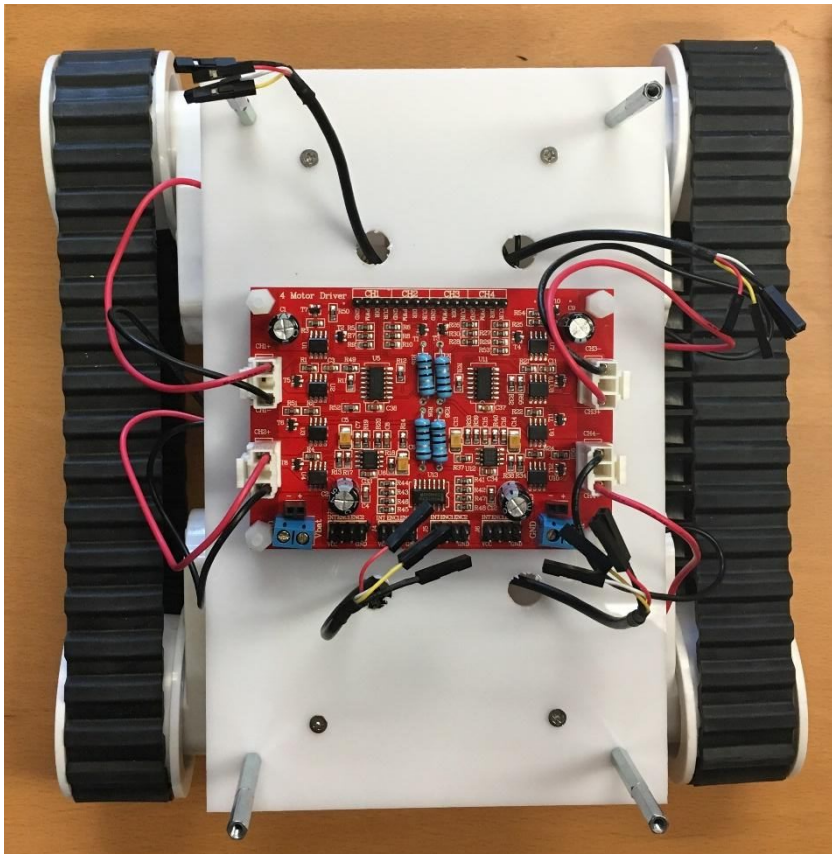
9) Pull power wires (black) from bottom chassis through the hole nearest to it on the 8”x5” sheet (green holes in step 5). Leave them unconnected for now.

Connect motor wires to their corresponding channel on the motor board.

Mount the 8”x 5” sheet to the rover 5 chassis using four flat head screws **(Part #27)**.

The result is shown on the following image.

Front



Back

10) Drill the following holes into the 8” x 8” polycarbonate sheet (leave the plastic wrap on for now):

- 9 holes – red/green using 5/16” drill bit
- 10 holes – blue/”x” using 9/64”drill bit

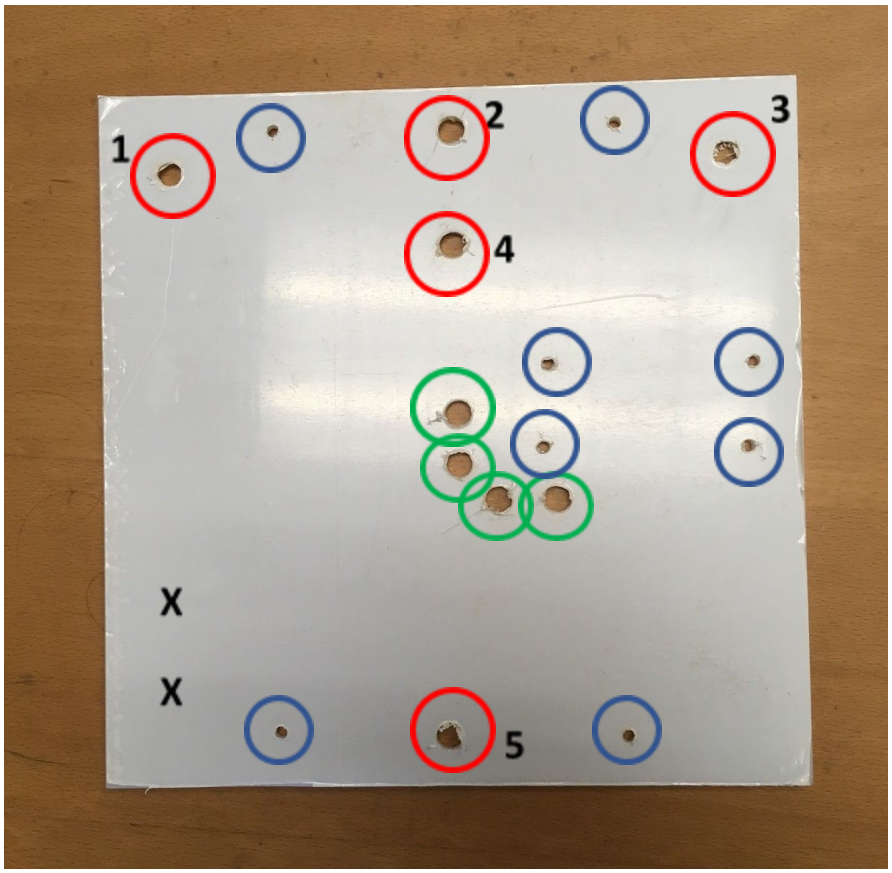
(See image on the following page for detail)

Make sure 4 of the 9/64” holes align to the 8” x 5” board and the other 4 align with the 4 holes of the IOIO board.

Make sure that 2 of the 9/64” holes (marked with an “x”) are spaced so that the power switch can be mounted **(Part #37).**

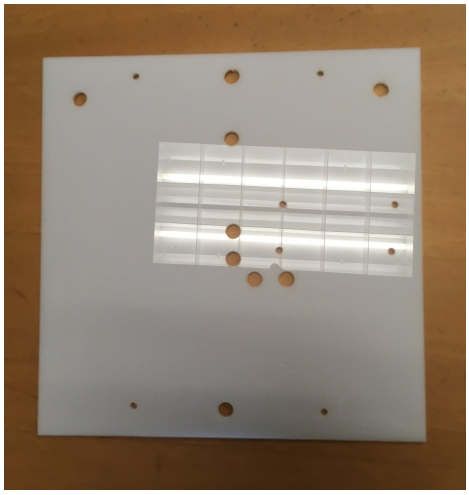
Please make sure before you drill, the piece of velcro fits between the holes in green and hole #5, so the battery can fit later.

FRONT

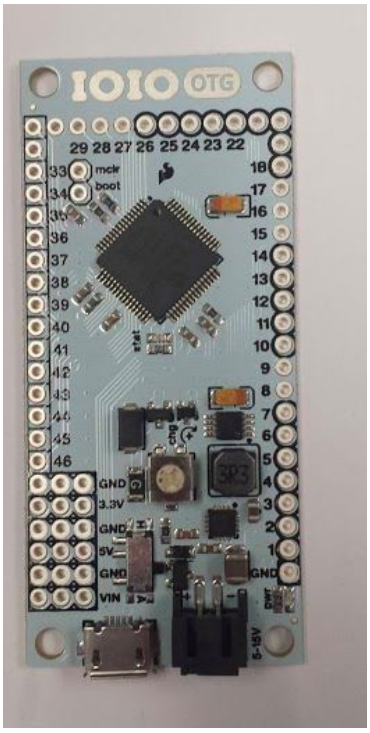


BACK

Take the plastic wrap off after you are done drilling.

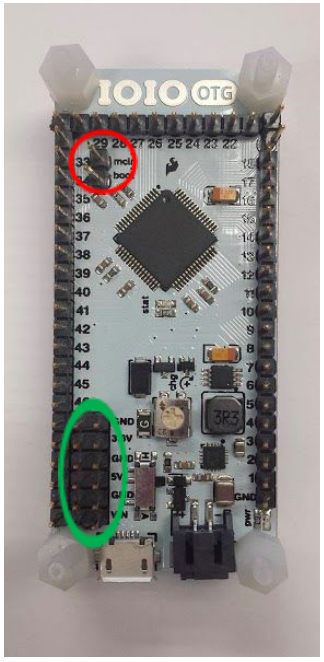


11) Solder pins **(Part #9 and #10)** to IOIO **(Part #7)**.



IOIO without pins (Part #7)

Use the double-row pins for the area located in the green circle (shown below) and single-row pins for everything else. Don't forget to solder the pins to the area in red too!

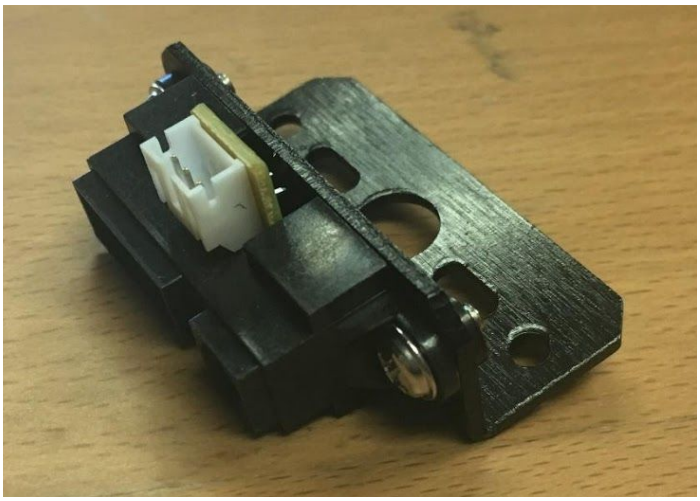


When you're done soldering, attach four 1/2" Nylon Male-Female Standoffs **(Part #28)** to IOIO and secure with four 1/4" Nylon Male-Female Standoffs **(Part #29)**, similar to what you did in Step #7.

12) Mount the IOIO to the 8”x 8” sheet using four Flat Head Screws **(Part #27)** through four blue holes drilled in Step #10.

13) Mount the phone holder **(Part #5)** to the 8”x 8” sheet using a screw **(Part #36)** and a washer **(Part #35)**, mounted beneath the board through red hole #4 drilled in Step #10.

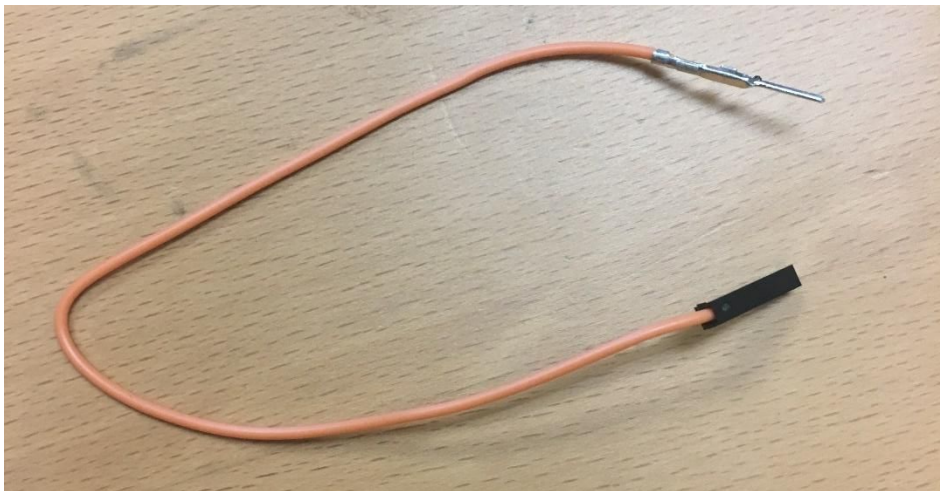
14) Attach IR sensors **(Part #11)** to provided bracket **(Part #12)** using the screws that came with the bracket. Repeat for the other 3 IR sensors.



15) Mount the 4 IR brackets to the 8”x 8” board through red holes 1,2,3 and 5 drilled in Step #10 using **(Parts #32-34)**.

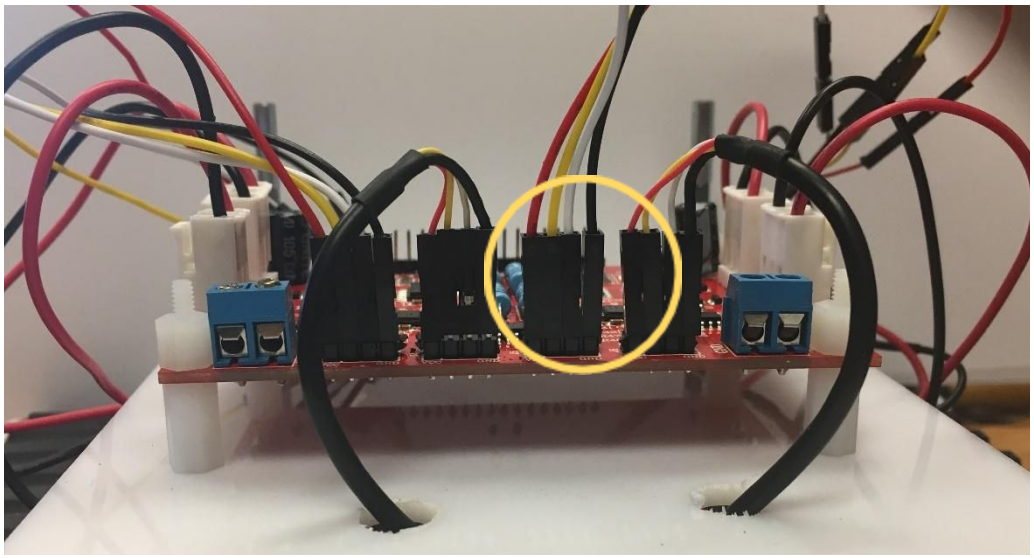
16) Mount the 8”x 8” plate to Rover 5 using four Oval Head Screws **(Part #26)**, as seen in the image below.

17) Prepare 8 male-to-female wires (2 red, 2 black, 2 white, 2 yellow) **(Part #13)** and attach crimp connector housings **(Part #14)** on both ends. A sample with and without crimp connector housings attached is shown in the following image.

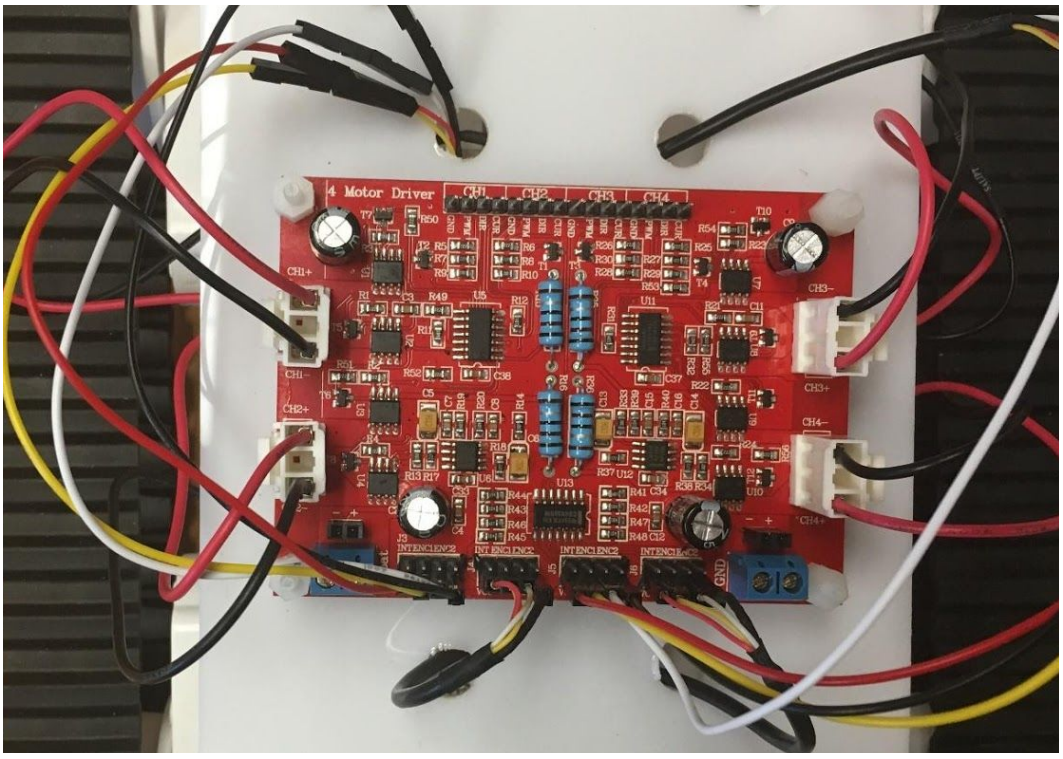


Attach prepared wires to channels 1 and 3. Wires are too short to connect to motor board without adding the extension.

Attach all cables to motor board as shown in the picture in a (red/yellow/white/black) configuration, as shown in the following images.



Front

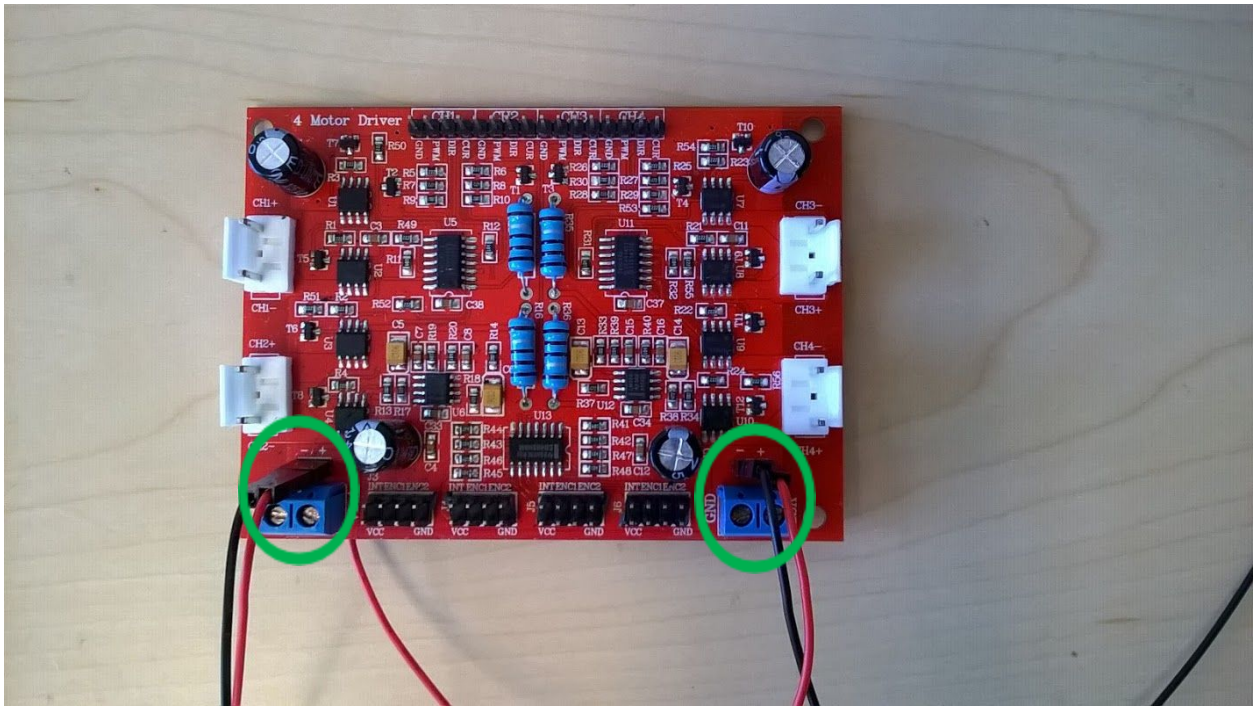


Back

The red cables connect to VCC pin and black cables to GND pin, while the white and yellow are in the middle.

<u>18)</u> Take 2 red and 2 black 12” male-female cables and attach crimps to both ends. Then, connect them to the board as shown in the green circles.

The red cable to the “+” side. The black cable to the “-” side.



19) Take 5 black female-female wires **(Part #16)** and only connect the crimp connector housing **(Part #14)** on one side. For the other sides, strip off a small part of all 5 wires, ~⅛ inch. Cut off 1 piece of heat shrink tubing **(Part #21)** about ~1.5 inches long. Align 4 cables facing one direction and the remaining cable facing the opposite direction. Twist the exposed ends of the cables together, solder them together and after you are done, maneuver the heat shrink tubing over the soldered portion and heat the tubing to enclose the soldered site.

For additional clarity, see the following image.

20) Make two additional sets of wires identical to Step 19 except one set will be black **(Part #16)** and the other set will be red **(Part #15)**.

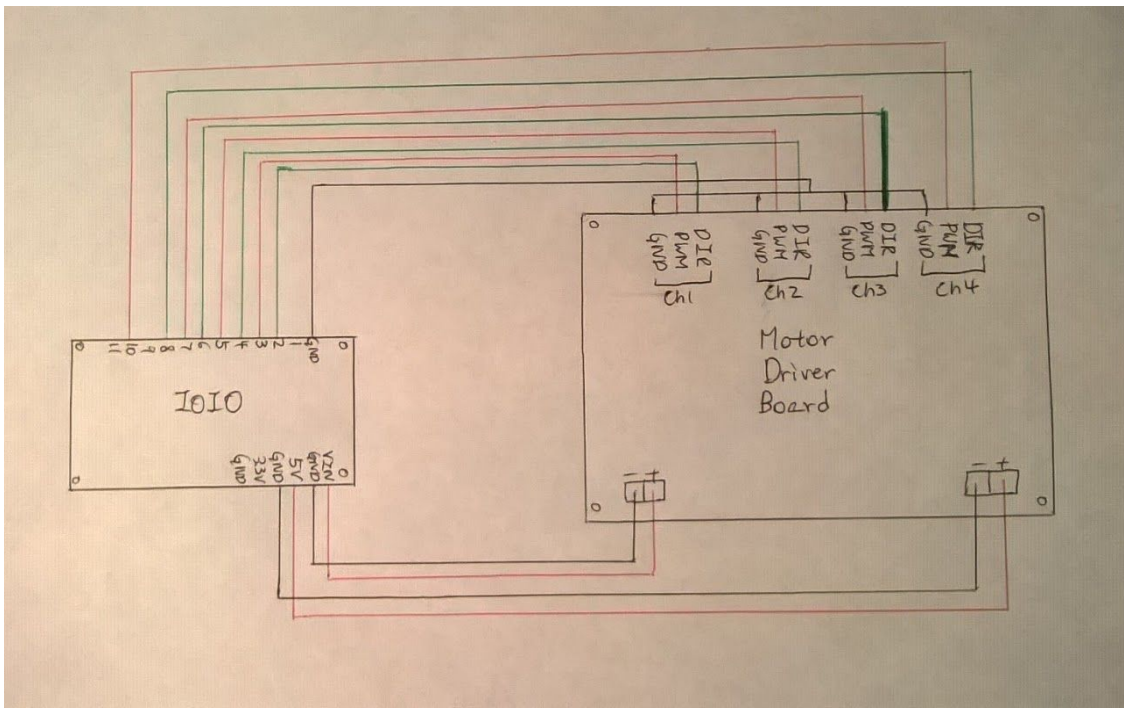
To be clear, after you have completed Step #20, you will have THREE sets of wires, each consisting of five wires.

2 of the sets will be Black, the other set will be Red.

21) Prepare 8 female-female wires from **(Part #18)** with one of each color: gray, blue, orange, green, brown, yellow, purple, and white. Add crimps **(Part #14)** to both ends on all eight wires.

22) Now we will attach the cables to the motor board and connect them to the IOIO by passing through the 4 Green holes that you drilled in Step #10.

See the following images for instructions.



Pin # on IOIO to Pin # on Motor Board	**Wire Color (all 6” Female to Female Wires)**
2 to Ch 1 DIR	Gray
3 to Ch 1 PWM	Blue
4 to Ch 2 DIR	Orange
5 to Ch 2 PWM	Green
6 to Ch 3 DIR	Brown
7 to Ch 3 PWM	Yellow

8 to Ch 4 DIR	Purple
10 to Ch 4 PWM	White

Now take one of the sets of wires (black) that you made in Step #19 and connect it to the four GND on CH 1, 2, 3, and 4 and connect them to one of the GND pins on the IOIO.

Now, connect the two cables that you have in place on the motor board from Step #18 and attach them to the IOIO. The red cable located in the green circle goes to VIN on the IOIO while the black cable goes to a GND pin. The red cable located in the red circle goes to 5V pin on the IOIO while the black cable goes to a GND pin.

WARNING:

MAKE SURE TO CHECK THAT THESE FOUR WIRES ARE SECURELY CONNECTED BEFORE TURNING ON THE ROBOT or else it WILL CATCH ON FIRE!

You can wrap electrical tape around the connector to better secure it, if you wish!

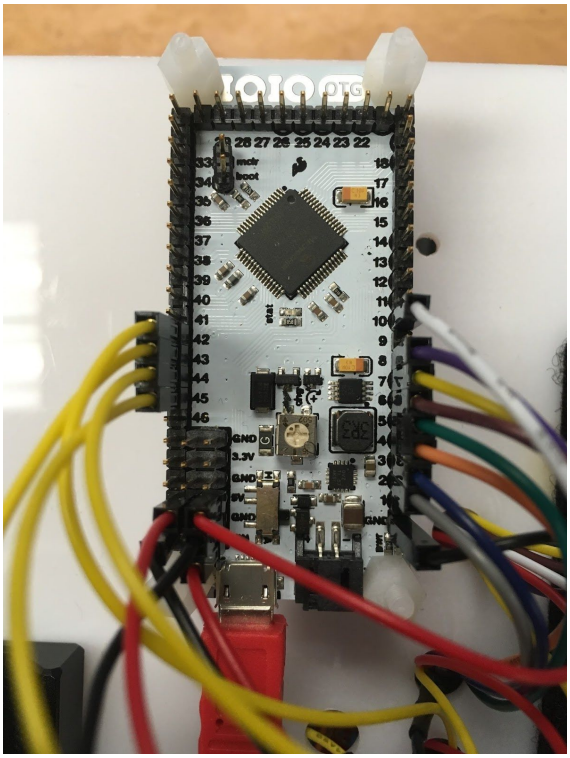
Read the manufacturer's warning for motor board here, (Page 2, first paragraph):

https://cdn.sparkfun.com/datasheets/Robotics/4%20Channel%20instruction%20manual.pdf

Now take the red Bluetooth cable out of the bag that came with the IOIO and place a Bluetooth Dongle on one side **(Part #8)** and attach it to the IOIO via the microUSB port.

WARNING: When pulling out the red Bluetooth cable from the IOIO, place a finger on the silver microUSB port so that the microUSB port does not shear off from the IOIO when you pull the red Bluetooth cable.

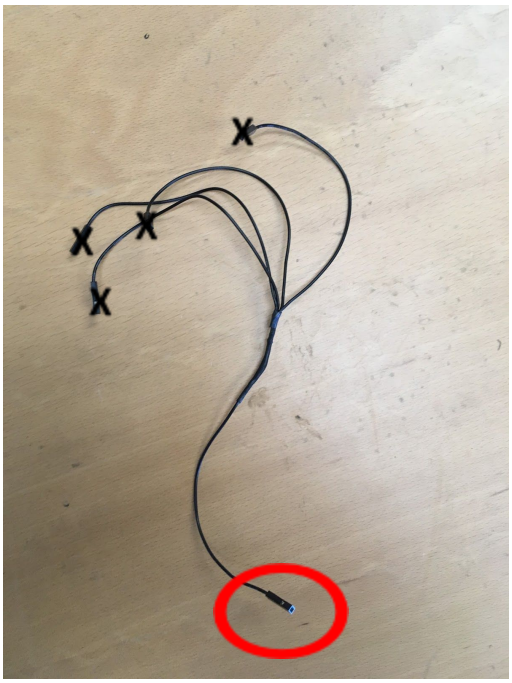
After completing this step, your IOIO should look like the picture on the next page (minus the 4 yellow cables from ports 42-45).



23) Now, take the 4 IR Jumper Wires **(Part #25)**, and strip off ~1/4" of wire on all three wires (Red, Black, Yellow).

24) Take the two remaining sets of wires from Step #20: the red and the black one. Take the remaining black set of wire, align it as shown in the following picture with the original 4 cables facing one side and the single cable facing the other side.

25) Now cut off the crimps and strip ~1/3" off the 4 wires, as shown below with the “x”. LEAVE THE OTHER WIRE INTACT! (as shown by the red circle).



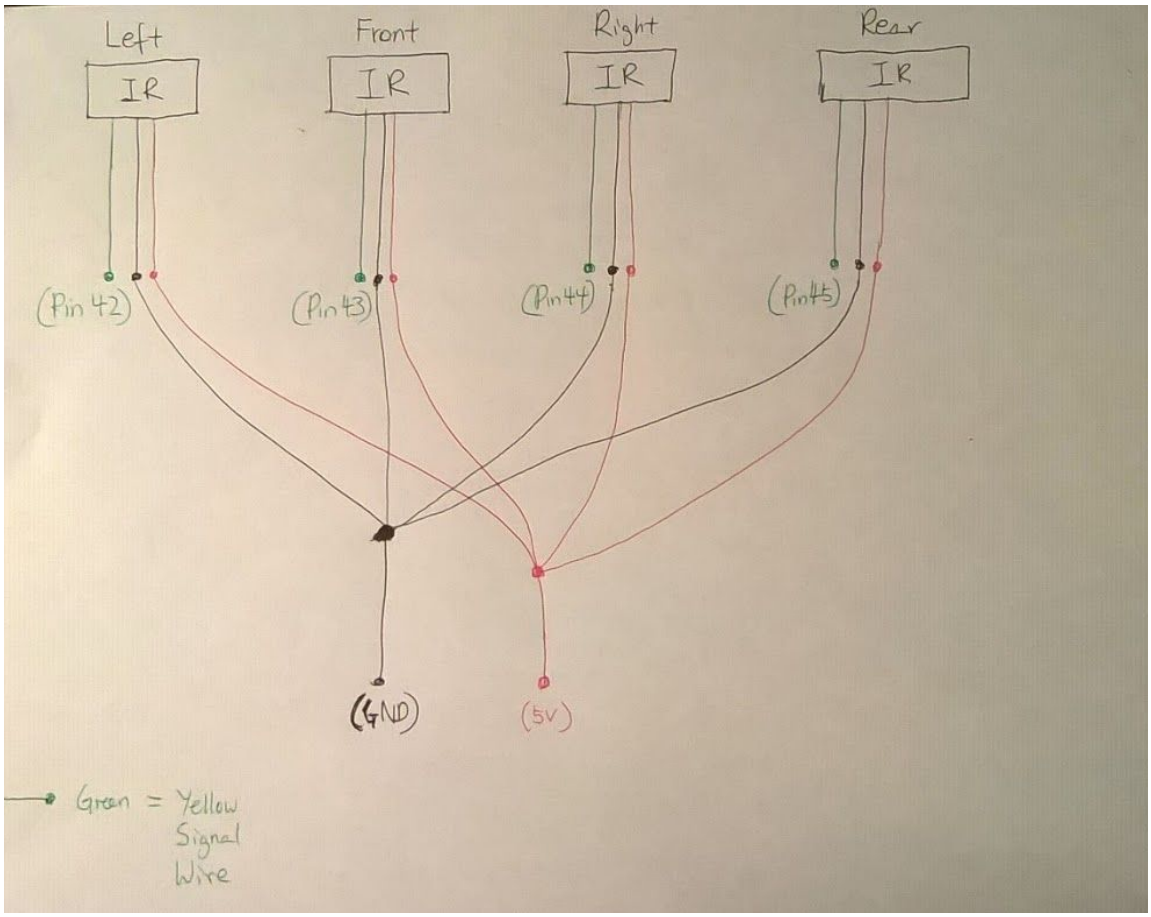
26) Now, cut off 4 pieces of heat shrink tubing, add it onto the wire and solder the black wires you just stripped to the stripped off black wires on the 4 IR sensors.

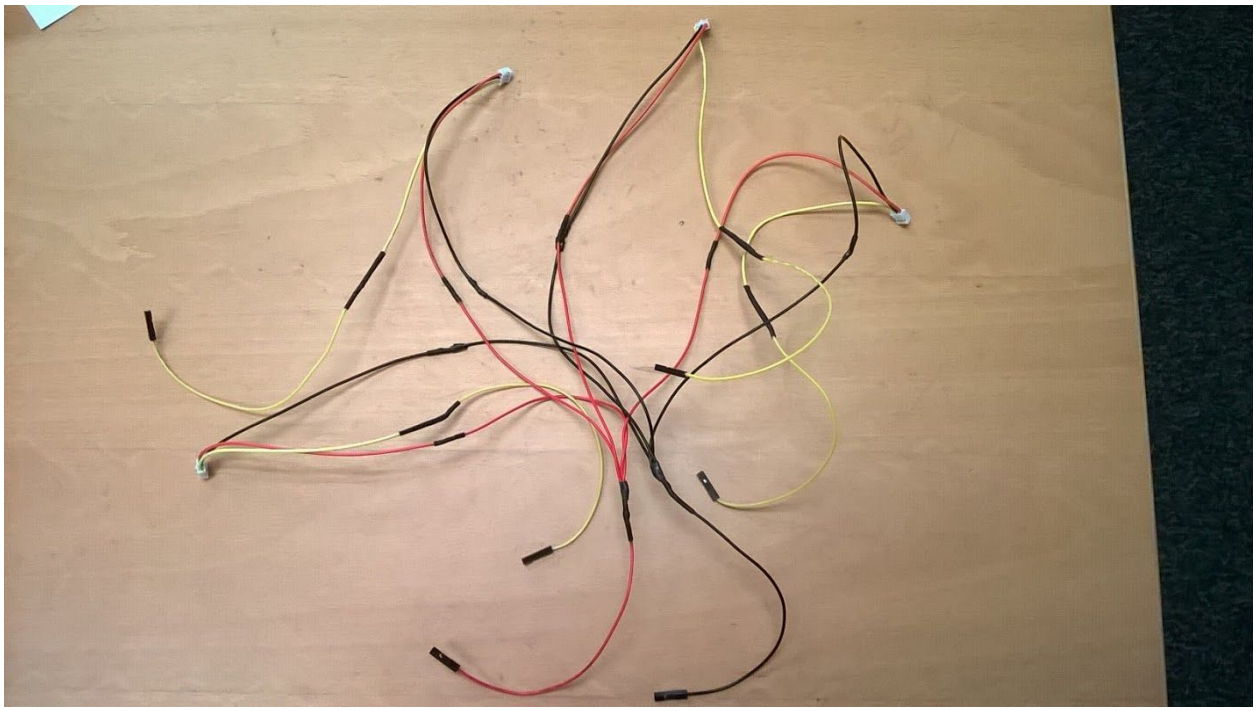
27) Repeat Steps #24 and #25 for the remaining red wire and solder it to the red wires on the 4 IR sensors.

28) Now, take 4 yellow female-female wires **(Part #17)** and for each one, strip off one side and leave the the other side intact and put a crimp connector housing on that end.

29) Now, cut some heat shrink tubing and add it onto the wire before soldering the each yellow wire you prepared in Step #28 to a yellow wire on the IR sensor.

Pictures for clarification/reference are on the next page.

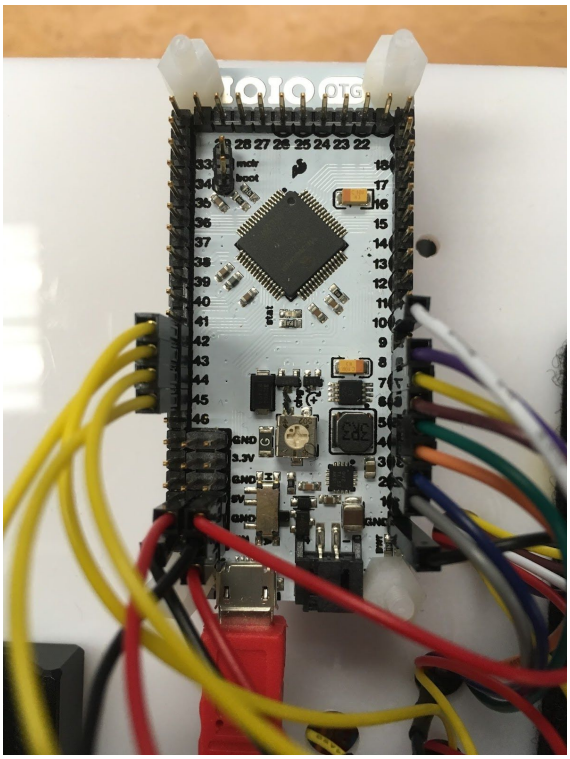

Left
IR
Front
IR
Right
IR
Rear
IR
(Pin 42)
(Pin 43)
(Pin 44)
(Pin 45)
(GND)
(5V)
Green = Yellow Signal Wire



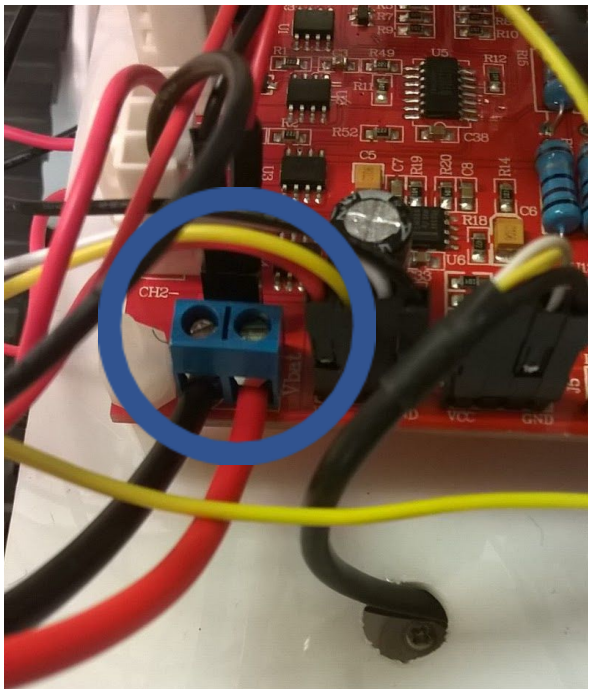
30) Now connect the 6 wires to the IOIO by feeding it through the 4 Green Holes you drilled in Step #10.

Pin # on IOIO	**Wire Color (all 6” Female to Female Wires)**
5V	Red
GND	Black
42	Left IR Sensor (Yellow) Signal Wire
43	Middle IR Sensor (Yellow) Signal Wire
44	Right IR Sensor (Yellow) Signal Wire
45	Back IR Sensor (Yellow) Signal Wire

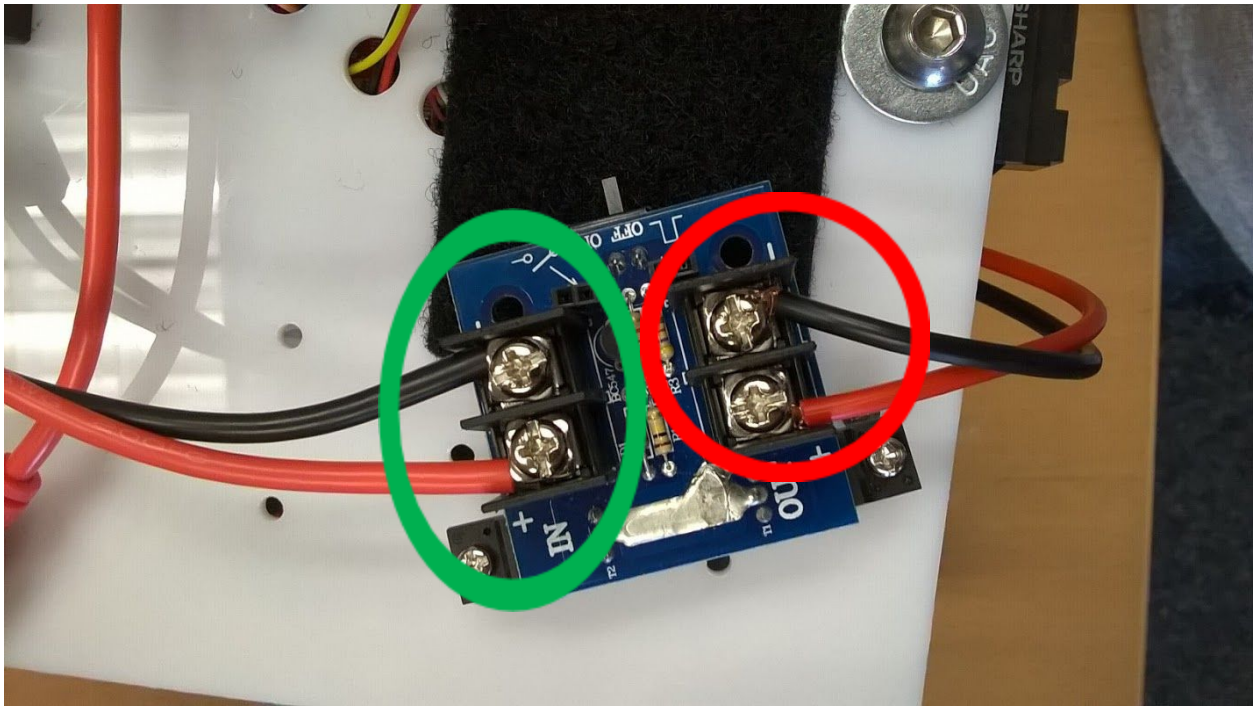
Your IOIO’s wiring should look like the following picture.



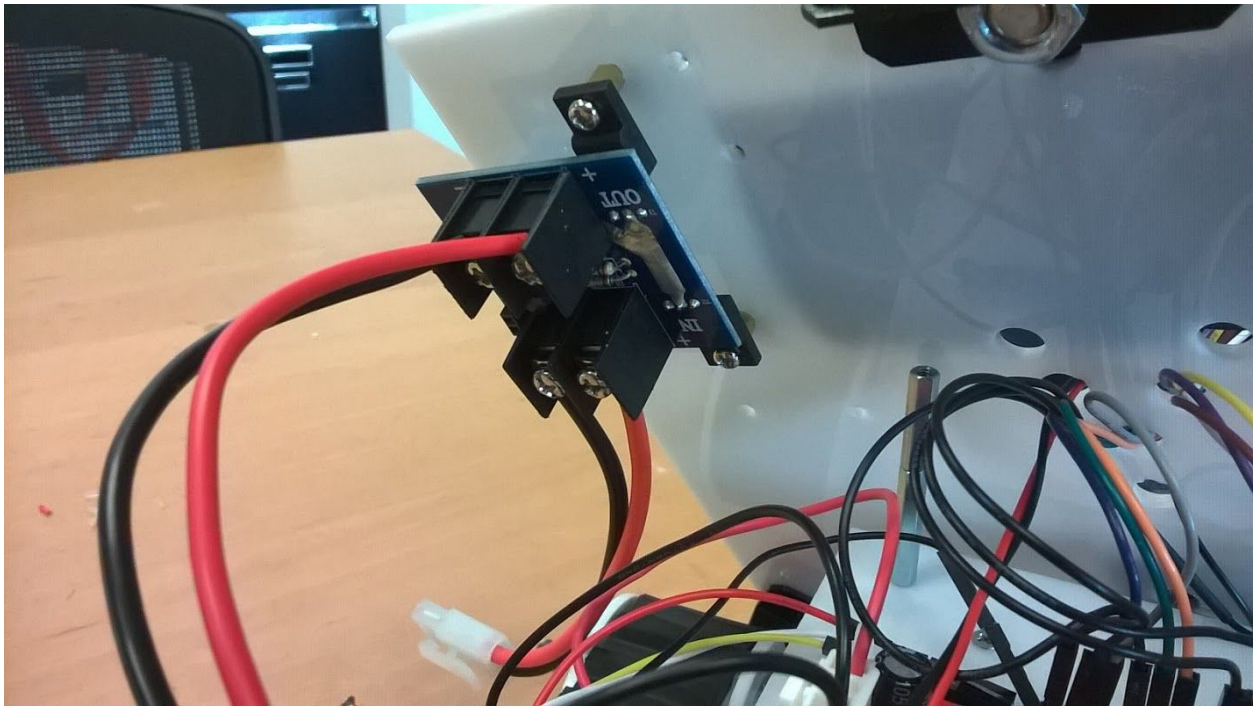
31) Cut about 5” of 16AWG wiring **(Part #22 and #23)** and strip both ends. Attach one end to the motor controller as shown (Black/Red) by the blue circle. Connect the other end to the power switch **(Part #37)** red wire to the (+ OUT) and black wire to the (- OUT) as shown in the second picture by the red circle.

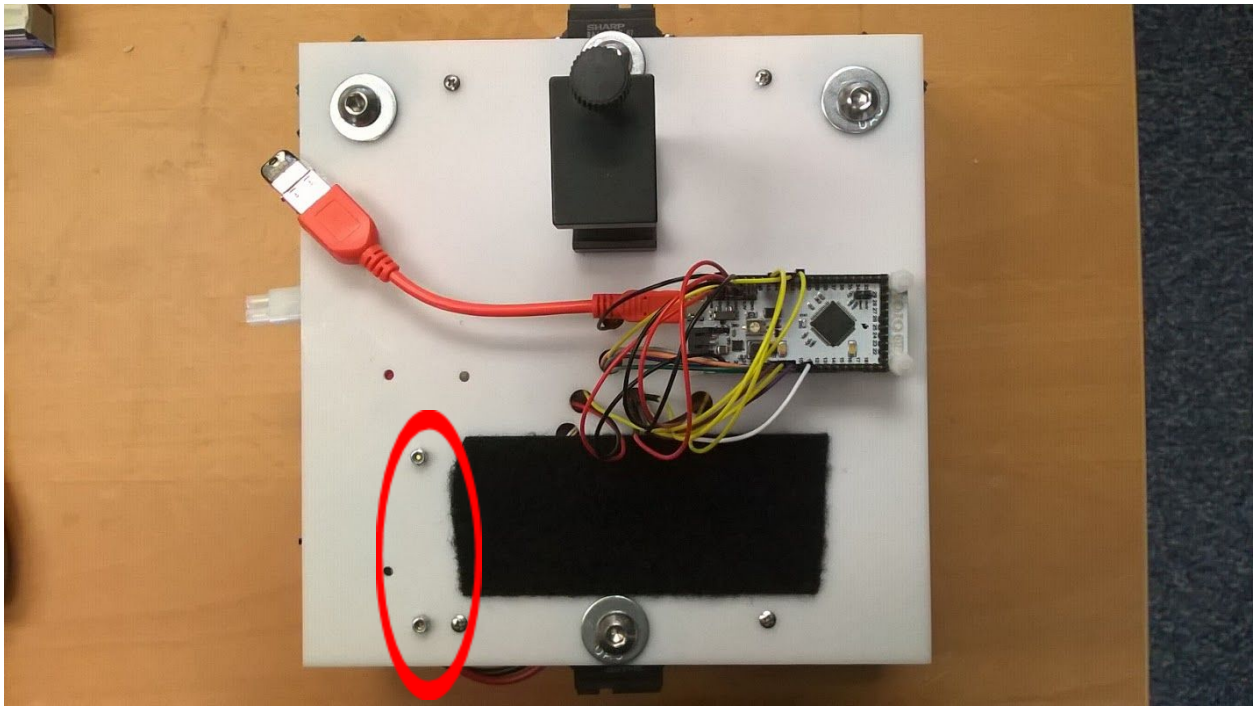


Take the Tamiya Power Plug **(Part #38)** and attach it to the Power Switch as shown below in the green circle. NO need to strip the wire! Red wire to the (+ IN) and black wire to the (- IN).



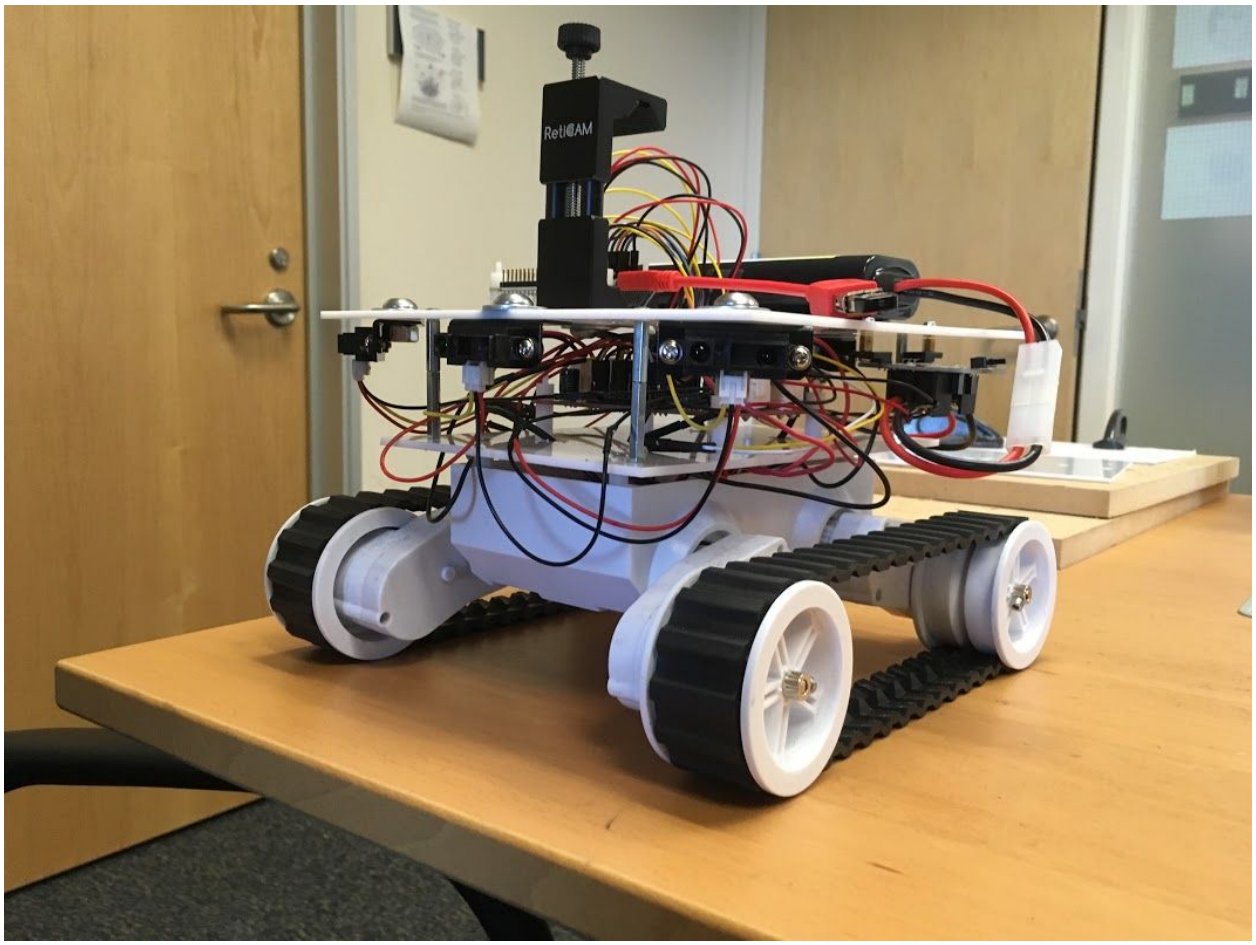
32) Now take the screws, standoffs, and bolts that came with the power switch and attach the power switch to the underside of the 8” x 8” board via the 2 “x” holes that you drilled in Step #10. Attach the power switch to the board by screwing the switch to the standoff and securing it on the other side of the board with the hex nut (as shown in the two pictures below).

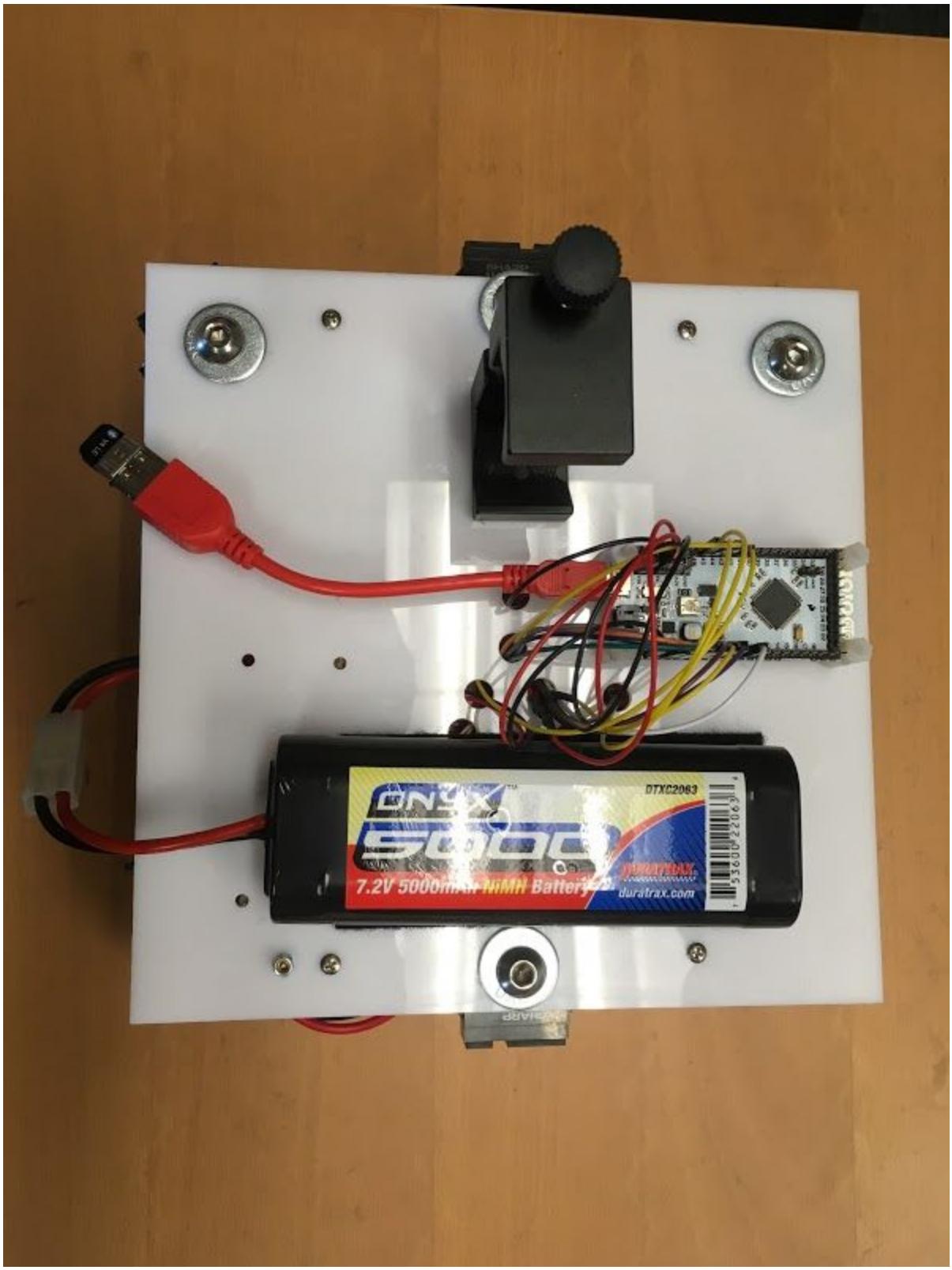




33) Finally, measure (about 3/4 the length of a battery), cut, and adhere a piece of velcro (the furry side) as shown in the previous picture. Measure, cut, and adhere to corresponding velcro piece (non-furry) to the battery.

Your completed robot looks similar to the following two pictures!




DTXC2063
5000
7.2V 5000mAh NiMH Battery
duratrax.com

Parts List:

Part	Source	Quantity	Unit Cost
Robot Base:			
Rover 5 Robot Platform with Tank Treads	https://www.sparkfun.com/products/10336	1	$59.95
Wheels (Recommended)	https://www.pololu.com/product/1555	2	$14.95
9 x 8 Polycarbonate Sheet	https://www.tapplastics.com/product/plastics/cut_to_size_plastic/polycarbonate_sheets/516	1	$10.00
8 x 5 Polycarbonate Sheet	https://www.tapplastics.com/product/plastics/cut_to_size_plastic/polycarbonate_sheets/516	1	$10.00
RetiCAM® Smartphone Tripod Mount	https://www.amazon.com/RetiCAM%C2%AE-Smartphone-Tripod-Mount-Universal/dp/B00FS5L9D4/	1	$24.99
Electronics:			
DAGU Rover 5 tank motor driver board	http://www.jameco.com/z/RS011MC-Dagu-HiTech-Electronic-Motor-Controller-4-Channel-4-5A-4-5-12V-for-Rover-5-Chassis-Supports-Encoder-Mixing-_2150539.html?CID=GOOG&gclid=CKfHpcKQzs4CFc1hfgodZ3EDbg	1	$21.95
IOIO-OTG V2.2	https://www.sparkfun.com/products/13613	1	$39.95
SMK-Link Nano Dongle Bluetooth v4.0 LE+EDR	https://www.amazon.com/SMK-Link-Nano-Dongle-Bluetooth-VP6495/dp/B0093HNIBO	1	$9.99
TE Connectivity AMP Connectors 9-146285-0	https://www.digikey.com/product-detail/en/te-connectivity-amp-connectors/9-146285-0/A32700-40-ND/1044472	2	$4.63
TE Connectivity AMP Connectors 9-146252-0	https://www.digikey.com/product-detail/en/te-connectivity-amp-connectors/9-146252-0/A32707-40-ND/1044712	1	$7.65
Sharp Microelectronics IR Sensor	http://www.digikey.com/product-detail/en/sharp-microelectronics/GP2Y0A41SK0F/425-2819-ND/3884447	4	$7.86
IR Bracket Mount	https://www.dfrobot.com/product-127.html?gclid=CNeH3ZeNr9QCFdNyfgod-MkCgg	4	$5.00
Wiring:			
Wires with Pre-crimped Terminals 50-Piece Rainbow Assortment M-F 6"	https://www.pololu.com/product/1801	1	$9.95
0.1" (2.54mm) Crimp Connector Housing: 1x1-Pin 25-Pack	https://www.pololu.com/product/1900	5	$0.59
Wires with Pre-crimped Terminals 10-Pack F-F 6" Red	https://www.pololu.com/product/1812	1	$2.49
Wires with Pre-crimped Terminals 10-Pack F-F 6" Black	https://www.pololu.com/product/1810	1	$2.49
Wires with Pre-crimped Terminals 10-Pack F-F 6" Yellow	https://www.pololu.com/product/1814	1	$2.49
Wires with Pre-crimped Terminals 50-Piece Rainbow Assortment F-F 6"	https://www.pololu.com/product/1800	1	$9.95
Wires with Pre-crimped Terminals 10-Pack M-F 12" Black	https://www.pololu.com/product/1850	1	$4.49
Wires with Pre-crimped Terminals 10-Pack M-F 12" Red	https://www.pololu.com/product/1852	1	$4.49
Thermosleeve Heat Shrink Tubing 3/32" "Black" - 100 FT	https://www.amazon.com/Thermosleeve-Heat-Shrink-Tubing-Black/dp/B006HU7XCA	1	$8.25

16 Gauge Primary Wire (25 feet) Black	https://www.amazon.com/Grand-General-55230-16-Gauge-Primary/dp/B00INVEQB2?th=1	1	$6.38
16 Gauge Primary Wire (25 feet) Red	https://www.amazon.com/Grand-General-55230-16-Gauge-Primary/dp/B00INVEUS6?th=1	1	$6.10
VELCRO Brand - Industrial Strength - 2" x 4' - Black	https://www.amazon.com/VELCRO-Brand-Industrial-Strength-Black/dp/B00006IC2T	1	$9.15
Infrared Sensor Jumper Wire - 3-Pin JST	https://www.sparkfun.com/products/8733	4	$1.50
Nuts and Bolts:			
Phillips Oval Head Screws, M3 x 0.5 mm Thread, 8 mm Long	McMaster: 90258A178	1	$5.18
18-8 Stainless Steel Phillips Flat Head Screws 4-40 Thread Size, 3/8" Long	McMaster: 91771A108	1	$4.56
Nylon 6/6 Male-Female Threaded Hex Standoff, 1/4" Hex Size, 1/2" Length, 4-40 Thread Size	McMaster: 92745A322	4	$0.32
Nylon 6/6 Male-Female Threaded Hex Standoff, 1/4" Hex Size, 1/4" Length, 4-40 Thread Size	McMaster: 92745A320	4	$0.31
Male-Female Threaded Hex Standoff, Zinc-Plated Brass, 4.5 mm Hex Size, 25 mm Length, M3 Thread Size	McMaster: 93655A021	4	$2.24
Zinc-Plated Brass Female Threaded Hex Standoff 4.5 mm Hex Size, 19 mm Length, Fully Threaded	McMaster: 92080A014	4	$1.18
18-8 Stainless Steel Hex Drive Rounded Head Screw 5/16"-18 Thread Size	McMaster: 92949A578	1	$5.17
18-8 Stainless Steel MIL. Spec. Washer Passivated, 5/16" Screw Size, MS-16212-12	McMaster: 92503A120	1	$11.80
18-8 Stainless Steel Hex Nut, 5/16"-18 Thread Size	McMaster: 91845A030	1	$5.11
18-8 Stainless Steel MIL. Spec. Washer Passivated, 1/4" Screw Size, MS-16212-11	McMaster: 92503A110	1	$11.80
Hex Drive Rounded Head Screws, Zinc-Plated Alloy Steel, 1/4"-20 Thread Size, 1/2" Long	McMaster: 91306A375	1	$12.08
Hex L-Key: 3/16" Size, 3" Overall Length	McMaster: 7122A22	1	$0.29
Power:			
DAGU - Wild Thumper High Power Switch	http://www.ebay.com/itm/6wd-Wild-Thumper-Motor-Switch-Board-power-DAGU-RS003HP-high-Power-Swith-/191811733307	1	$15.00
Tamiya Plug with 10cm Leads, Female (14AWG)	https://www.pololu.com/product/2172	1	$1.49
Duratrax Onyx 200 AC/DC Sport Peak Charger	https://www.amazon.com/Duratrax-Onyx-Sport-Peak-Charger/dp/B001BCF4YS/ref=pd_bxgy_21_2/142-9340309-5731663?_encoding=UTF8&pd_rd_i=B001BCF4YS&pd_rd_r=HH2ACGC2RVKGDS9XSMYH&pd_rd_w=e4rQq&pd_rd_wg=993V5&psc=1&refRID=HH2ACGC2RVKGDS9XSMYH	1	$47.98
Duratrax Onyx 7.2V 5000mAh NiMH Battery Stick Pack with Standard Connector	https://www.amazon.com/dp/B004AF88K0/ref=olp_product_details?_encoding=UTF8&me=	1	$31.98