Advanced Kit Construction Guide

TI Robotics System Learning Kit (TI-RSLK): The Maze Edition

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This assembly guide is based on the design of a robotic system described in the TI-RSLK curriculum. The choice made during the design and assembly meet the educational objectives provided in the TI-RSLK curriculum experiments.
This is for your guidance only.

Lab Tools Needed:

Soldering Iron

Wire Stripper and Cutter

Heat Gun

Precision Knife

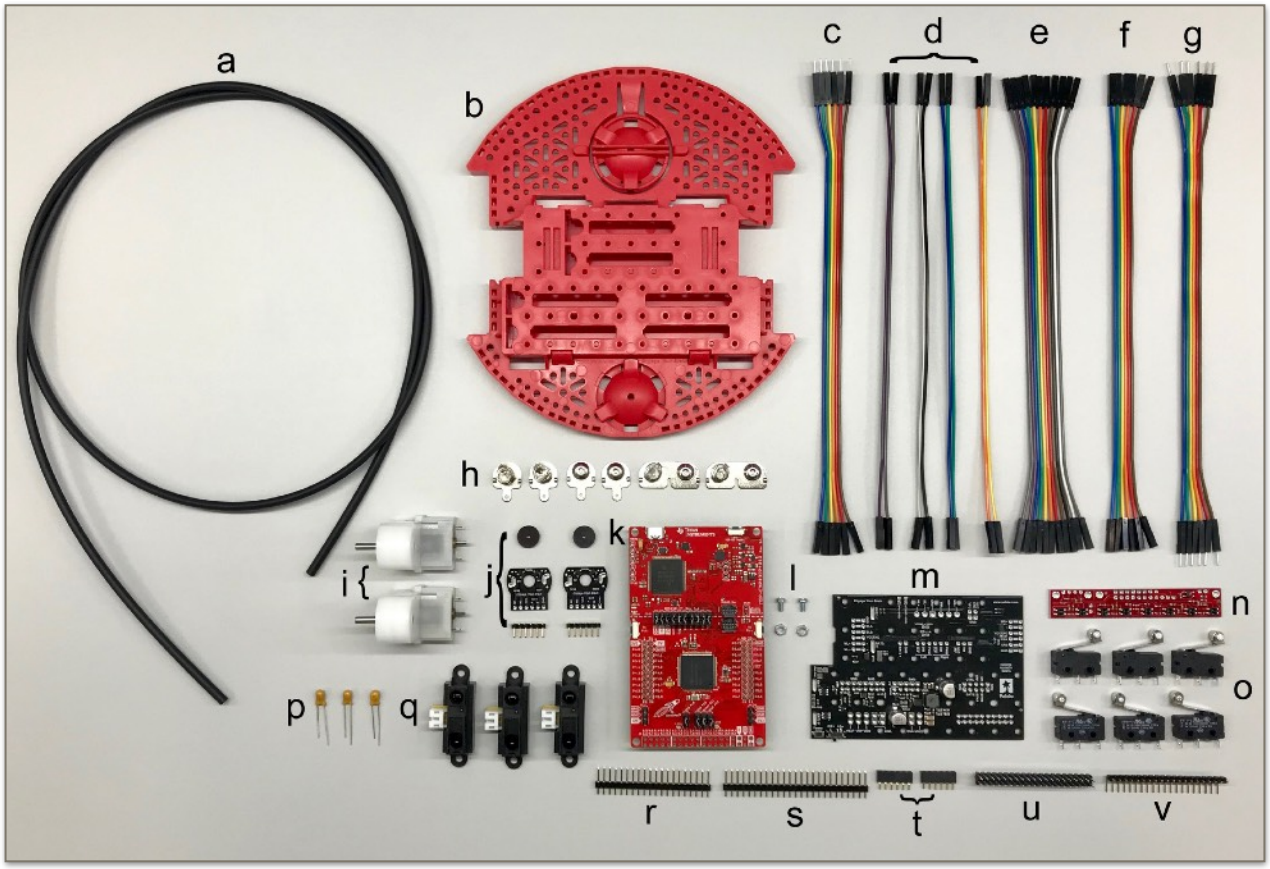
Pliers

Screwdriver

Review the manufacture data sheet for each device prior to advancing through the guide. Be sure to follow all lab and safety guidelines.

Section 1: Soldering

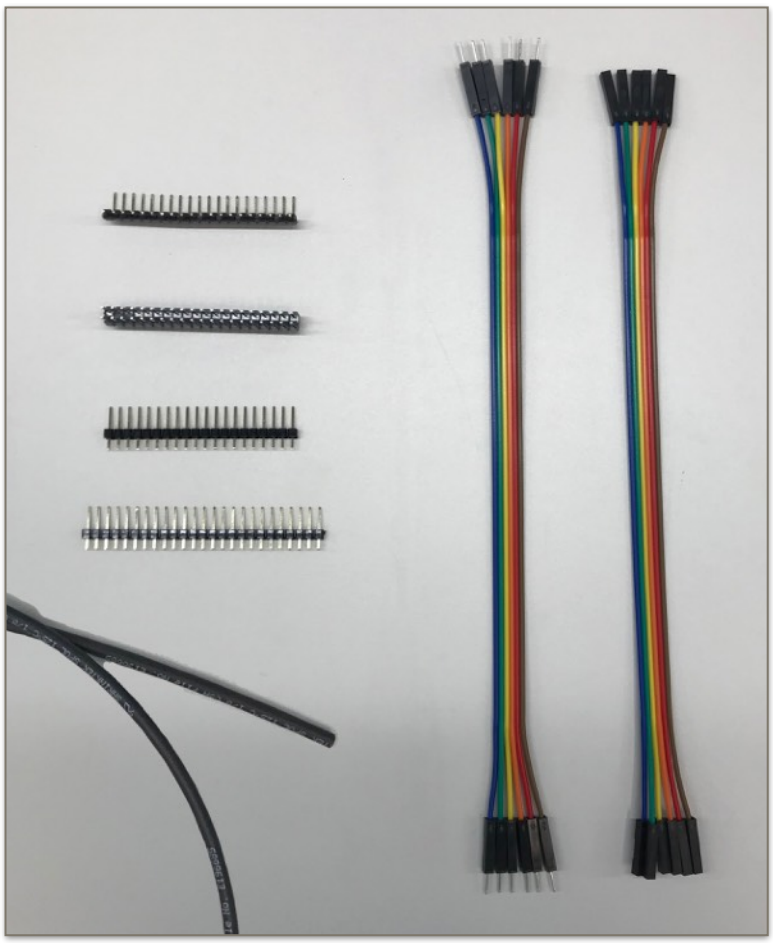
Step 1: Gather Your Supplies



	Description	Qty	Part #
a	Heat Shrink Tube	1	01M8939
b	Chassis	1	55AC1156
c	6 Female to Male Wires	1	44AC9484
d	2 Female to Female Wires	4	44AC9484
e	11 Female to Female Wires	1	44AC9484
f	6 Female to Female Wires	1	44AC9484
g	6 Male to Male Wires	1	44AC9484
h	Battery Terminals	6	55AC1157
i	Motor	2	55AC1157
j	Motor Encoder	2	55AC7013
k	TI LaunchPad™ Kit	1	41Y9541

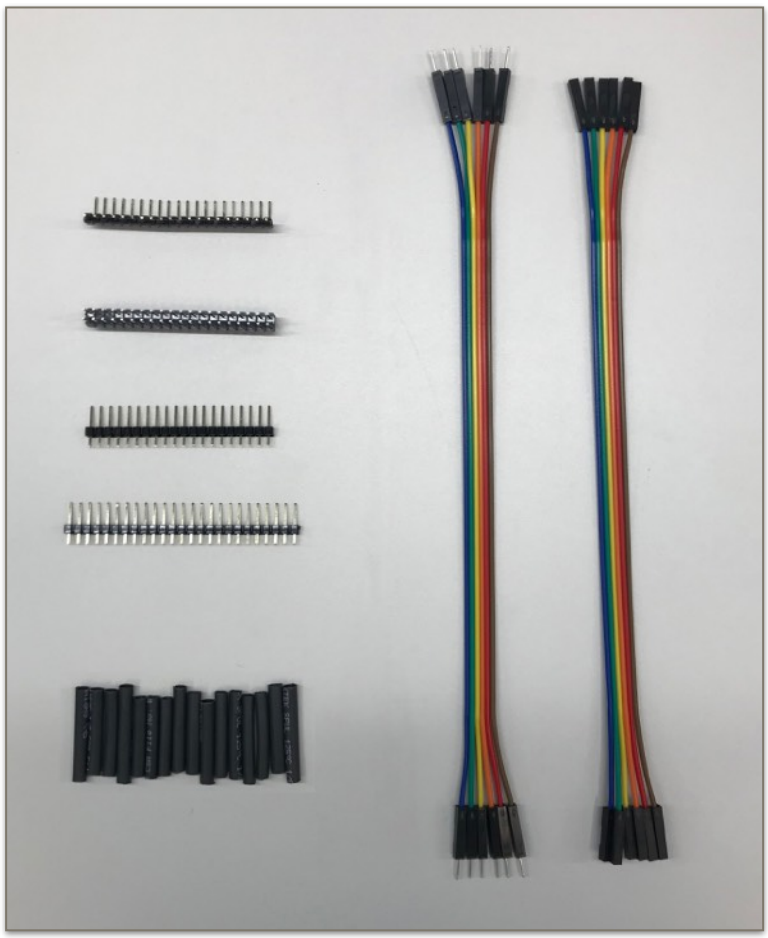
	Description	Qty	Part #
l	Motor Board Screws	1	55AC1157
m	Motor Board	1	55AC1157
n	Line Follower Sensor	1	55AC1158
o	Bump Switch	6	55AC1159
p	10 µF Capacitor	3	54J4427
q	IR Sensor	3	55AC7015
r	1x20 Header	1	08N6754
s	1x25 Header	1	55AC1158
t	1x6 Header	2	55AC1157
u	2x20 Header	1	93K5757
v	90° Bent Headers	1	08N6741

Step 2: Prepare Headers, Tubing, and Wires

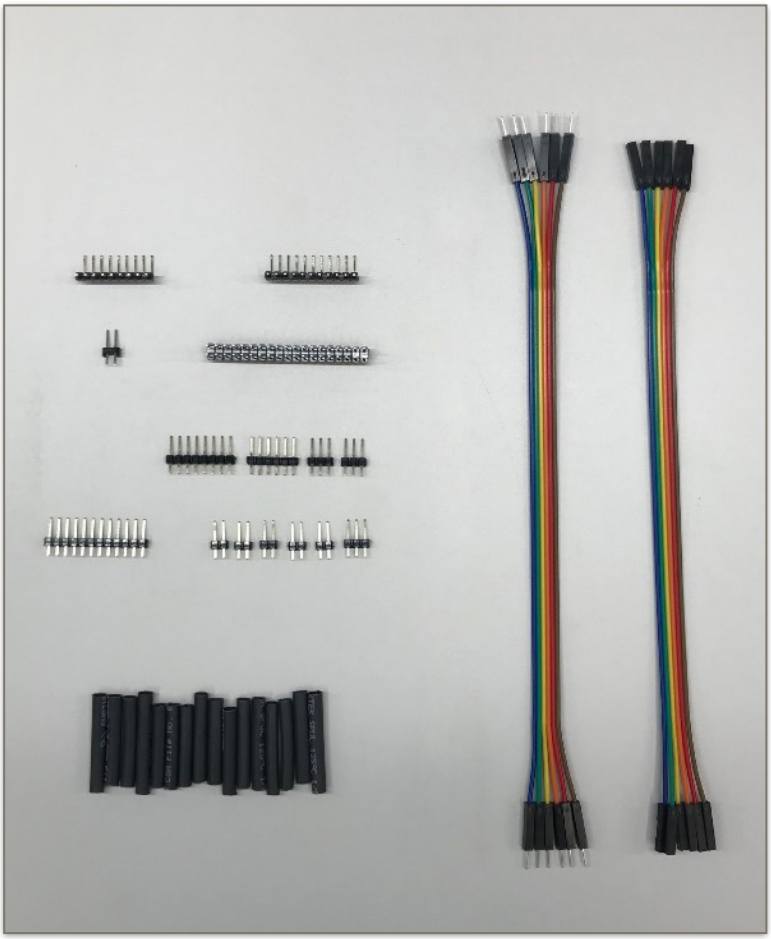


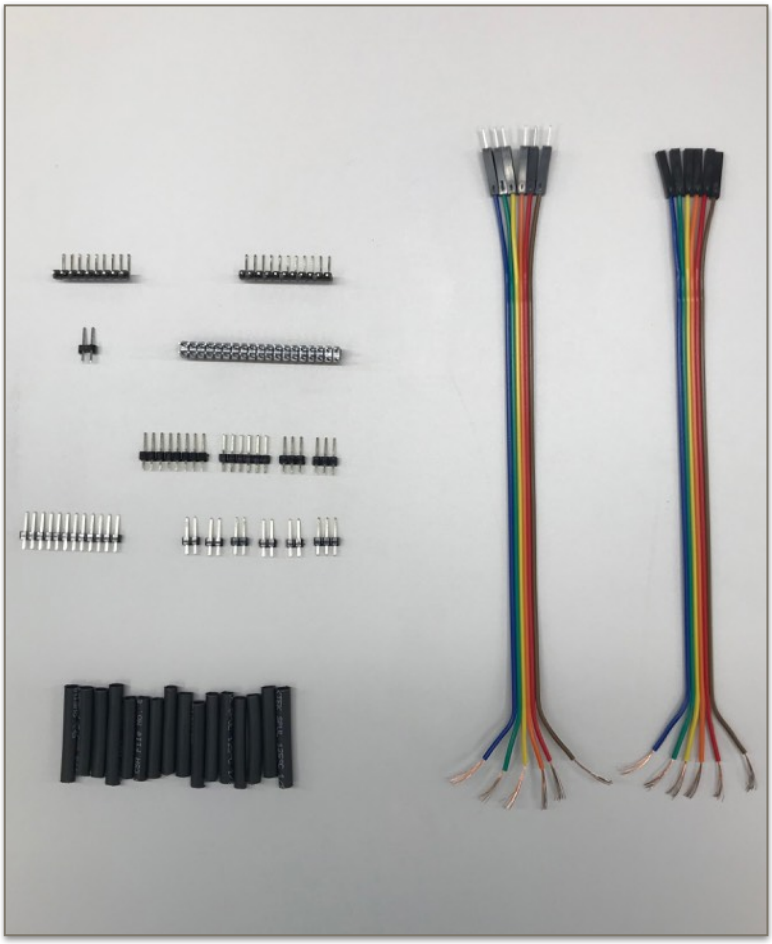
Gather the following:

- Heat Shrink Tubing (a)
- 6 Female to Female Wires (f)
- 6 Male to Male Wires (g)
- 90º Bent Headers (v)
- 2x20 Header (u)
- 1x20 Header (r)
- 1x25 Header (s)



Cut the heat shrink tubing (a) into 12 1in (~2.5cm) minimum pieces.





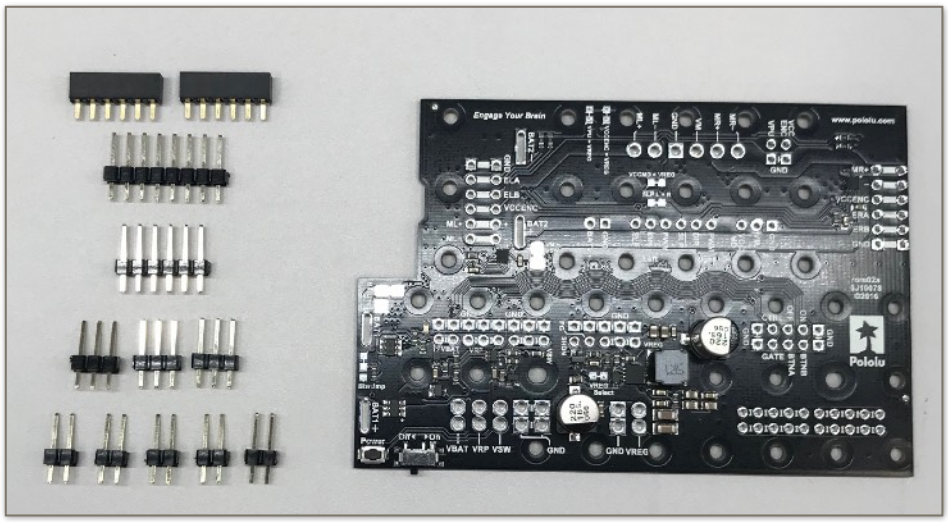
Cut the following:

- 90º bent headers (v) into a 1x11
- 2x20 header (u) into a 2x19
- 1x20 header (r) into a 1x8, 1x6, and two 1x3
- 1x25 header (s) into a 1x3 and five 1x2

Cut and strip one end off of the 6 female to female wires (f) using the wire stripper.

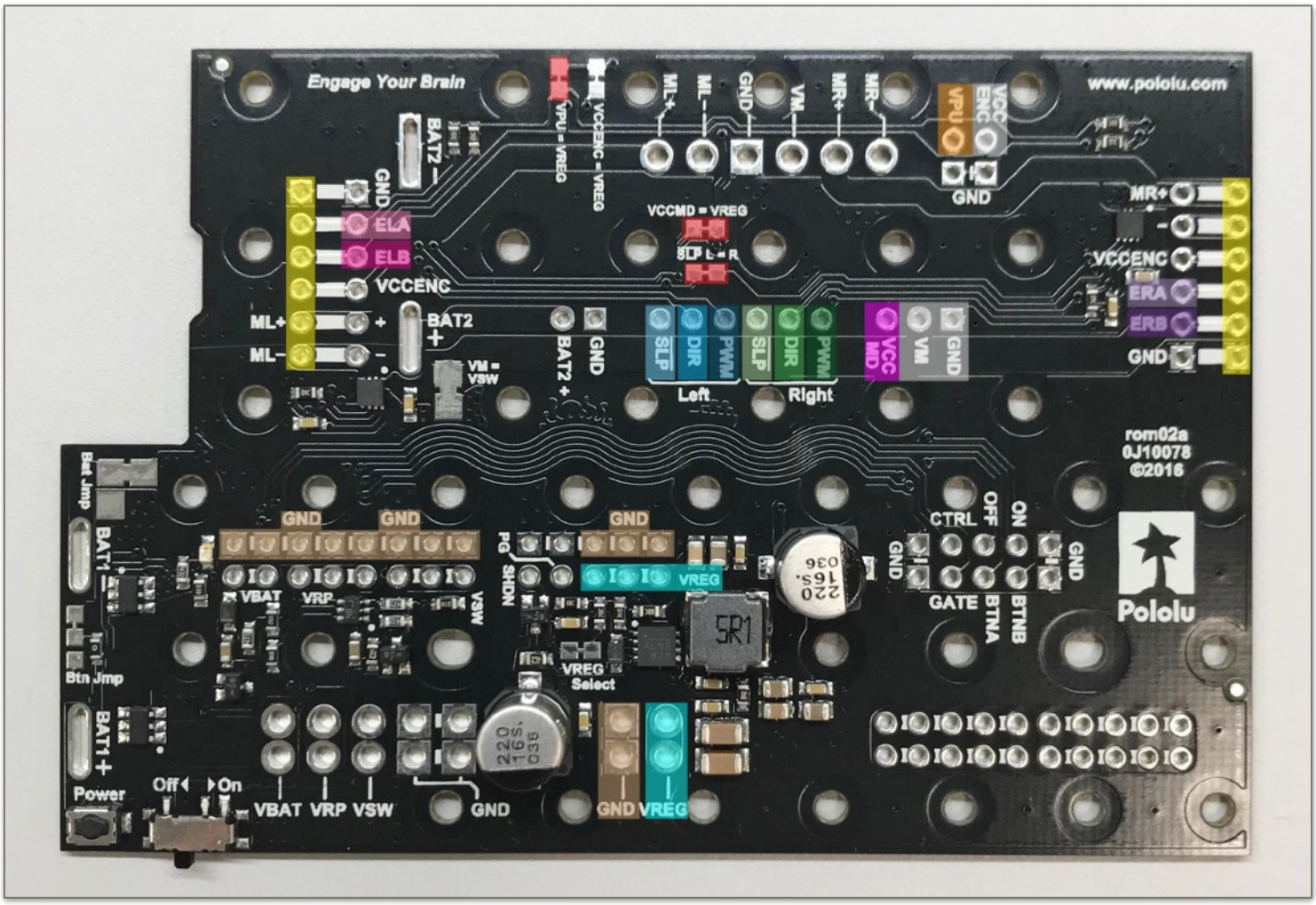
Cut and strip one end off of the 6 male to male wires (g) using the wire stripper.

Step 3: Prepare the Motor Board



Gather the following:

- Motor Board (m)
- Two 1x6 Headers (t)
- 1x8 Header (Prepared earlier)
- 1x6 Header (Prepared earlier)
- 3 1x3 Headers (Prepared earlier)
- 5 1x2 Headers (Prepared earlier)

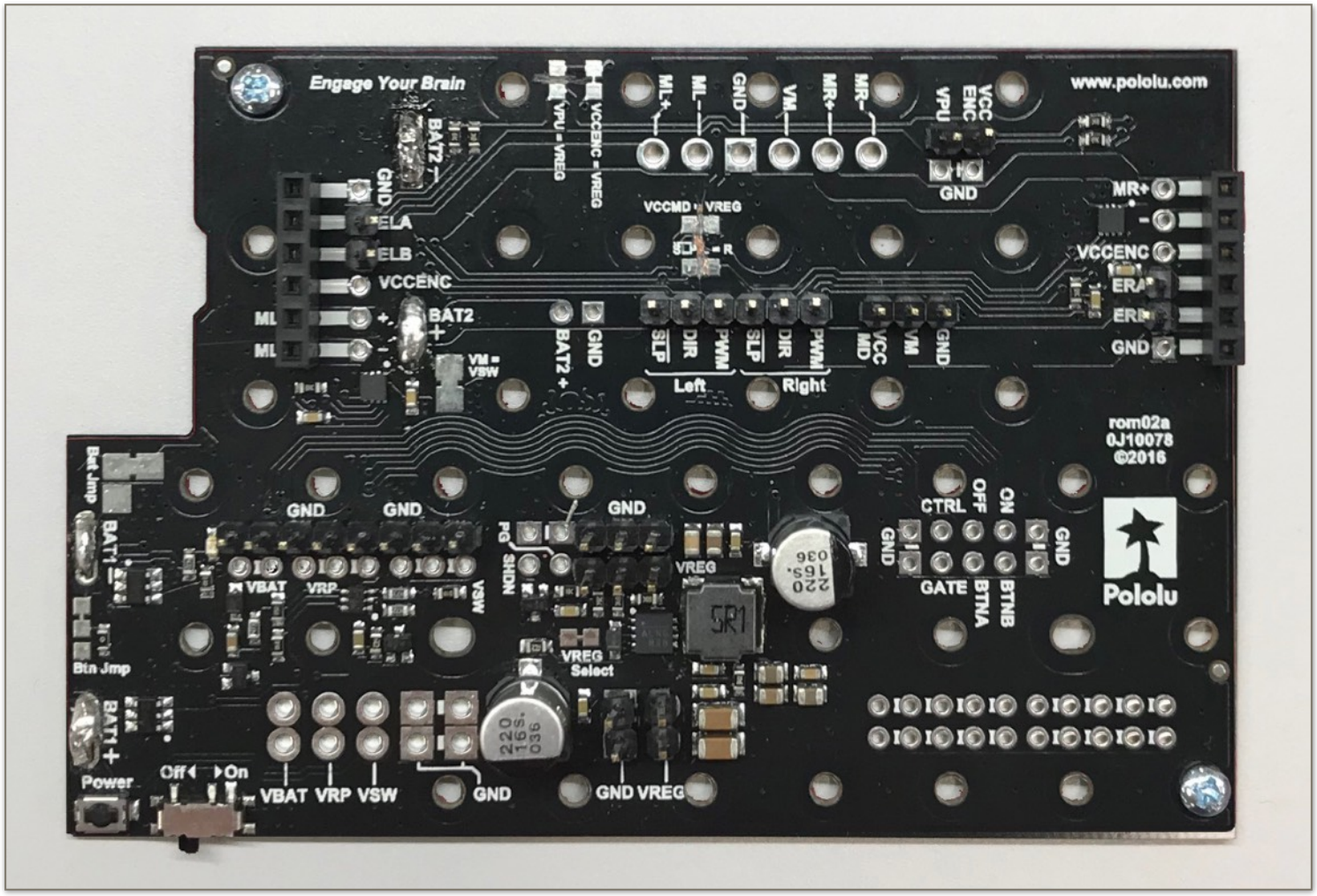


Use a precision knife to cut the VPU-VREG, VCCMD-VREG, and SLP L-R traces.

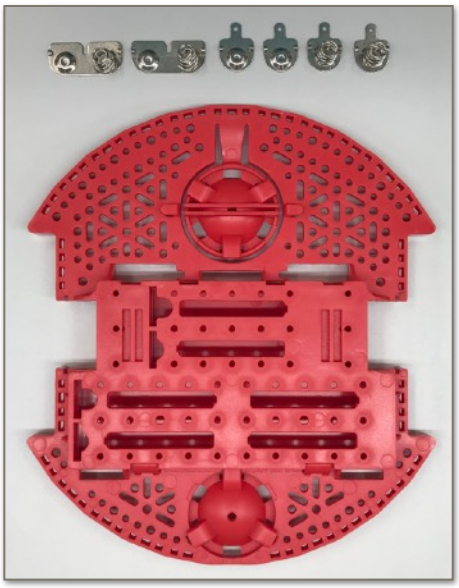
Solder the following:

- two 1x6 headers (t) to the yellow connections.
- a 1x2 header cut earlier to the ELA and ELB connections. **Note:** You will need to bend these to a 45º angle after soldering.
- a 1x2 header cut earlier to the ERA and ERB connections. **Note:** You will need to bend these to a 45º angle after soldering.
- a 1x2 header cut earlier to the VPU connection. **Note:** The white connection will never be used but helps with soldering.
- a 1x3 header cut earlier to the VCCMD connection. **Note:** The white connection will never be used but helps with soldering.
- a 1x6 header cut earlier to the Left and Right motor driver connections.
- a 1x3 and 1x2 header cut earlier to the VREG terminals.
- solder 1x8, 1x3, and 1x2 headers cut earlier to the GND terminals.

Finished Motor Board:

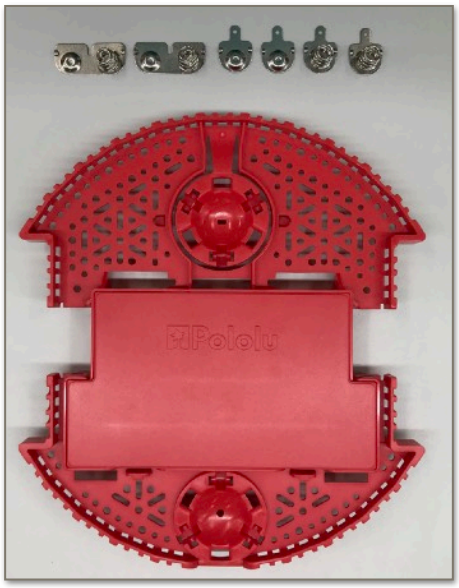


Step 4: Connect Battery Terminals and Chassis

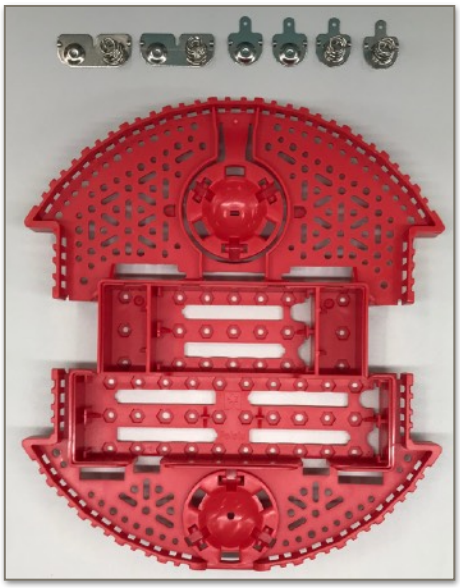


Gather:

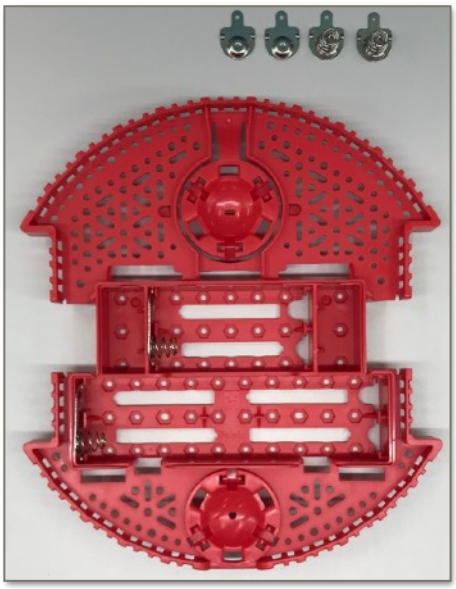
- Soldered Motor Board (m)
- Battery Terminals (h)
- Chassis (b)
- Screws for Motor Board (l)



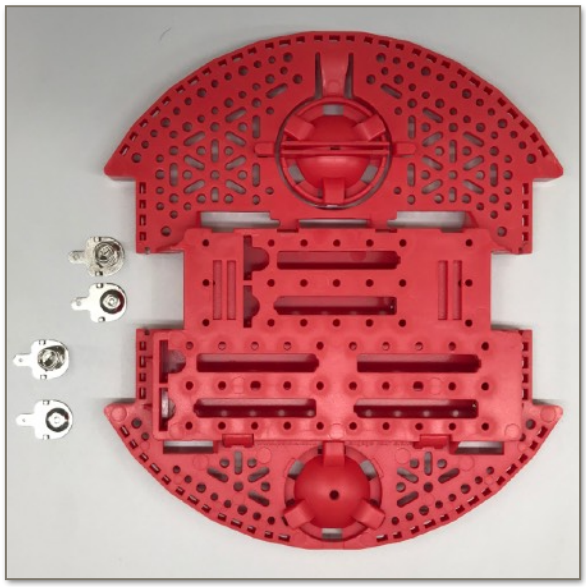
Flip chassis (b) over.



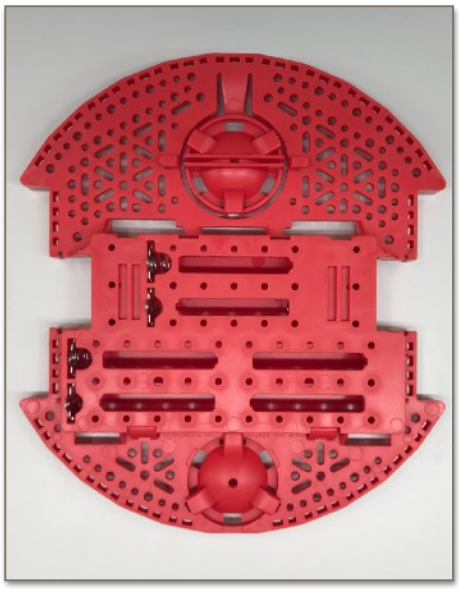
Remove battery cover.



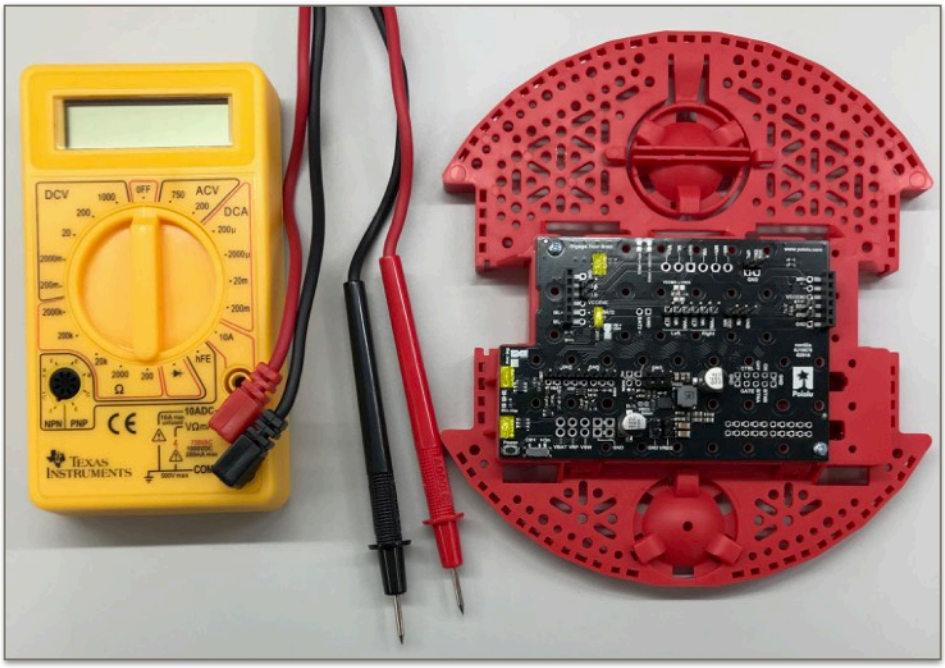
Insert the linking battery terminals (h) into the slots on the left.



Put battery cover back on and flip chassis (b) over.



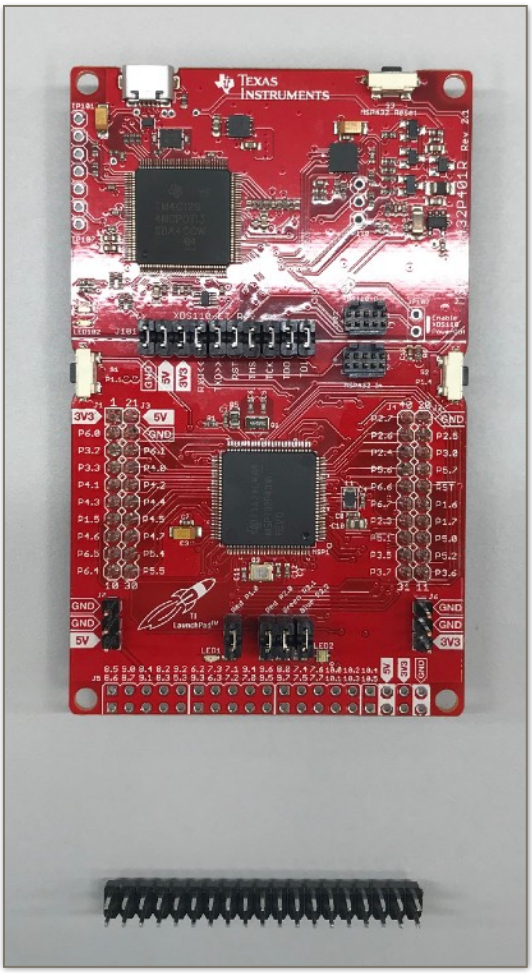
Insert battery tabs into the slots on the left. **Note:** the order from top to bottom is spring, flat tab, spring, flat tab.



Using a voltage meter, verify that the earlier solder connections were made and traces were cut on the motor board (m).

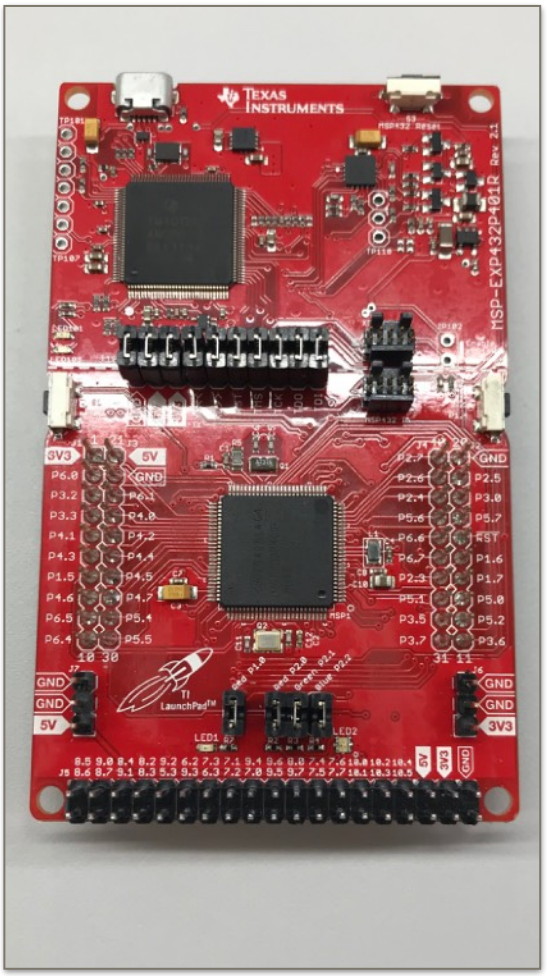
Solder the motor board (m) onto the battery terminals and secure the motor board (m) with two screws (l).

Step 5: Solder LaunchPad Connections

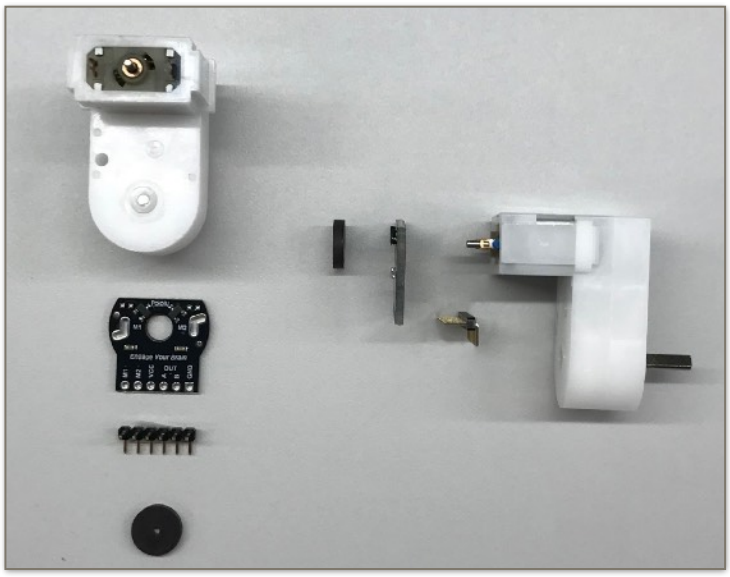


Gather your LaunchPad (k) and the 2x19 header you cut earlier.

Solder the 2x19 header on the J5 pinout at the bottom of the LaunchPad (k) with long pins facing upwards.

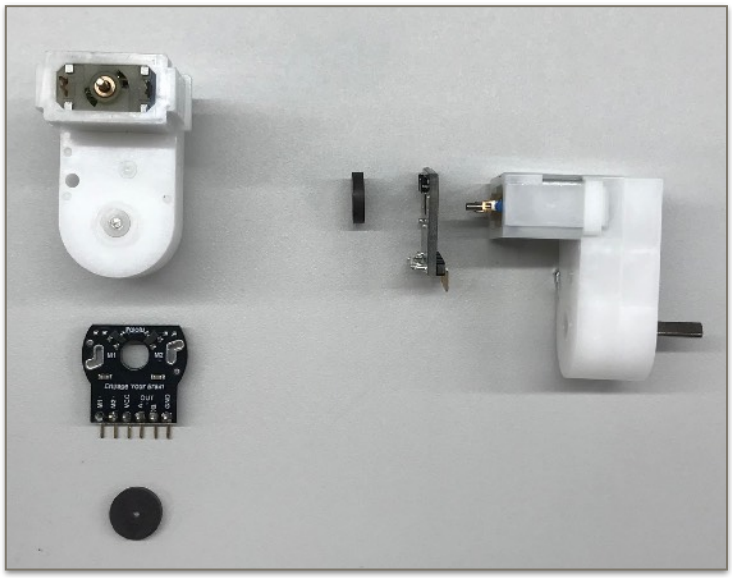


Step 6: Ready the Motors

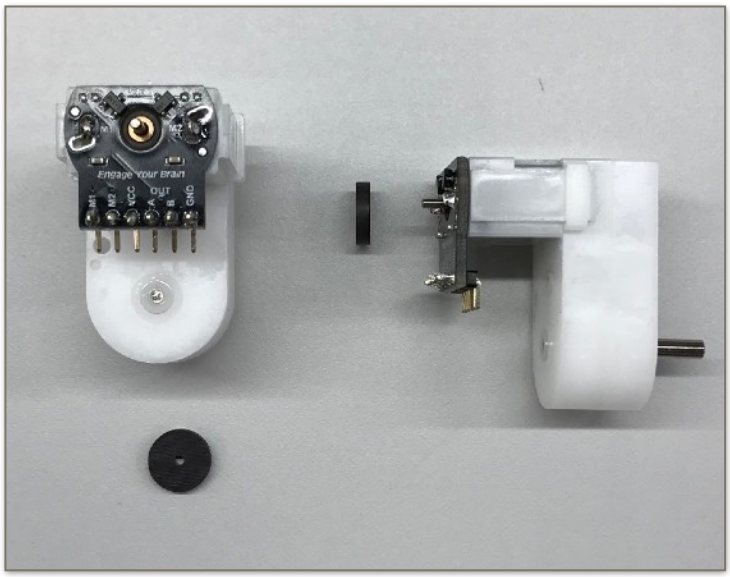


Gather:

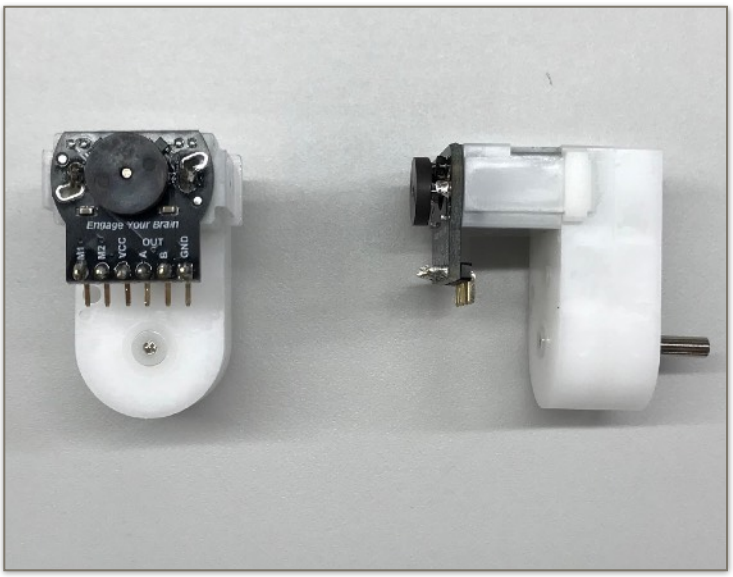
- Motors (i)
- 2 Motor Encoders (j)



Solder the included encoder headers (j) to the encoders (j). **Note:** The bent portion of the headers should be towards the motor as pictured above.

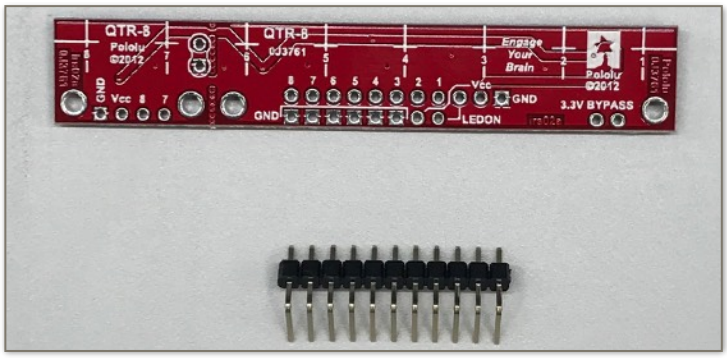


Solder the prepared encoders (j) onto the motors (i).

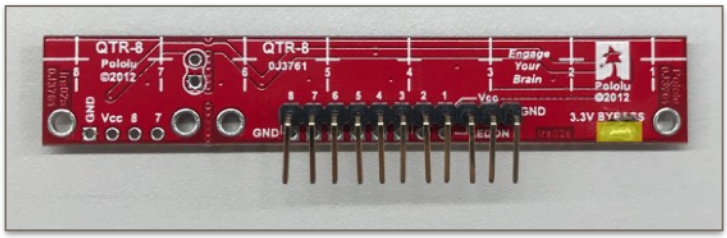


Attach the magnets onto the motors (i).

Step 7: Solder the Line Sensor Connections

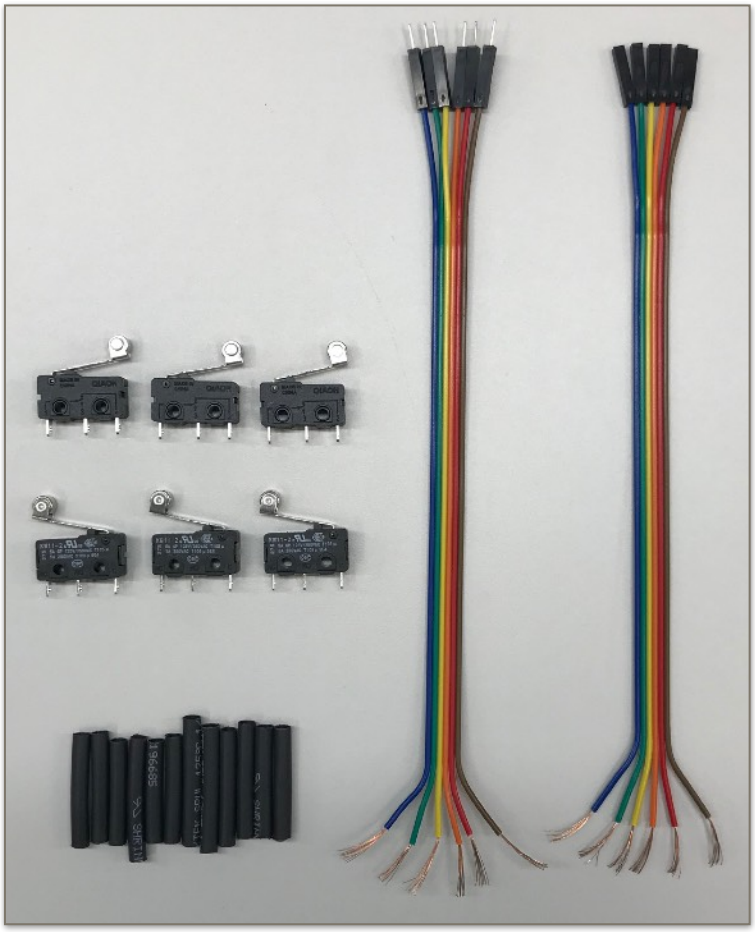


Gather the line sensor (n) and the 1x11 90º bent headers cut earlier.



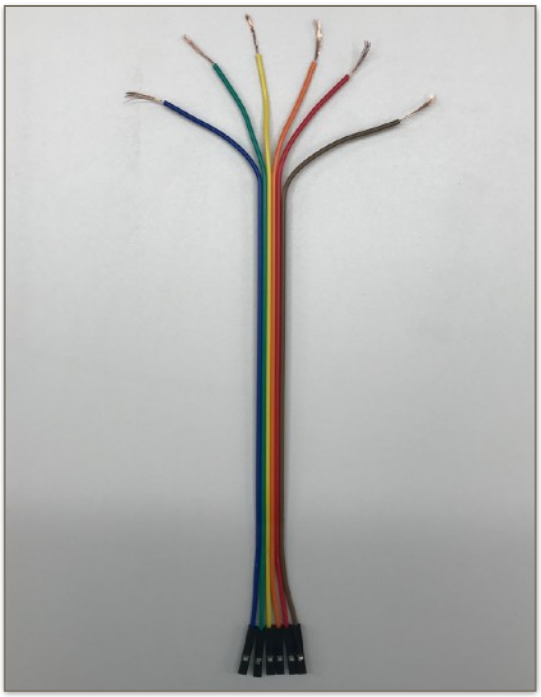
Solder the 1x11 bent headers onto the line sensor (n). Connect the highlighted 3.3V bypass by either creating a solder bridge or soldering a short wire.

Step 8: Prepare the Bump Switches

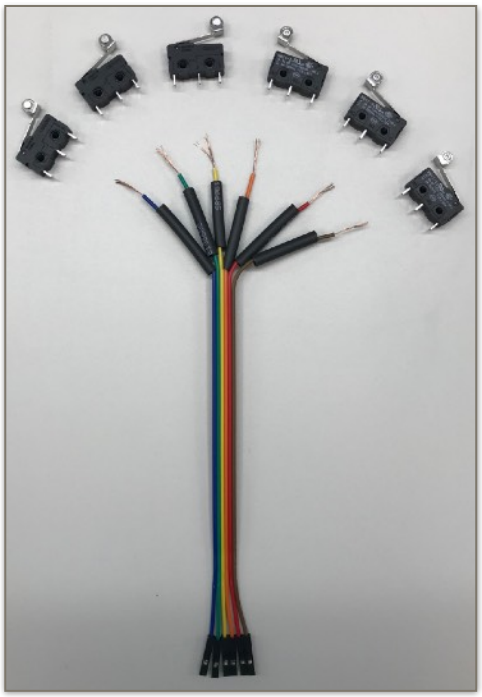


Gather the following:

- 6 Bump Switches (o)
- 12 Heat Shrink Tube pieces cut earlier (a)
- 6 Female wire with one end cut and stripped from earlier (f)
- 6 Male wire with one end cut and stripped from earlier (g)

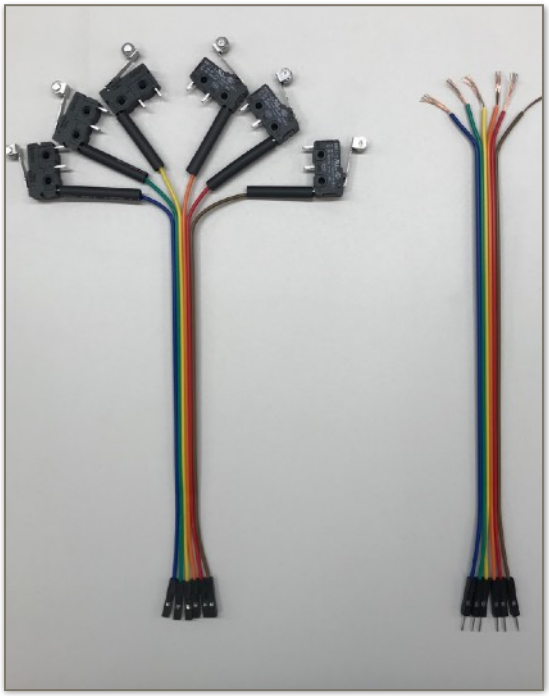


Start with the 6 female wires (f).



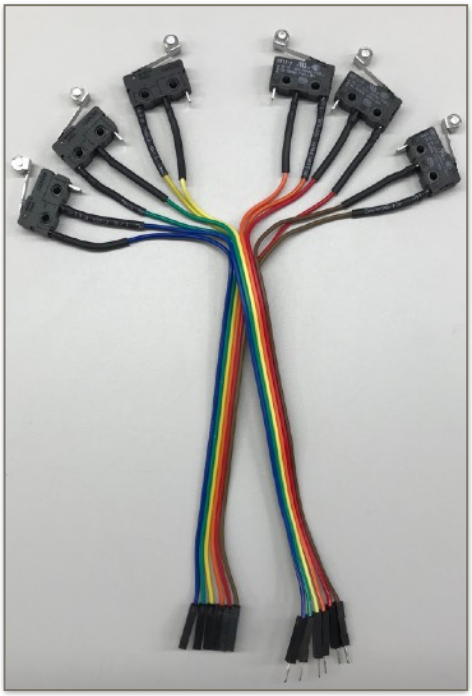
Slide a heat shrink tube (a) on each wire.

Solder one female wire on the “1” or “C” connection on each bump switch (0).



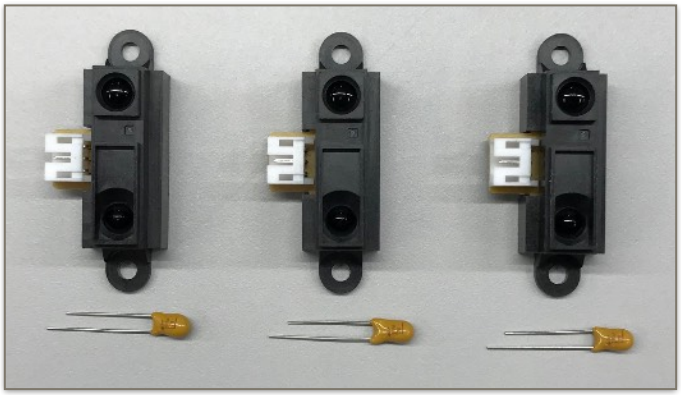
Ready the 6 male wires (g). **Note:** you can separate each wire but for a cleaner look try to keep them together.

Slide a heat shrink tube (a) on each wire.



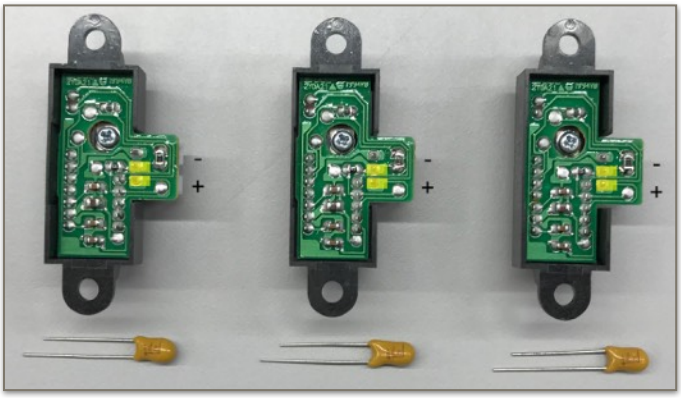
Solder one male wire on the “3” or “NO” connection on each bump switch (0). Color coding each switch will help you later when wiring.

Step 9: Ready the IR Sensors

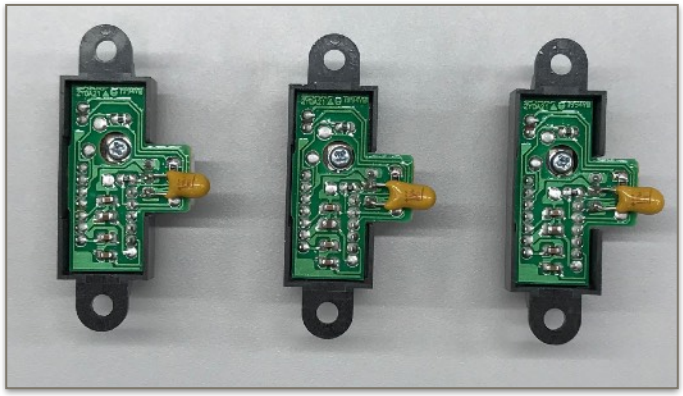


Gather the following:

- IR Sensors (q)
- 10 µF Capacitors (p)



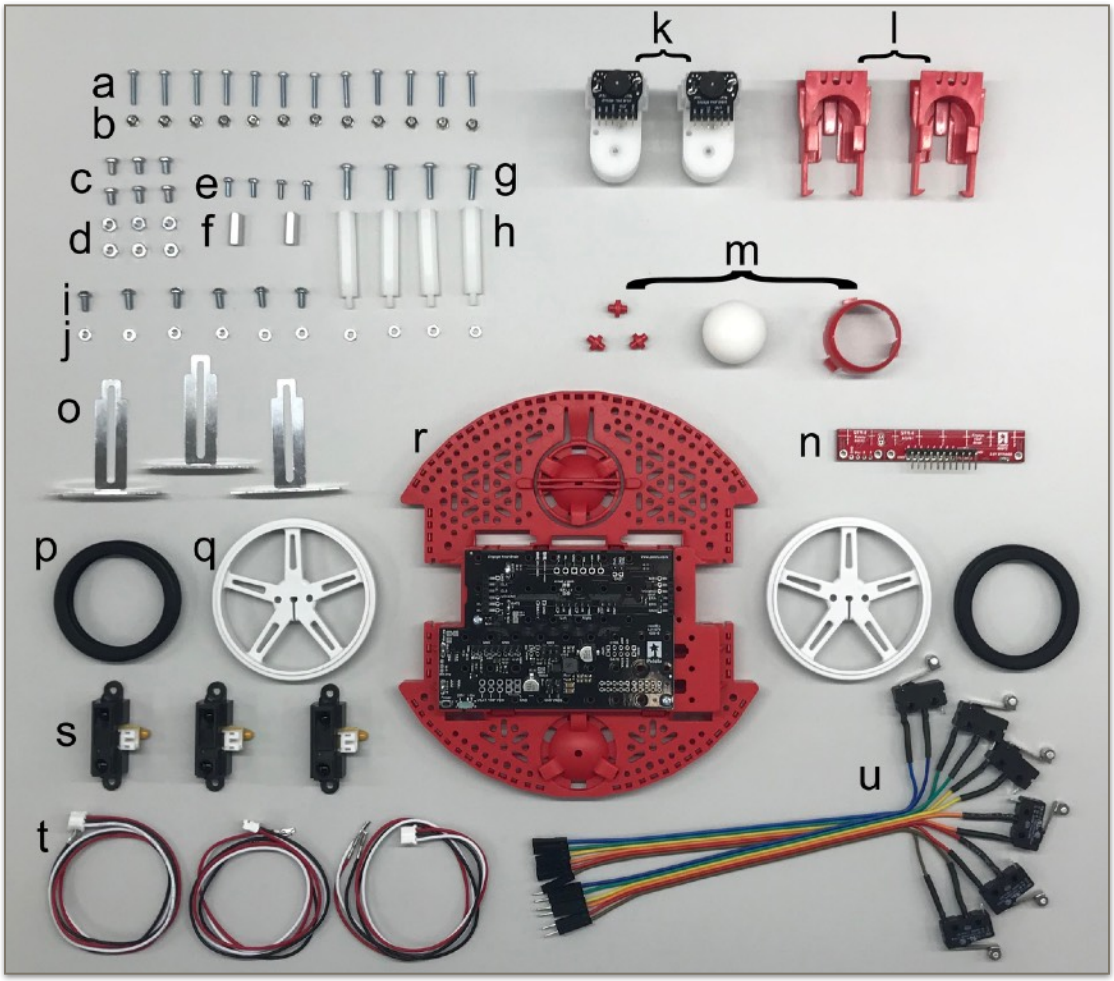
Flip the IR Sensors (q) over to expose the circuitry. Solder the 10 µF Capacitors (p) to the highlighted connections above. **Note:** The polarity of the capacitor connections.



Trim the excess capacitor wires to ensure they don't interfere with the rest of the circuitry.

Section 2: Assembly

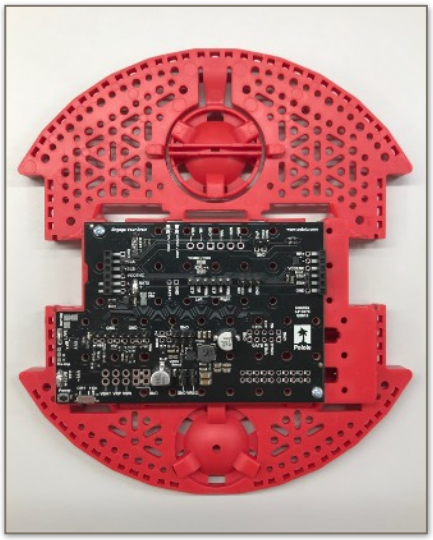
Step 1: Gather Supplies



	Description	Qty	Part #
a	#2-56 Screw 1/2”	12	55AC7011
b	#2-56 Nut	12	18M5986
c	M3 5mm Screw	6	55AC7014
d	M3 Nuts	6	55AC7014
e	#2-56 Screw 1/4”	4	56AC1176
f	#2-56 Metal Standoff 1/2“	2	27T8693
g	#4-40 Screw 1/2”	4	55AC7009
h	#4-40 Plastic Standoffs	4	16F1043
i	#4-40 Screw 1/4”	6	55AC7708
j	#4-40 Nut	10	43AC8400
k	Prepared Motor	2	55AC1157

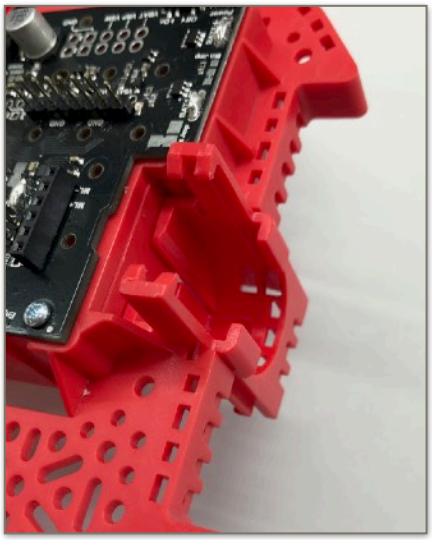
	Description	Qty	Part #
l	Motor Clip	2	55AC1156
m	Ball Caster	1	55AC1156
n	Prepared Line Sensor	1	55AC1159
o	Metal Brackets	3	55AC7014
p	Rubber Wheel	2	55AC1156
q	Wheel	2	55AC1156
r	Prepared Chassis	1	55AC1156
s	IR Sensors	3	55AC7015
t	IR Sensor Wires	3	55AC7016
u	Prepared Bump Switch	1	55AC1159

Step 2: Attach Motors

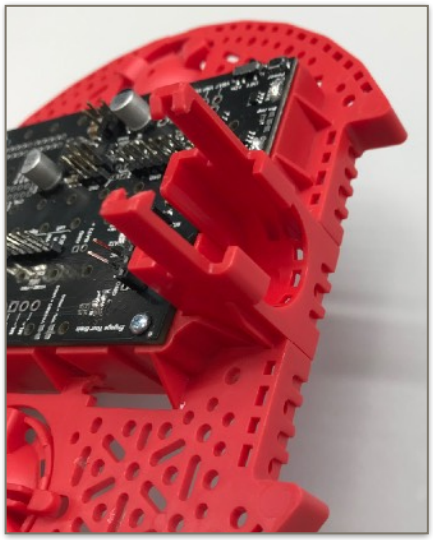


Gather:

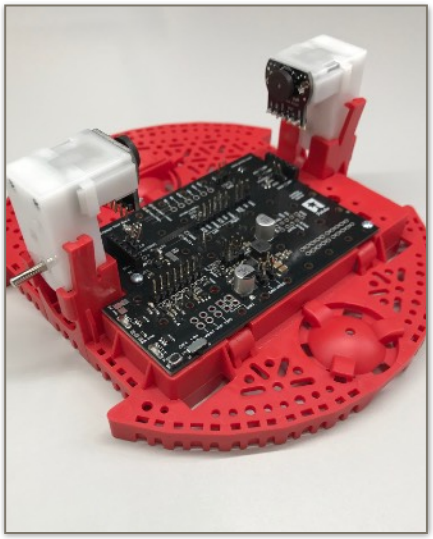
- Prepared Chassis and Motor Board (r)
- Motor Clips (l)
- Prepared Motors (k)



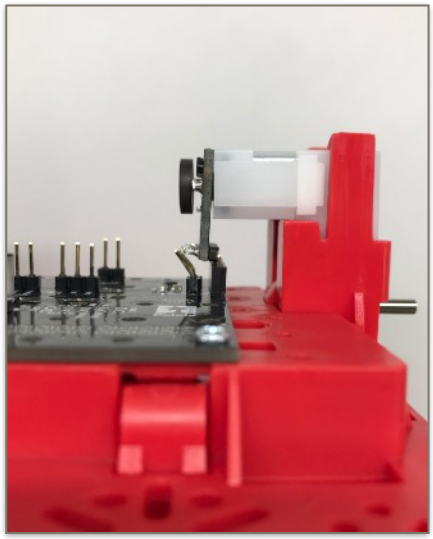
Insert the motor clips (l) into the motor board (r) as shown above.



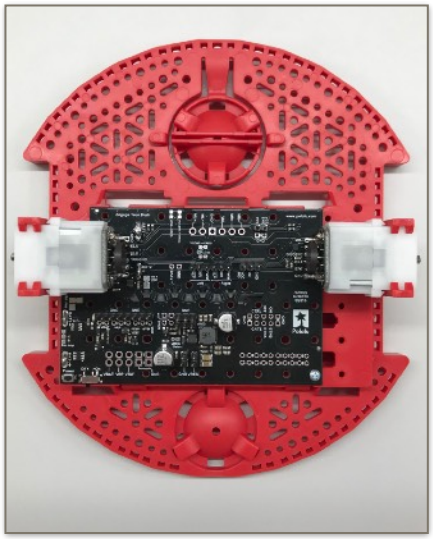
Ensure the motor clips (l) are fully inserted.



Fully slide the motors (k) into the motor clips (l) as shown above. Be careful not to over-stress the clips.



The pins from the encoders should plug into the motor board.

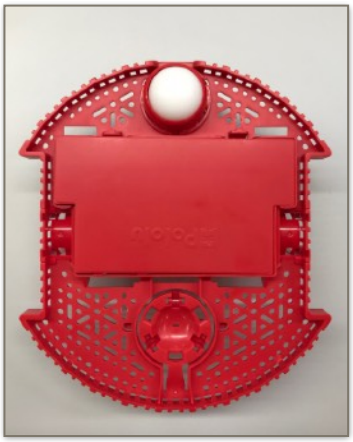


Step 3: Attach Ball Caster

Gather your Chassis (r) and the Ball Caster parts (m).

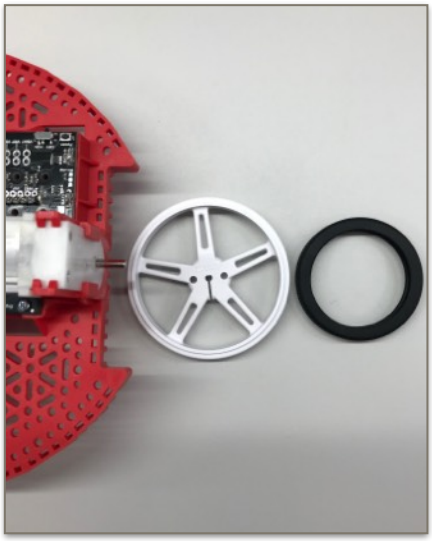
Place the three small wheels in the groves on the short side as shown above.

Place the white ball in the grove as shown above.



Secure the assembly with the final piece.

Step 4: Attach Wheels

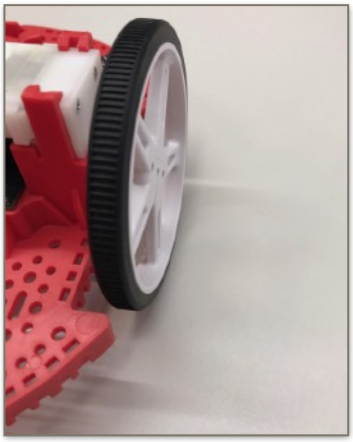


Gather:

- Prepared Chassis
- Wheels (q)
- Rubber Wheels (p)

Attach rubber wheels (p) to the wheels (q).

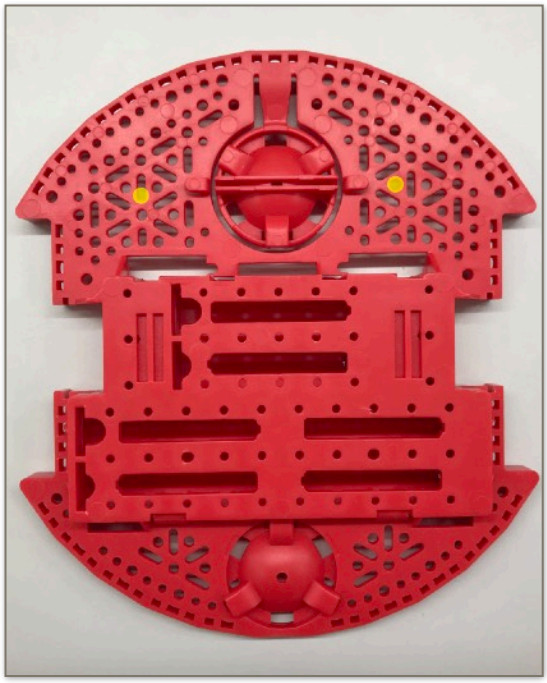
Attach the prepared wheel to the motor. Please be sure to align the flat portions of the wheel and motor.



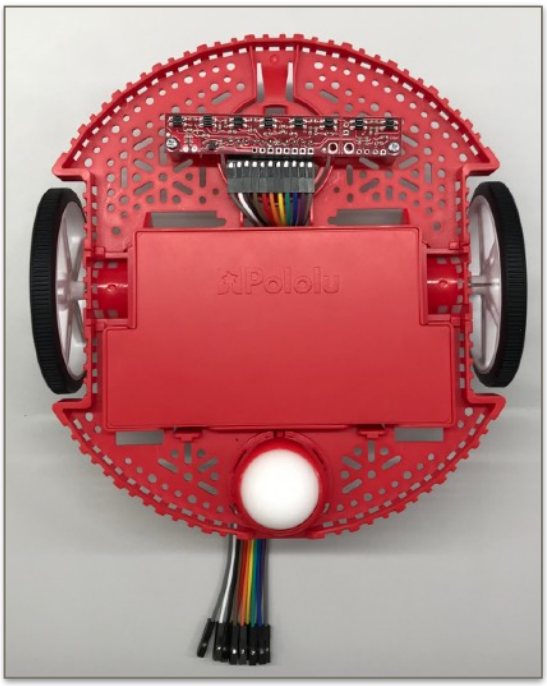
Step 5: Attach Line Sensor

Gather:

- Prepared Chassis
- Line Sensor (n)
- 11 Female to Female Wires (e from pg. 4)
- Screws #2-56 1/4” (e)
- Standoffs #2-56 (f)

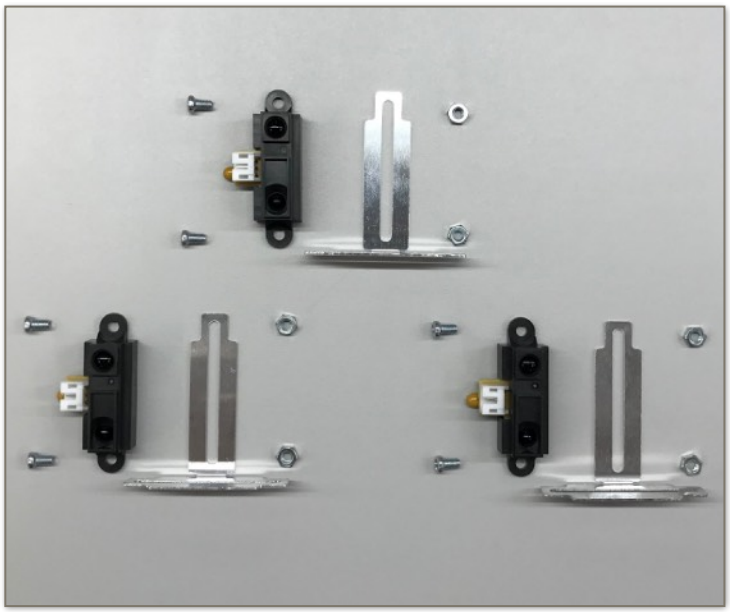


Attach the standoffs (f) to the bottom of the chassis with two screws (e) at the highlighted locations.



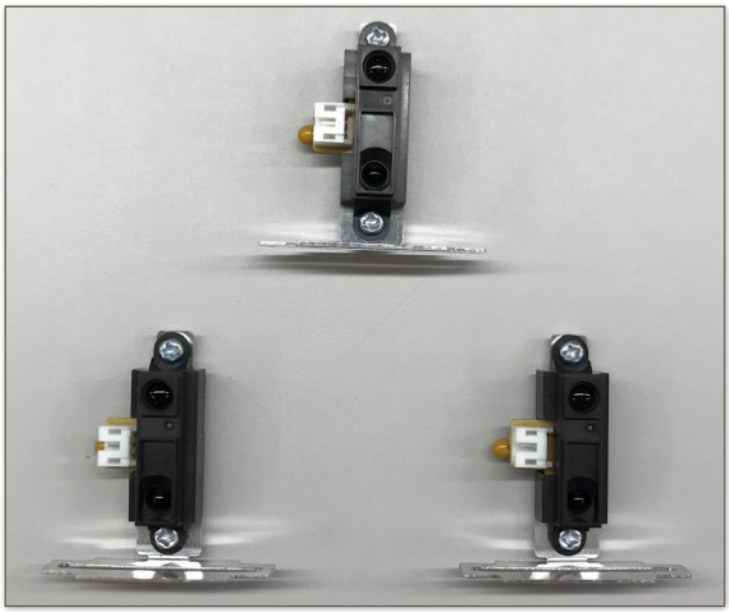
Run the wires (e from pg. 4) through the middle hole of the chassis. Attach the line sensor (n) using two screws (e) to the standoffs (f) you just attached.

Step 6: Attach IR Sensors

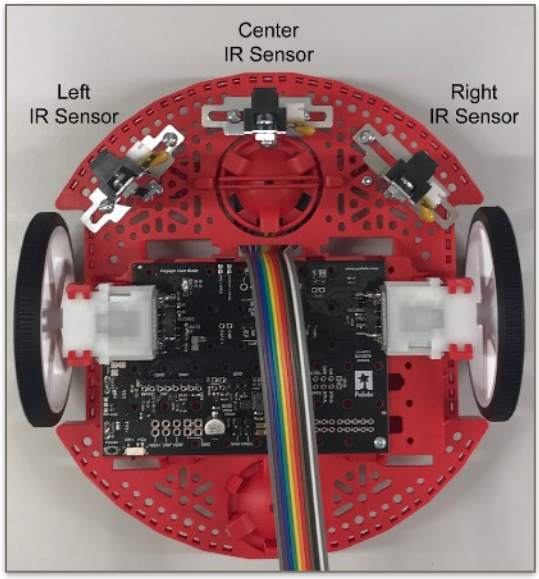


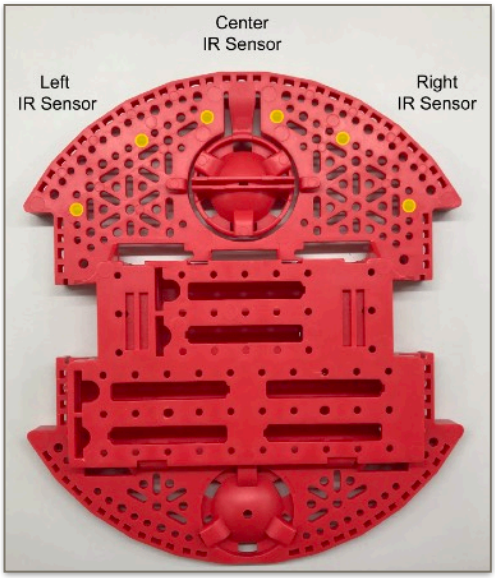
Gather the following:

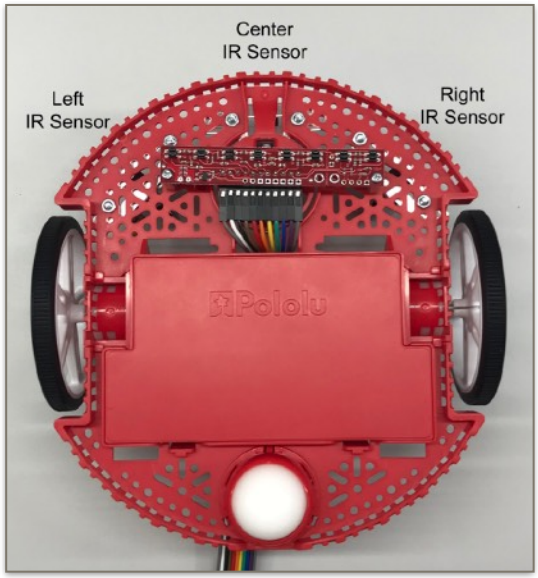
- M3 5mm Screws (c)
- M3 Nuts (d)
- Metal Brackets (o)
- IR Sensors (s)
- #4-40 Screw 1/4” (i)
- #4-40 Nuts (j)
- Prepared Chassis



Attach the IR Sensors (s) to the Metal Brackets (o) using the M3 5mm Screws (c) and M3 Nuts (d).
Note: The square eye of the Sensor will be towards the top of the mount.



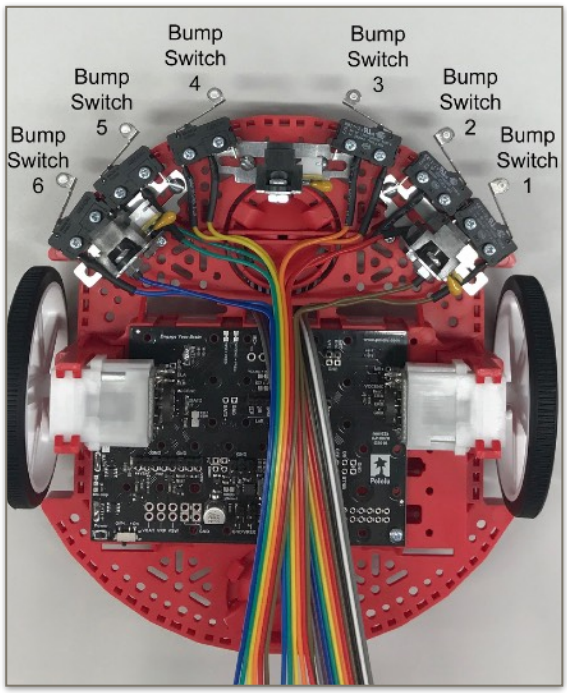




Attach the Metal Brackets (o) with the attached IR Sensors (s) to the Prepared Chassis using the #4-40 1/4” Screws (i) and six #4-40 Nuts (j).

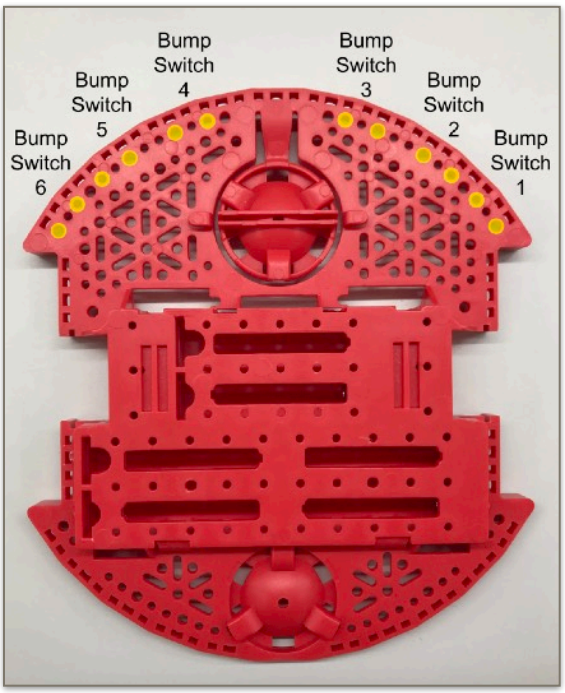
Bottom View.

Step 7: Attach Bump Switches

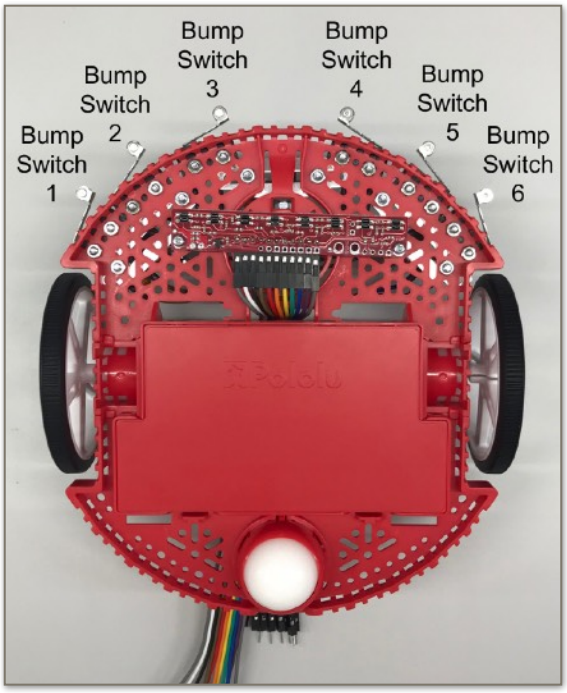


Gather:

- Prepared Chassis
- Bump Switches (u)
- Screws #2-56 1/2” (a)
- Nuts #2-56 (b)

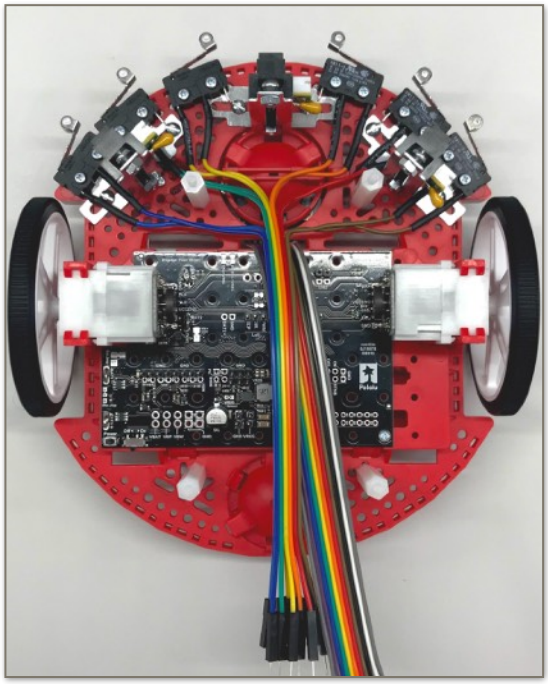


Attach the bump switches (u) to the Prepared Chassis via the holes above using the nuts (b) and screws (a).



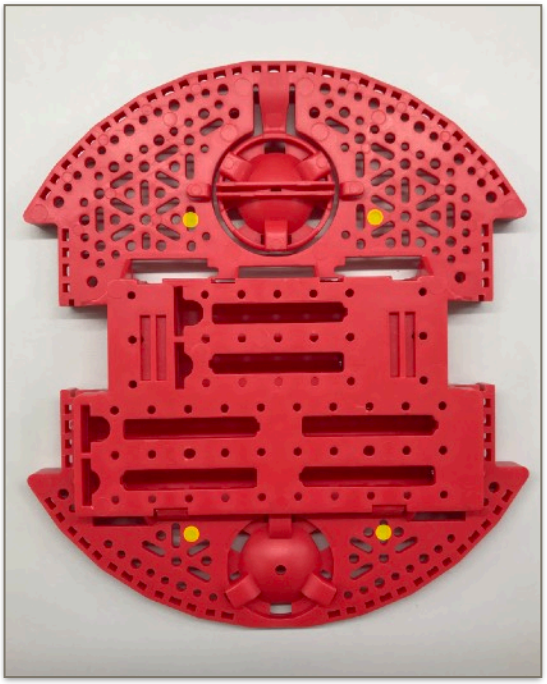
Bottom View.

Step 9: Attach LaunchPad Standoffs

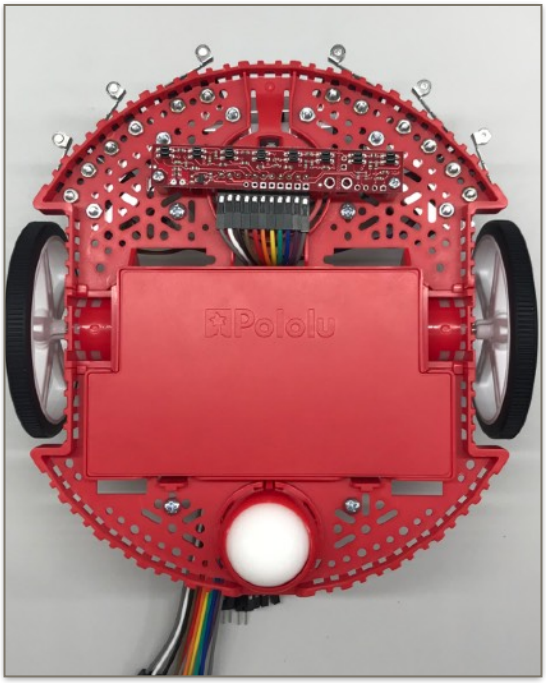


Gather:

- Prepared Chassis
- Plastic Standoffs (h)
- Screws #4-40 1/2” (g)
- Nuts #4-40 (j)



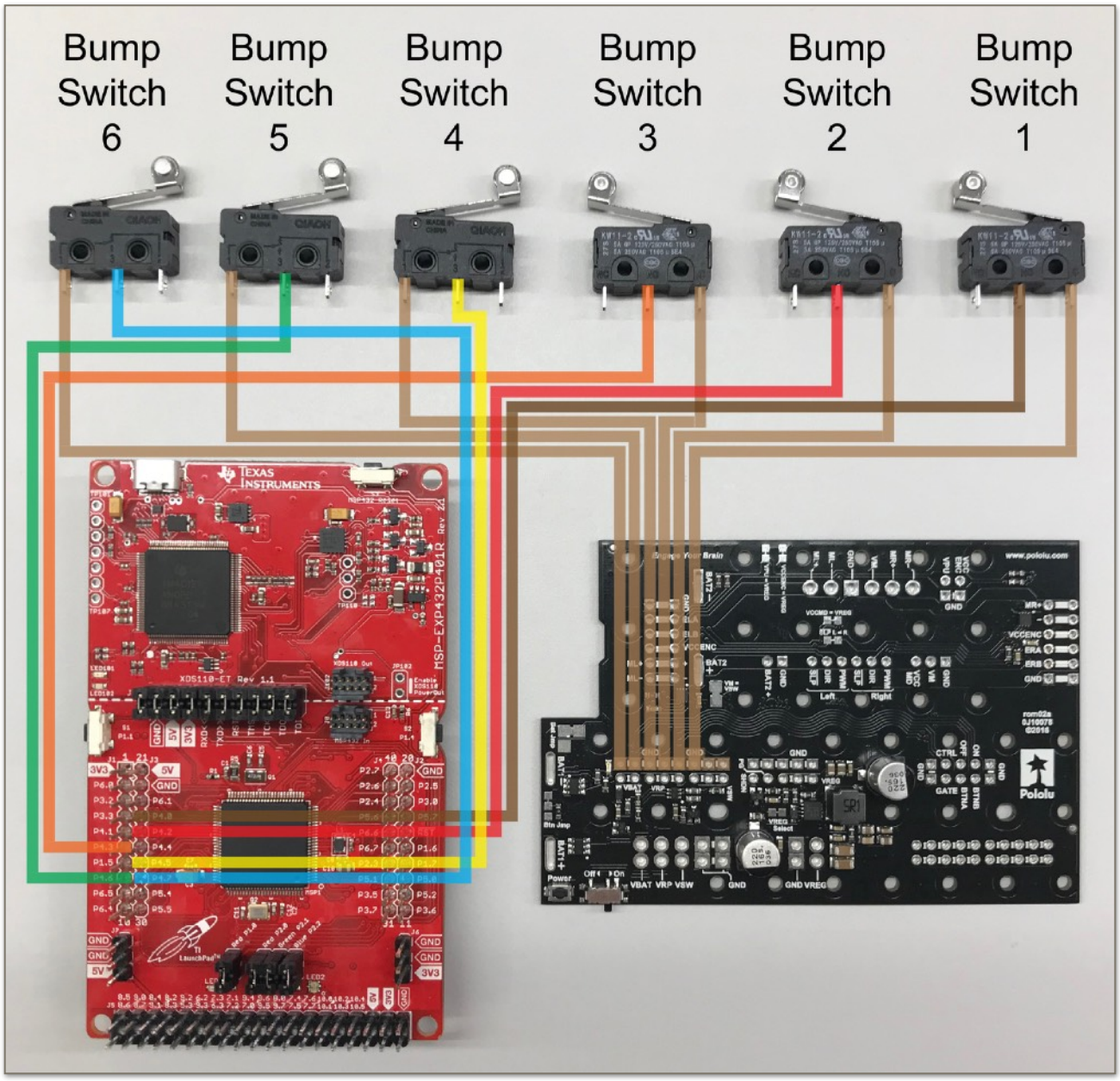
Attach the standoffs (h) to the top of the chassis with screws (g) via the highlighted areas above. Do not over tighten or screw them all the way in.



You will use four nuts (j) to attach the LaunchPad **after** the next section. **Note:** the Chassis holes may be slightly too small, but the screws will fit.

Section 3: Wiring

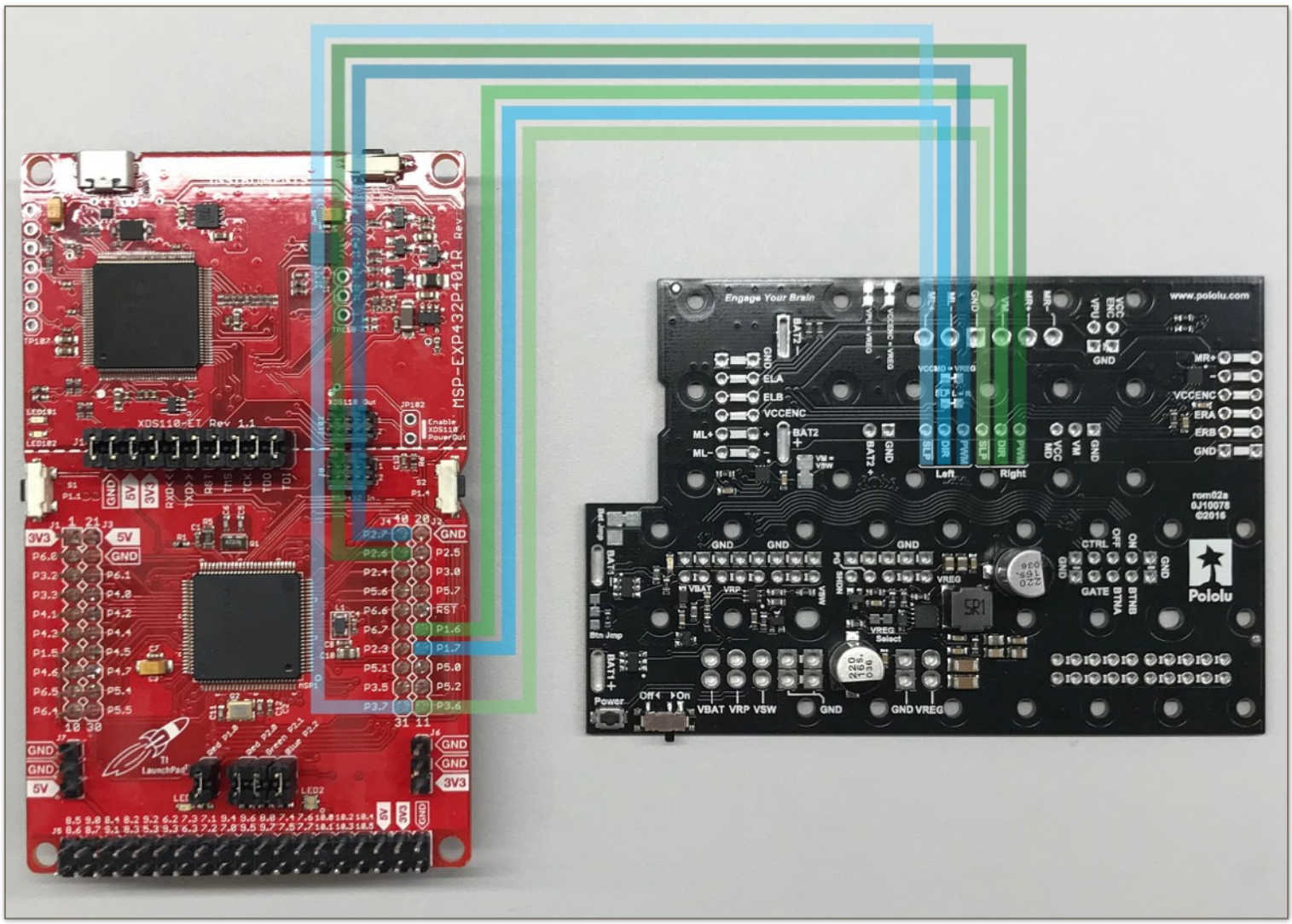
Step 1: Bump Switches



Connect the “1” or “C” output (female wire) from each bumper to GND on the motor board. Connect the “3” or “NO” output (male wire) from each bumper to the female LaunchPad inputs below.

	Bump 1	Bump 2	Bump 3	Bump 4	Bump 5	Bump 6
LaunchPad	P4.0	P4.2	P4.3	P4.5	P4.6	P4.7

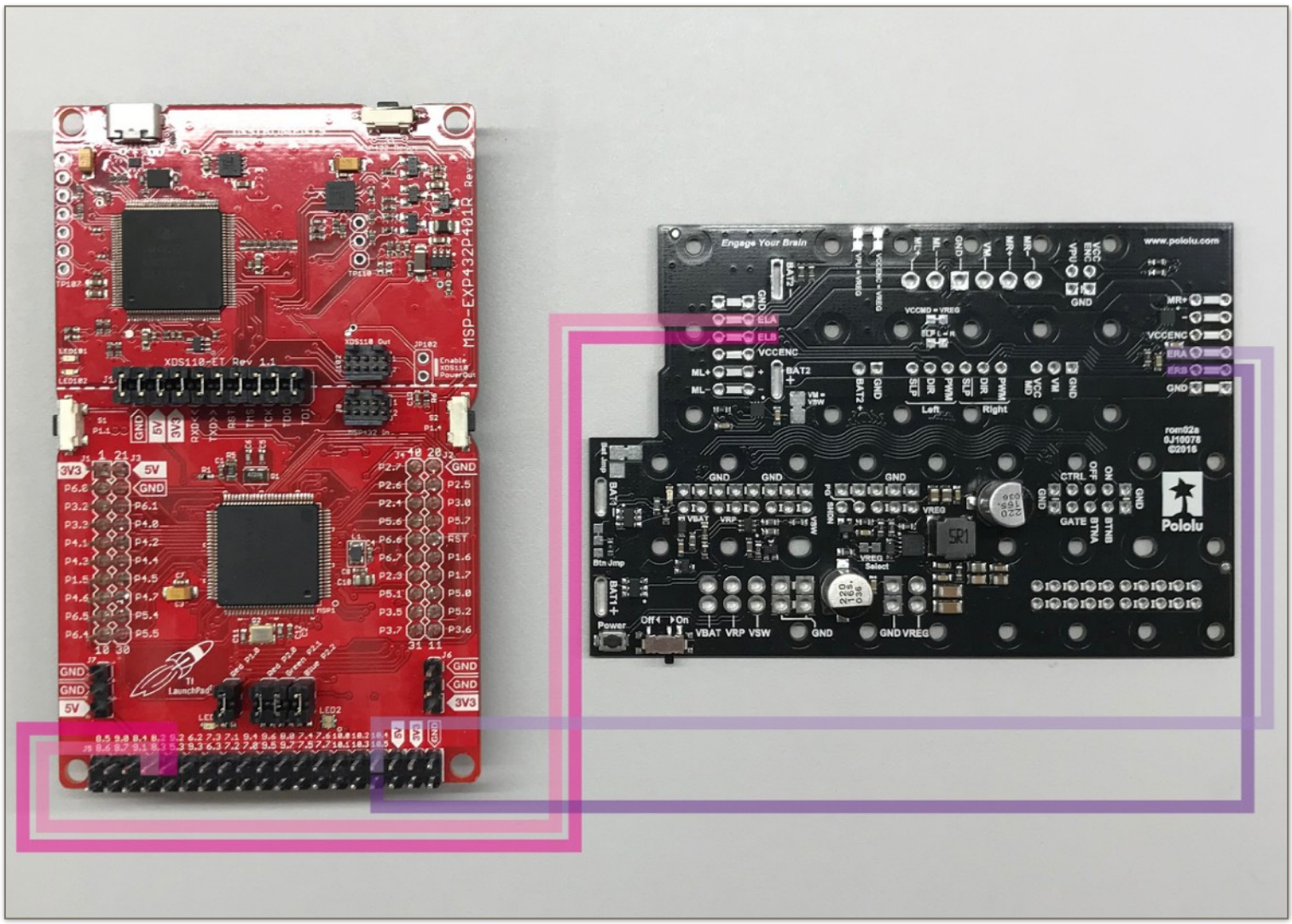
Step 2: Motor Board Logic



Using the 6 female to male wires (c from pg. 4), connect the motor driver connections to the female LaunchPad inputs below.

Motor Board	Left SLP	Left DIR	Left PWM	Right SLP	Right DIR	Right PWM
LaunchPad	P3.7	P1.7	P2.7	P3.6	P1.6	P2.6

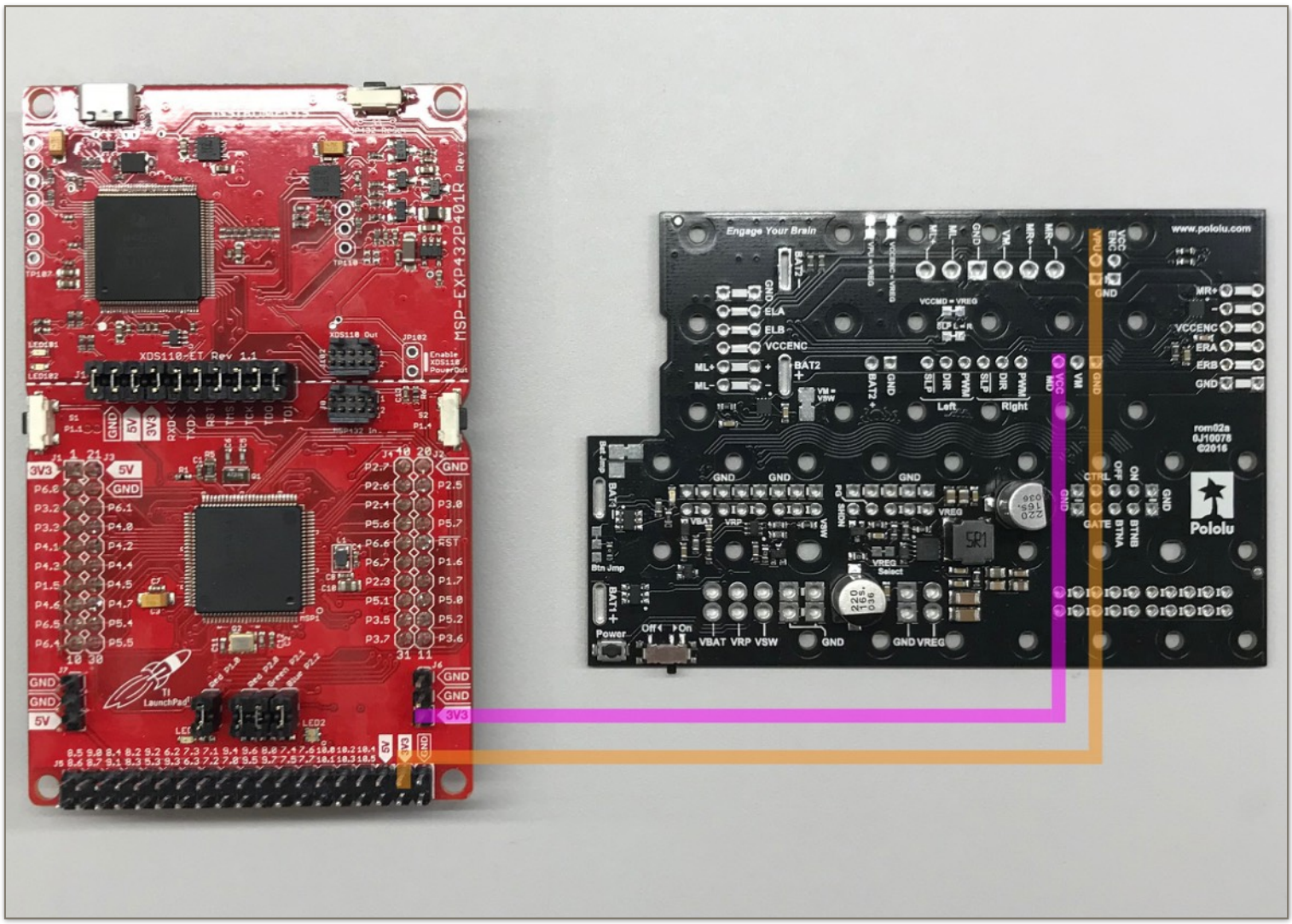
Step 3: Motor Encoders



Using two sets of the 2 female to female wires (d from pg. 4), connect the motor encoder connections to the male LaunchPad inputs below.

Motor Board	ELA	ELB	ERA	ERB
LaunchPad	P8.2	P9.2	P10.4	P10.5

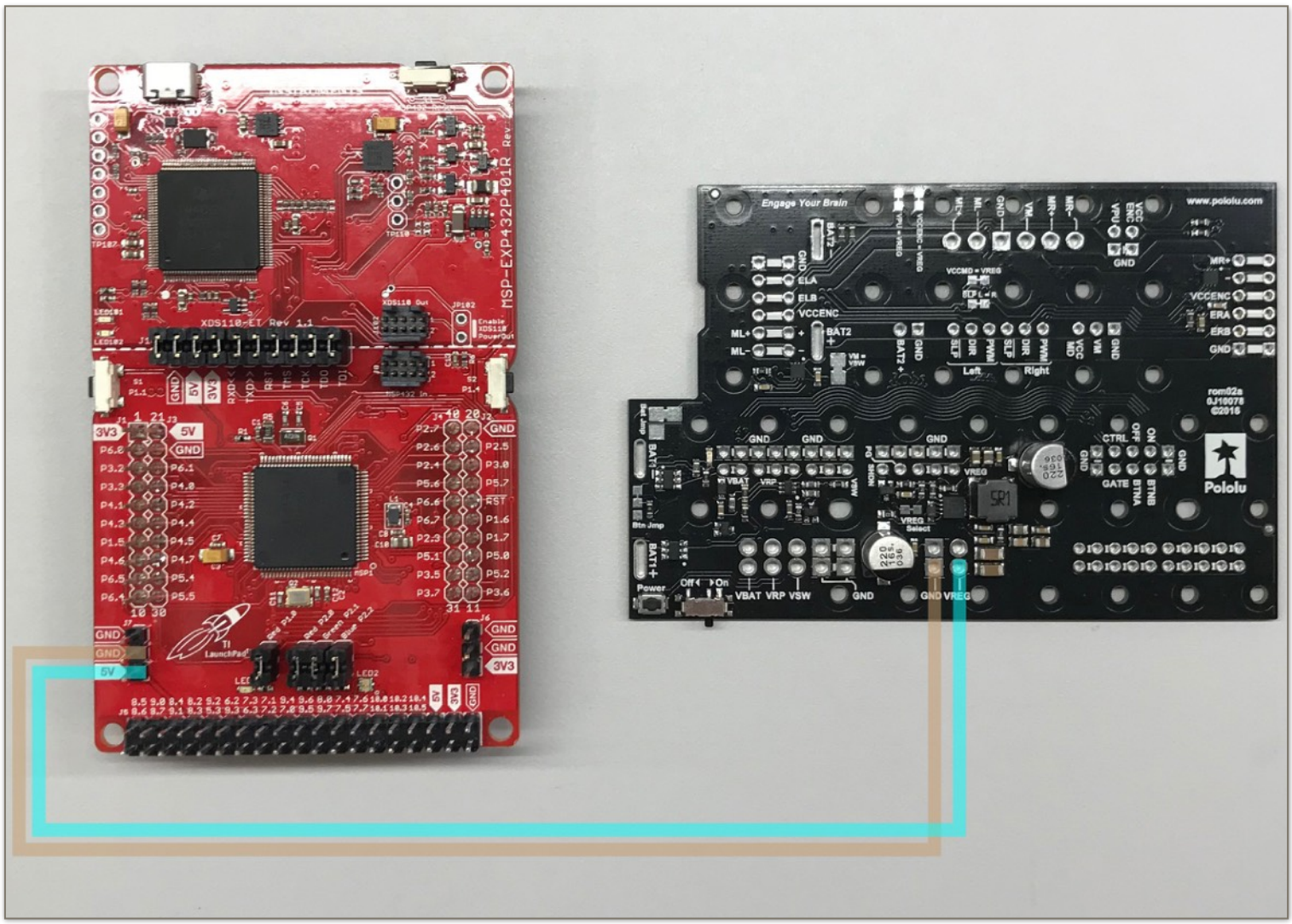
Step 4: Motor Board Power



Using the 2 female to female wires (d from pg. 4), connect the VPU and VCCMD connections to the male LaunchPad's 3.3V outputs (3V3).

Motor Board	VPU	VCCMD
LaunchPad	3V3	3V3

Step 5: LaunchPad Power

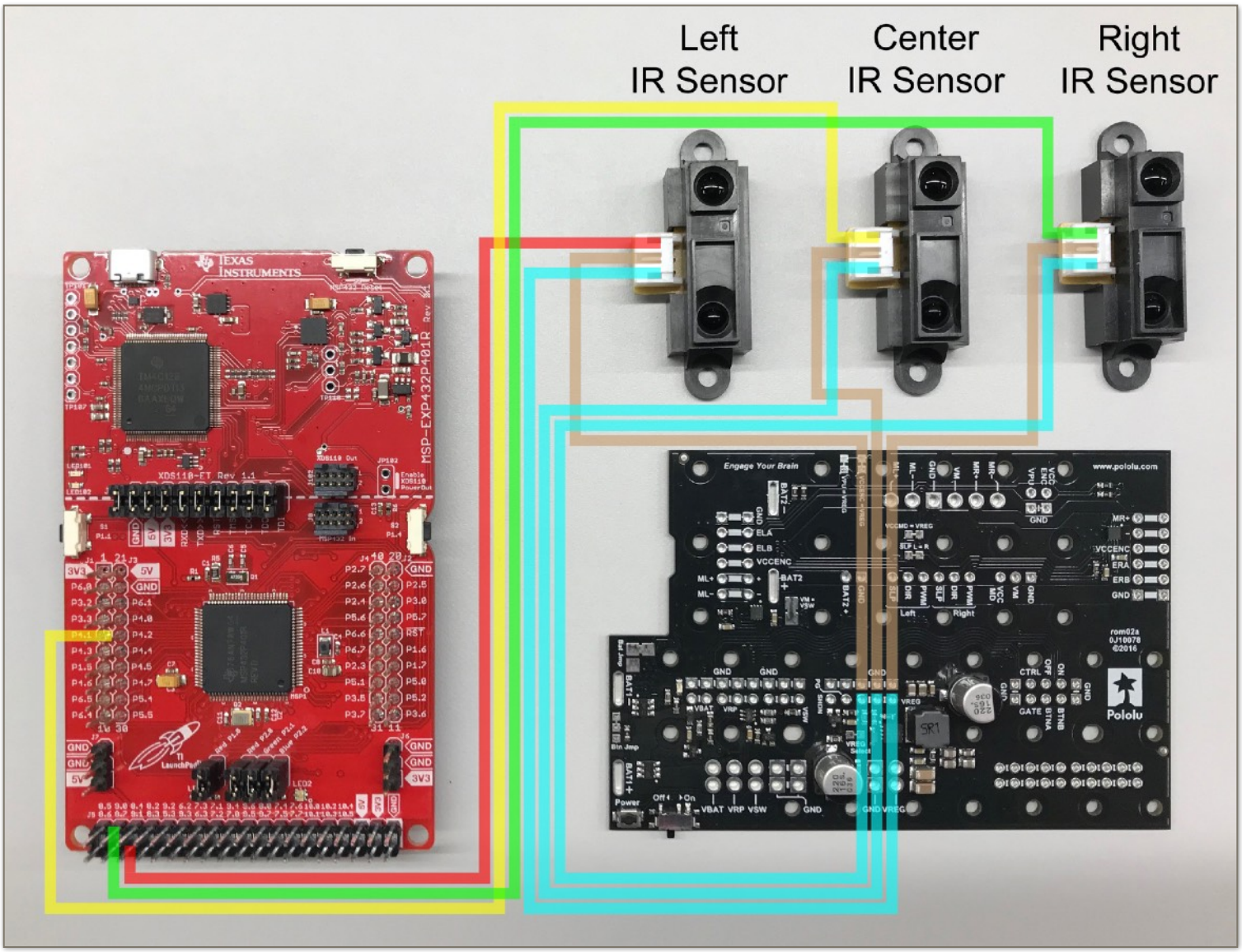


Using the 2 female to female wires (d from pg. 4), connect the VREG and GND connections to the male LaunchPad's 5V and GND connections respectively.

Note: You must disconnect these wires every time you connect your LaunchPad to your computer via USB.

Motor Board	VREG	GND
LaunchPad	5V	GND

Step 6: IR Sensors

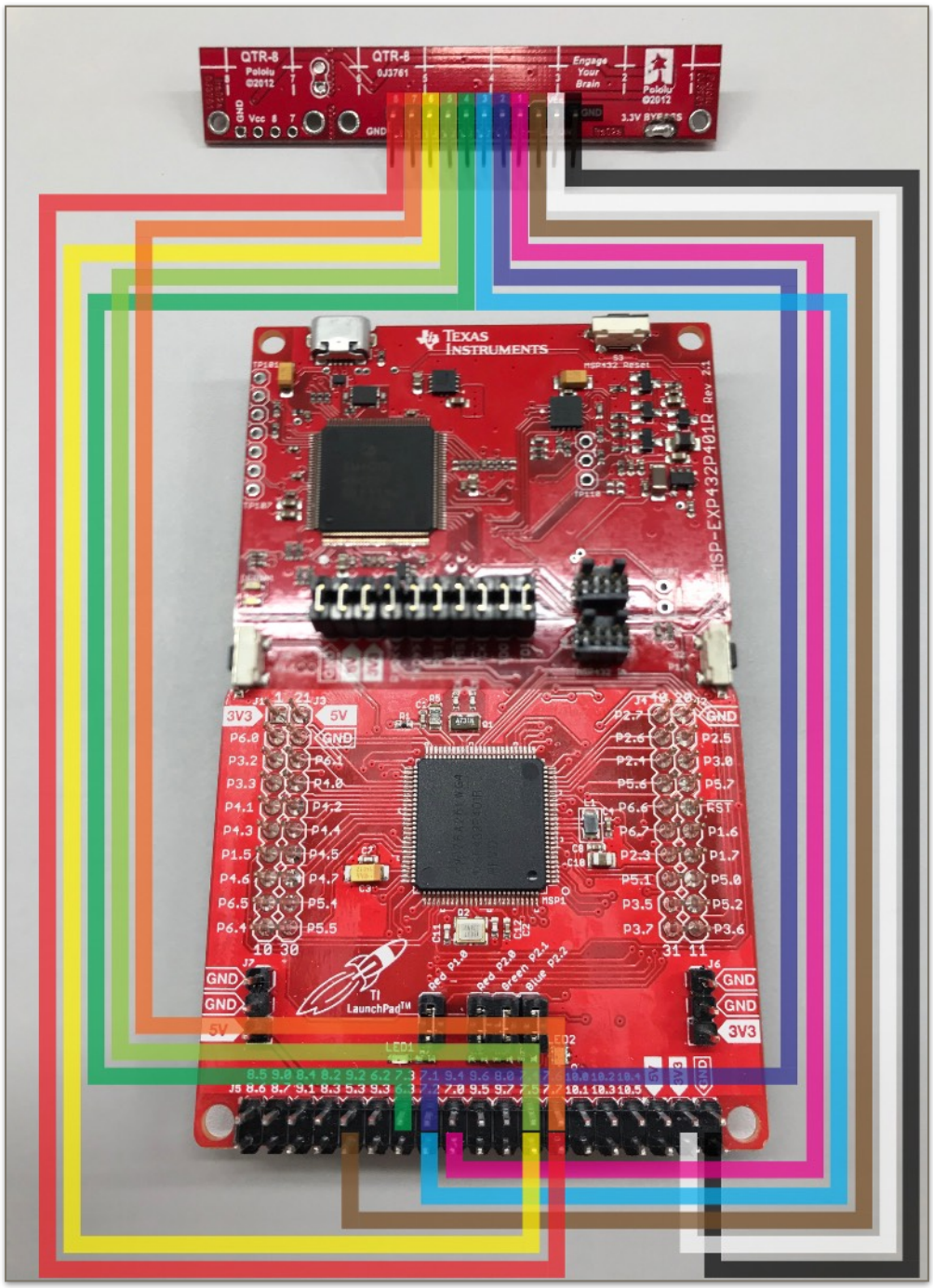


Connect the IR sensor wires (t from pg. 15) to the IR sensor connectors via the PH connector. When viewing the IR sensors upright; connect the bottom wire to the VREG connections of the motor board, the middle wire to GND, and the top wire to the following LaunchPad connections.

Note: The Center IR Sensor will be connected to the male LaunchPad pin after the BoosterPack is connected as the BoosterPack will block the connection. The Left and Right IR Sensors will connect to the male LaunchPad inputs below.

	Left IR Sensor	Center IR Sensor	Right IR Sensor
Launchpad	P9.1	P4.1	P9.0

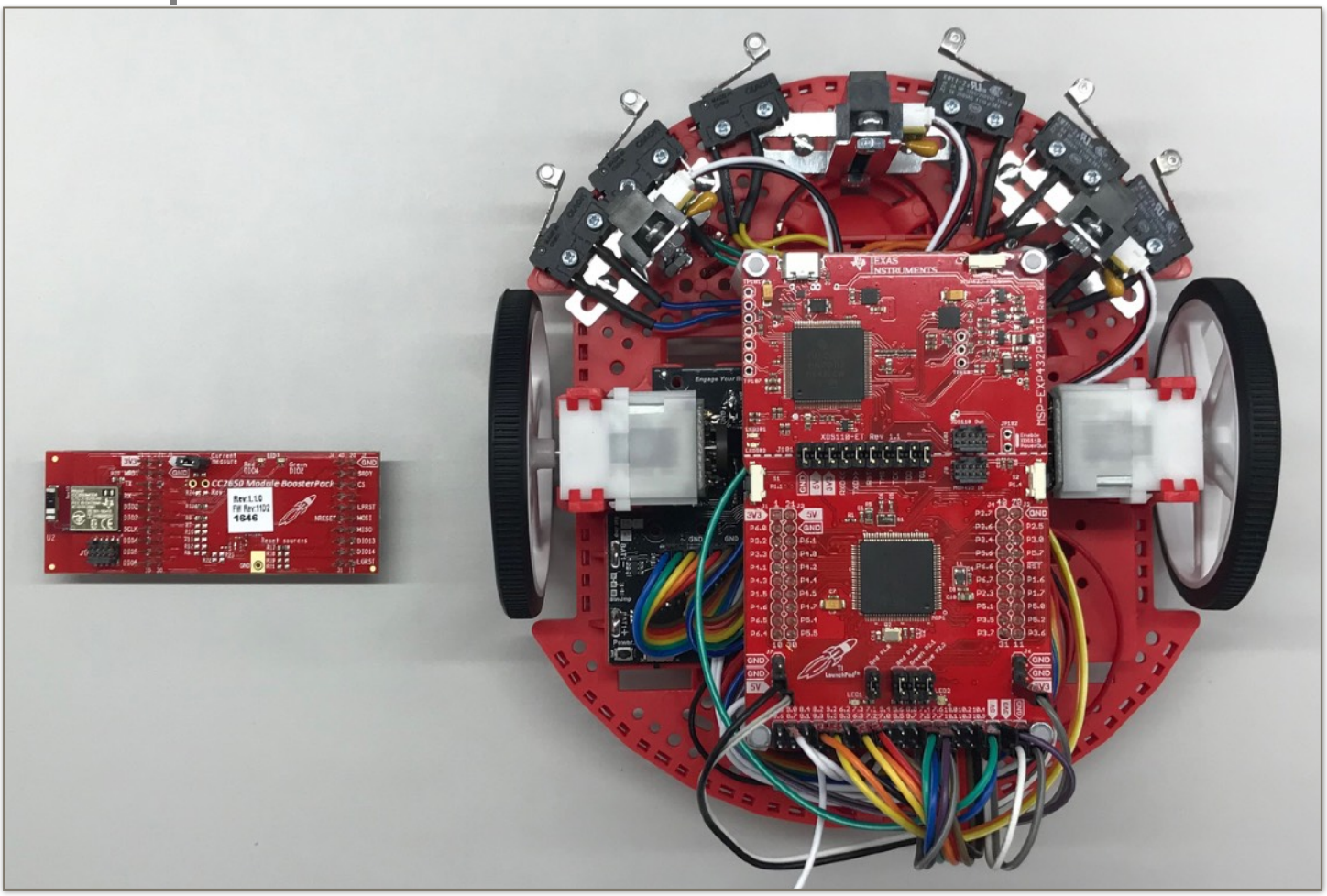
Step 7: Line Follow Sensor



Using the 11 female to female wires (e from pg. 4) you fed through the chassis earlier (Step 5 on pg. 18) make the below connections between the line sensor and male LaunchPad inputs.

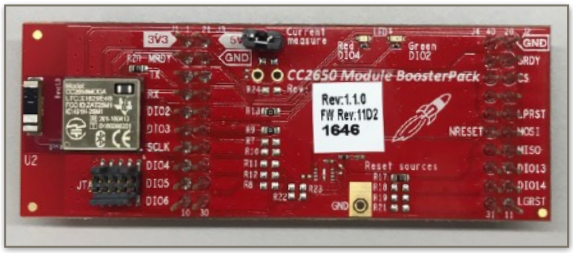
Line Sensor	8	7	6	5	4	3	2	1	LED ON	VCC	GND
LaunchPad	P7.7	P7.6	P7.5	P7.4	P7.3	P7.2	P7.1	P7.0	P5.3	3V3	GND

Step 8: Attach LaunchPad and BoosterPack

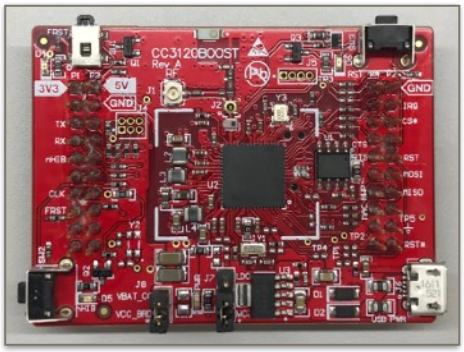


Next, secure the LaunchPad to the LaunchPad standoffs using the nuts you set aside earlier. Then attach the BLE BoosterPack included in the kit.

Note: When connecting any BoosterPack be sure the white flagged 3V3 connection aligns with the LaunchPad. Do not connect both the Wi-Fi and BLE BoosterPacks at the same time. The Wi-Fi lab is coming soon. Lastly, be sure to connect the IR sensor wire from pg.26.

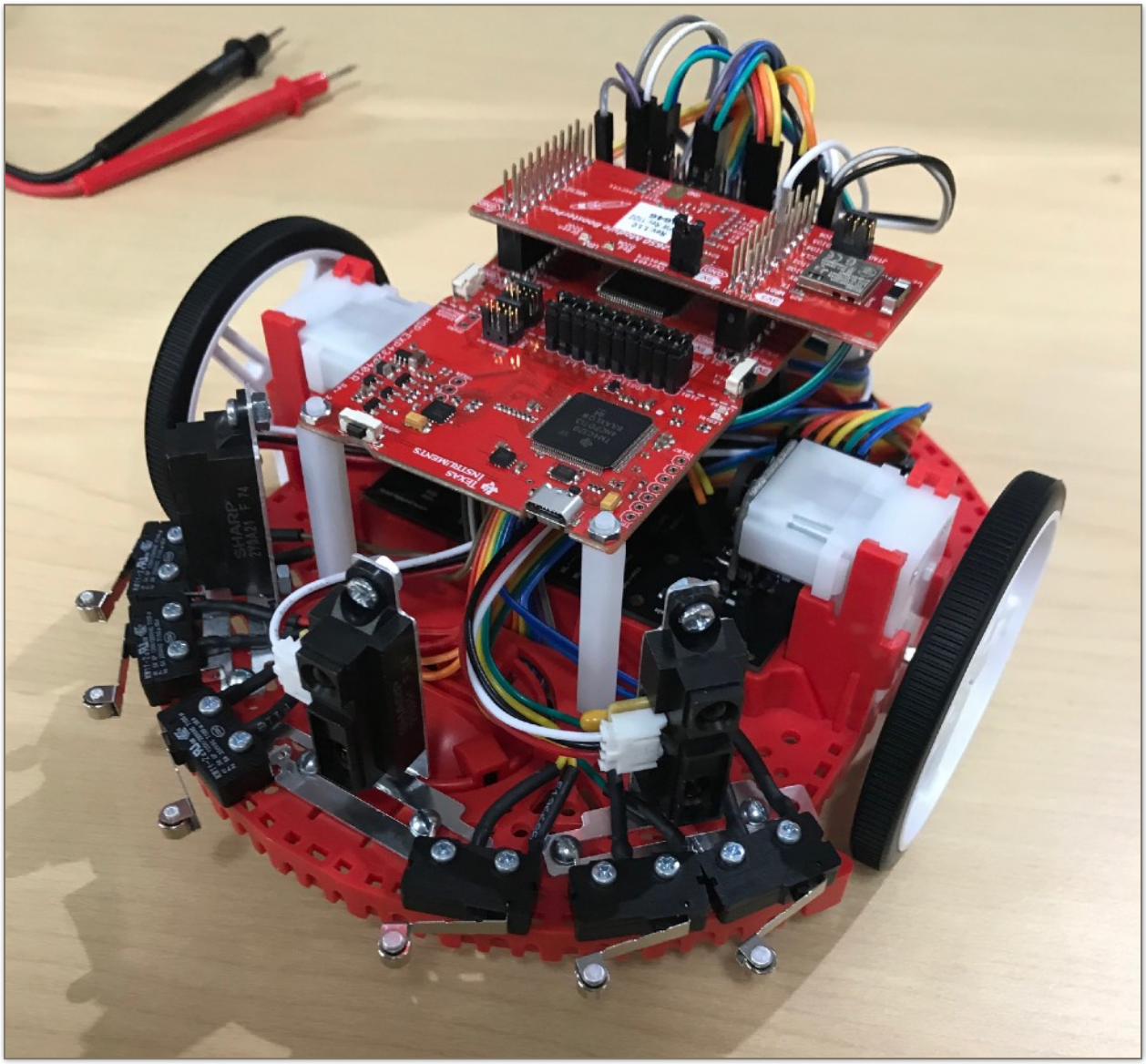


BLE BoosterPack



Wi-Fi BoosterPack

Congratulations; your TI-RSLK is built!



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