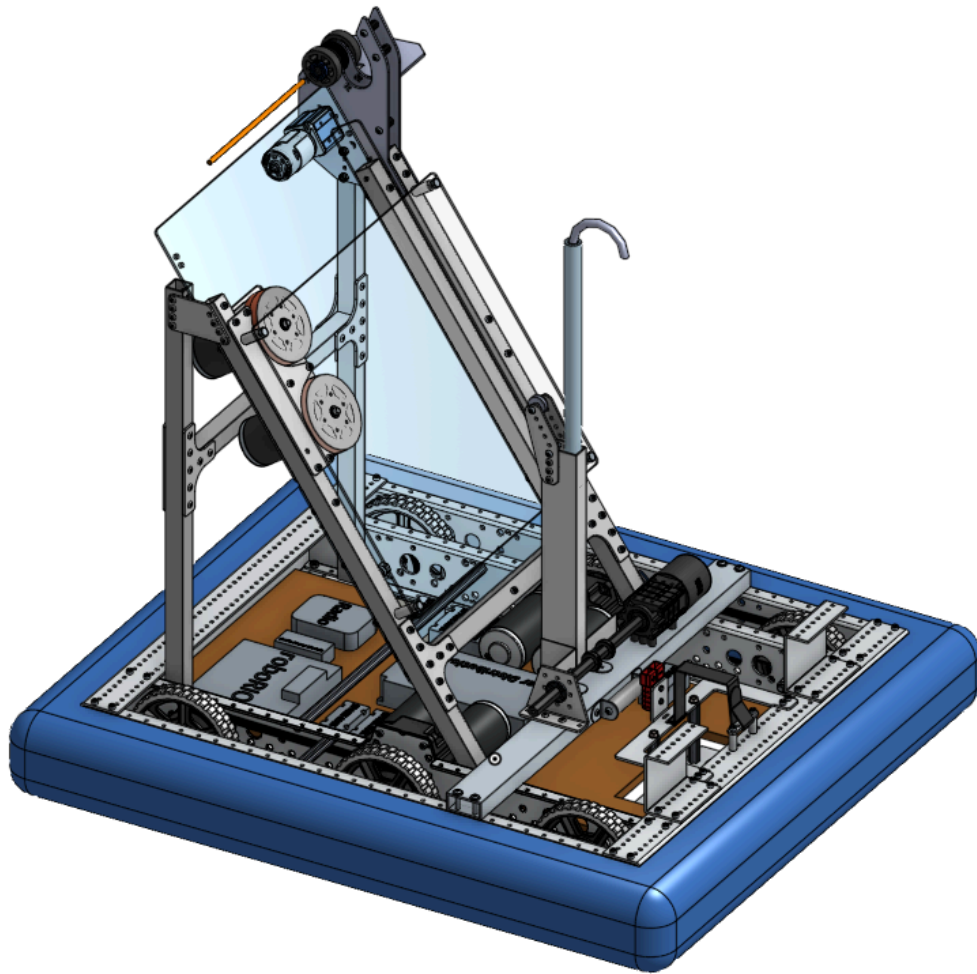


Robonauts' 2024 Everybot

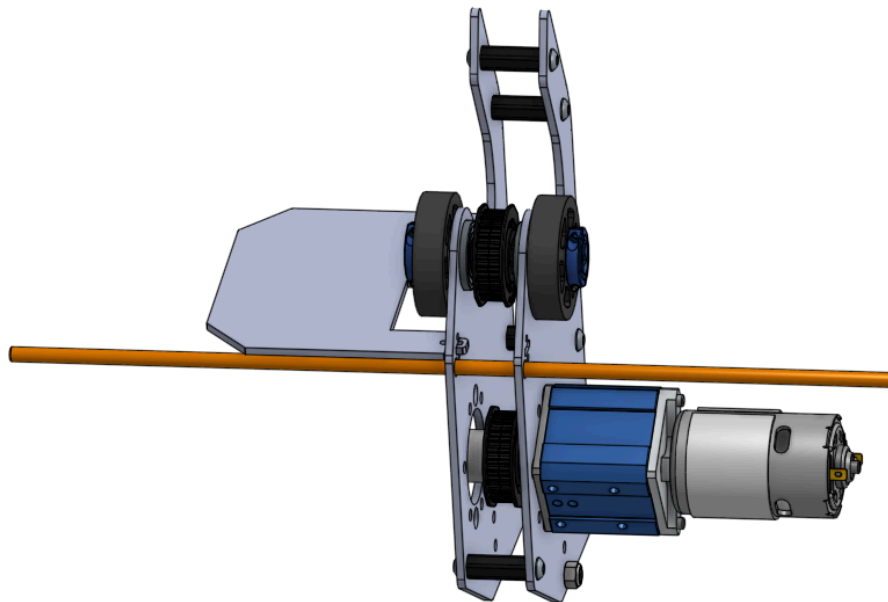
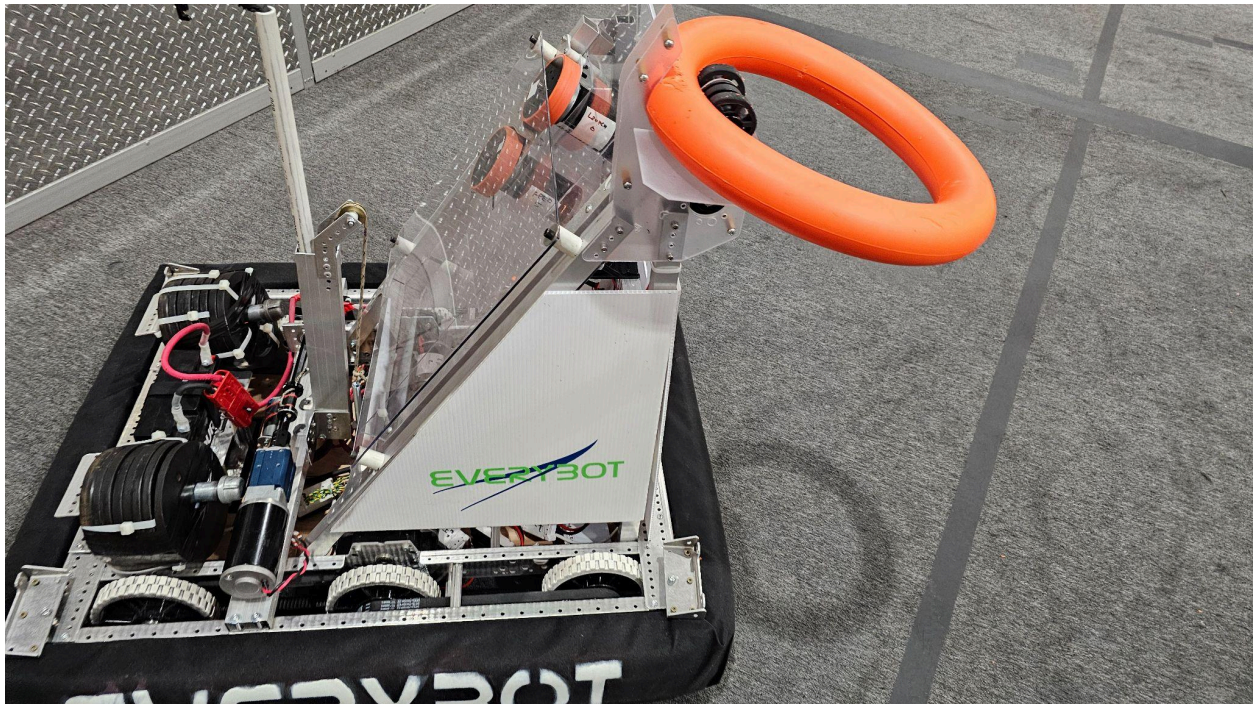


The Robonauts' Everybot is an affordable, competitive, and elegant robot that can be built using basic tools and items found from the Kit of Parts, common FRC suppliers, or your local hardware store. The 2024 Everybot is based on the FIRST KitBot and offers a clear and simple upgrade path. The Everybot mechanisms can be built and installed independently and can also be incorporated into different robot designs. The 2024 Everybot costs around 900 U.S. dollars when built from the KitBot and Rookie Kit of Parts and weighs approximately 110lbs when complete.



The 2024 Everybot adds functionality to FIRST's KitBot by adding an Amp and Climbing mechanism.

Roller Claw

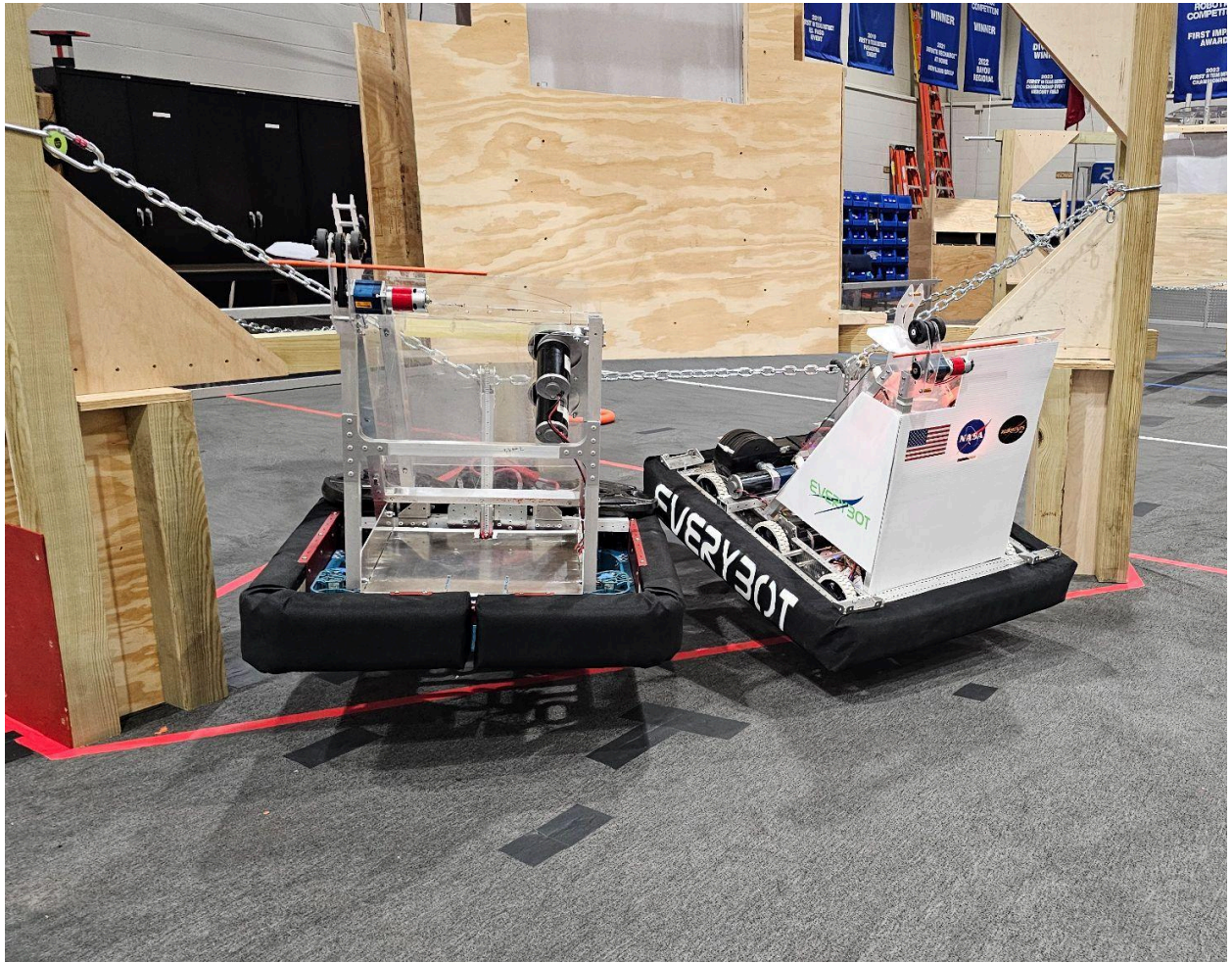


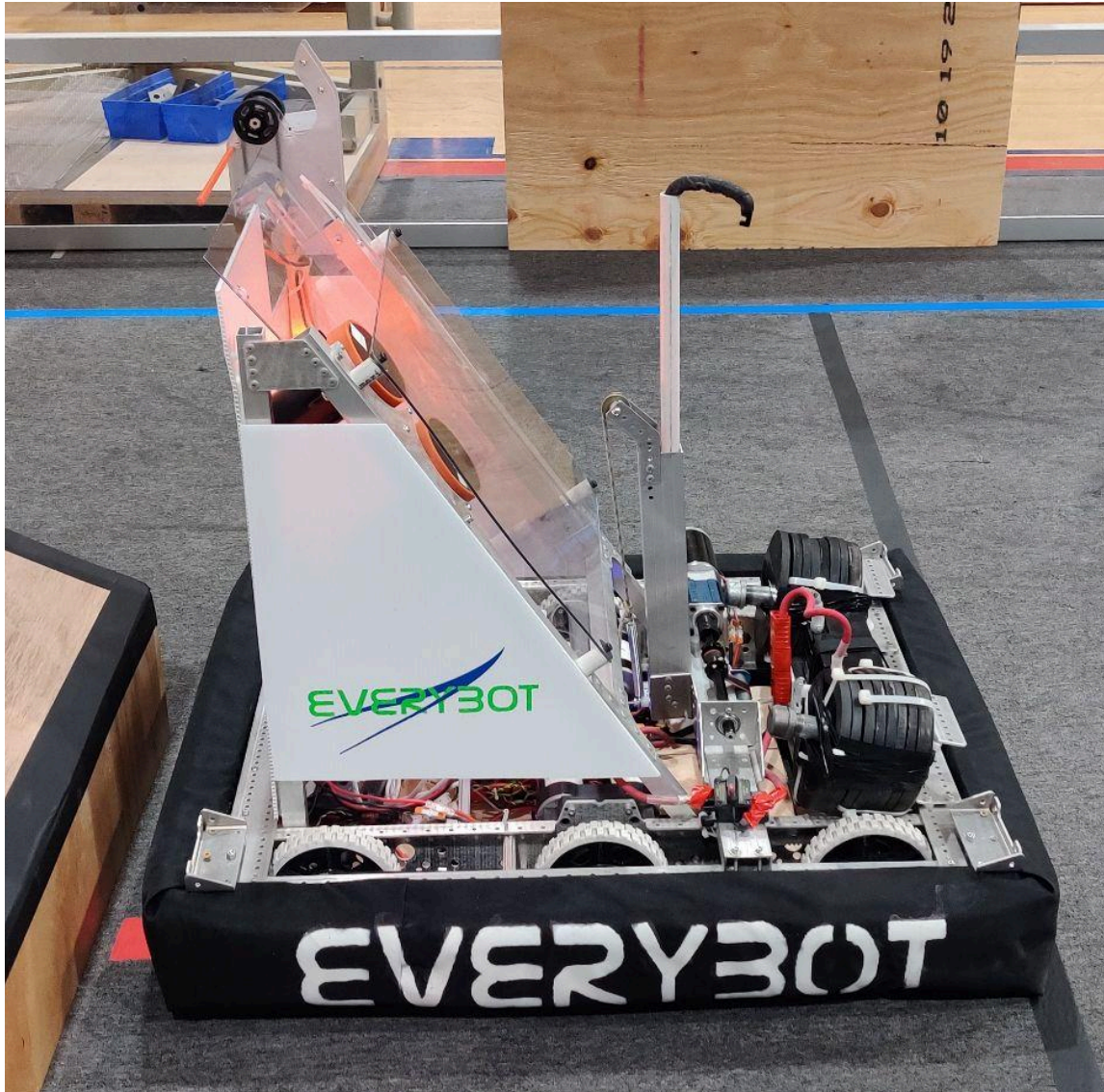
The roller claw reliably picks up Notes from the Source and drops them into the Amp. The wheels are spun towards the inside of the claw when intaking from the Sources and spun away from the claw when scoring in the Amp. The Note is tightly held by the compliant wheels with the

deflection plate and fiberglass rod preventing the Note from pivoting below the scoring position. The wheels can be run passively inward at low power (>10%) if your claw is losing control of game pieces while the robot is in motion.

The roller claw consists of 3 polycarbonate parts that can be bought from [AndyMark](<https://www.andymark.com/products/2024-everybot-intake-kit>), a motor and gearbox, two pulleys with a belt running between them, a short section of 1/2" hex shaft with compliant wheels, spacers, bearings, and shaft collars, and a fiberglass rod to hold the Note at a downward angle to make scoring in the Amp easy.

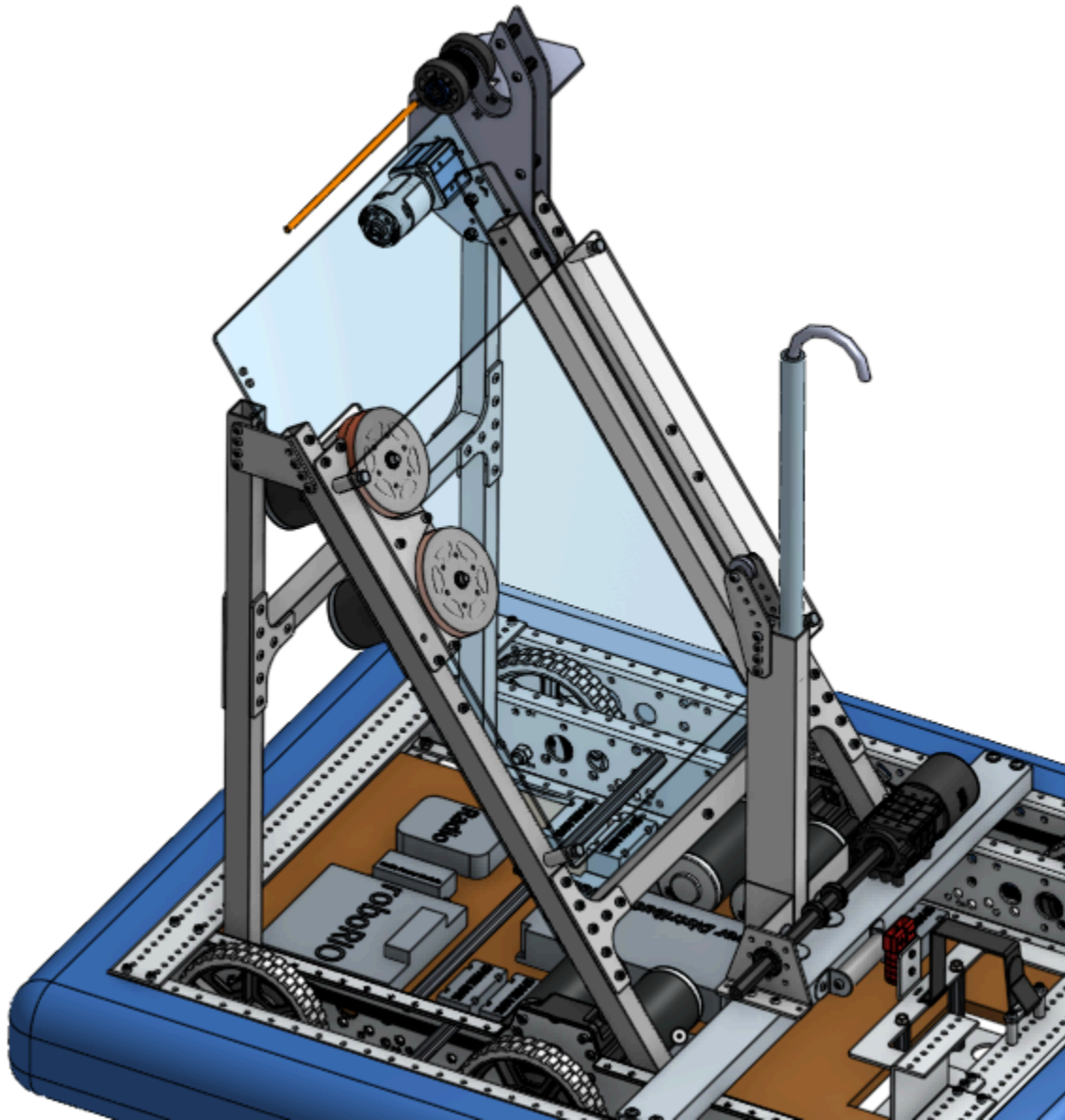
Climber





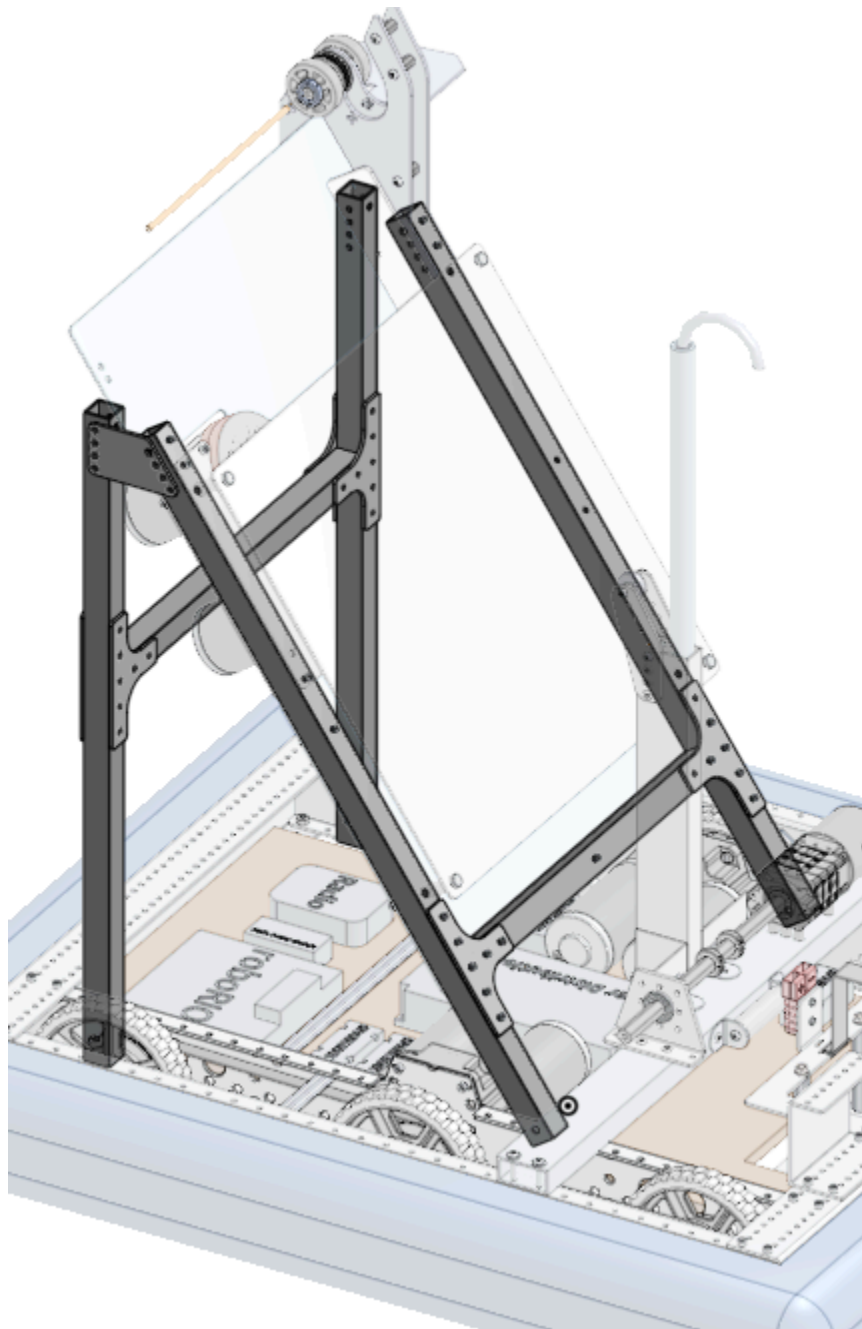
The Everybot climber uses a vertical box tube and PVC pipe telescoping system to lift a hook up to the Stage chain. The inner slider is pulled upward by extension springs routed around the top of the robot by paracord and downward by a ratchet strap and winch that bear the robot's weight when climbing. The height restrictions of this year's game allow for the climber to start the match already extended upwards and remain that way for the entire match until the robot goes to hang at the end of the match, where the winch winds the ratchet strap up and pulls the hook down (and itself up). The spring pulls the hook back up when the winch unwinds, allowing the robot to retry a missed climb. The climber does require rear ballast or the weight at the front of the robot will cause the bumpers to touch the ground when the climber is fully pulled in. It is recommended that you generally leave the climber extended so the spring does not wear out over time.

KitBot's Launcher

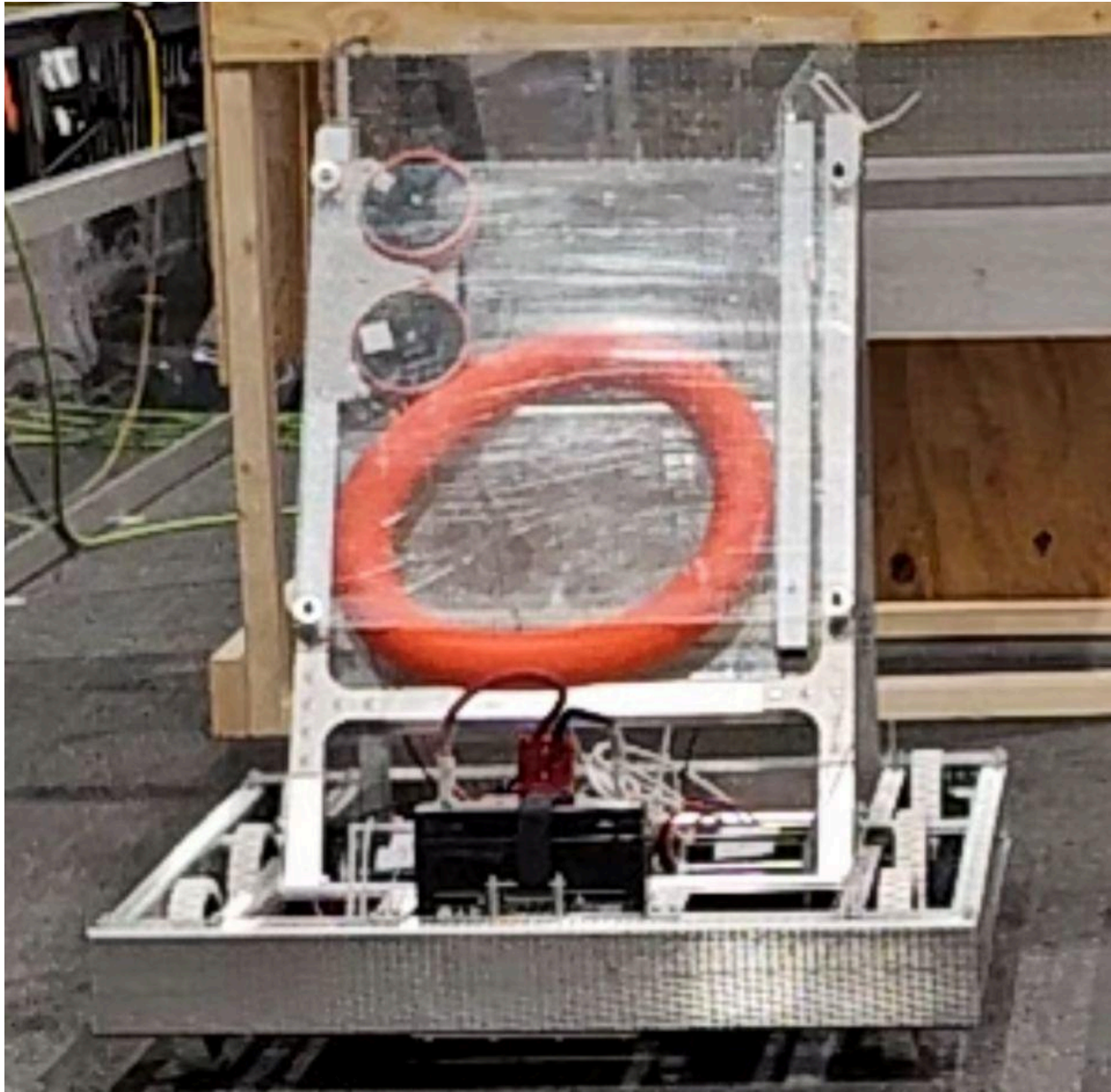


The Everybot is built around the 2024 FIRST KitBot and incorporates its Speaker launcher into the design. The Launcher consists of a superstructure, two wheels powered by CIMs, some launcher panels, and a compression beam.

The superstructure supports the launcher and needs to be at the correct height and angle to properly intake and launch Notes. The roller claw mounts in place of the FIRST-provided bracket in the upper right corner, and the superstructure also needs to be built correctly for the roller claw to function correctly.



The two wheels move and launch the Note inside the launcher. When intaking from the Source, both wheels are run inwards so the Note ends up resting against the crossmember of the angled portion of the superstructure and still in contact with the lower “feeder” wheel.



When launching, the upper "launch" wheel needs to spin up for around 1 second to reach top speed in order to be able to properly launch the Note. Once the launch wheel is spun up the feeder wheel feeds the Note up to the launcher wheel, which propels it outward using the built-up speed.

The lower launcher panel is the surface that the note moves across. At the end it is bent by a zip tie to allow for easier intaking from the source. This bend will also start to cause the middle of the plate around the launcher wheels to bend upwards - make sure it does not bend so much that the Note contacts both the lower and upper launcher plates - this will introduce too much drag and cause Notes to fall short. Make sure Notes are only ever gliding along the bottom surface.



The upper plate prevents the note from popping out the top during the launching and intaking process.

The final important part of the KitBot launcher is the compression beam.



Whenever you are launching game objects in FRC, compression is one of the most important factors. If the compression beam was the diameter of the Note away from the launching wheel, the launching wheel would have no compression and no way to effectively transfer energy to the Note, as there would be enough room for the Note to sit in the gap without contacting the wheel. The compression could also be too high - if the gap between the wheels and the wall was only an inch or two wide, the Note might not fit at all and would probably stall the launching motor or tear

up the Note. The 10 inch gap in the launcher offers about four inches of compression on the 14" Notes, which allows the launcher to launch relatively fresh Notes effectively. We found that an additional inch or two of compression also worked, but have not changed the location of the compression wall or otherwise modified the functional KitBot launcher other than removing a small strip of polycarb to fit the roller claw.

Everybot Chassis

If you are building your robot based off of a completed KitBot, you do not necessarily need to read this section of the manual. This section of the documentation is intended to aid teams that have little or no experience with the Kit of Parts chassis or those that are having problems following the AndyMark instructions.

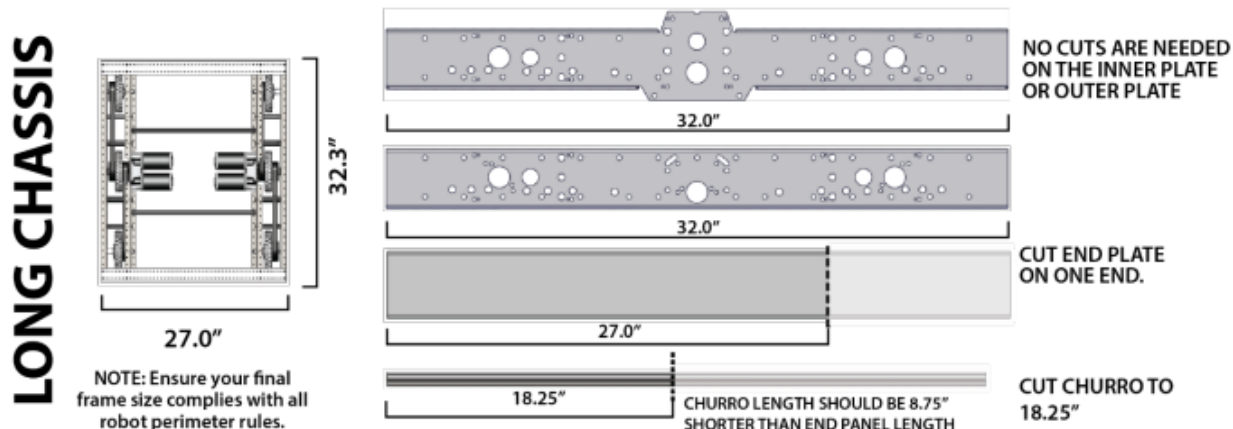
Chassis Type

The AndyMark AM14U5 chassis is part of the Kit of Parts and is well-tested and reliable. The included 6 inch rubber treaded wheels have good traction with the field carpet and the center wheel is 1/8" lower than the front and rear wheels to make it easier for the robot to turn on the spot and make small adjustments when trying to pick up and score game pieces (this is called a "drop center" drive because the center wheel is dropped down slightly).

The Everybot's mechanisms can be adapted for a variety of drivetrain bases including an omnidirectional "swerve" drive, but the changes required to properly adapt an Everybot or KitBot mechanism to a drive base other than the AM14U5 are not officially supported by this documentation. Please visit the [Everybot Discord](https://discord.com/invite/b3GbxrFzkt) if you have specific issues or questions about using a different drive base.

Chassis Size

The AndyMark "long" chassis configuration was chosen primarily to retain compatibility with the FIRST KitBot. The long chassis also has plenty of room to mount mechanisms and electronics.



Chassis Assembly

Required tools:

- 1/4" socket and ratchet (preferred) or flat blade screwdriver or bit
- 1/2" wrench
- 9/16" wrenches or sockets
- 7/16" or similar size socket
- 3/8" socket or ratchet
- 5/32" allen wrench or t-handle
- Bandsaw, chop saw or hacksaw

Adjustable wrenches can be used in place of the 9/16" and 1/2" wrenches

A cordless drill and 10-32 tap are optional but can make assembly faster and easier

All required parts for the chassis are from the AndyMark AM14U5 Kit of Parts chassis box except for four CIM (or CIM-replacement) motors. Two CIM motors are included in the standard Kit of Parts, with four additional CIMs included in the Rookie Kit of Parts. The chassis assembly section of the manual refers to AndyMark part numbers, so keeping the AndyMark manual open to the parts checklist may help you when following this manual.



Before beginning to assemble the chassis, the two Chassis End Plates will need to be cut down to 27" by removing 4" from one end. The two 24" churros will need to be cut down to 18.25". If the size of your team allows for it, have someone begin making these cuts while another group begins assembling the wheels. Measure out your cuts and mark them with a combination

square to make sure your cuts are perpendicular and cut the plates in a bandsaw or chop saw, making sure to account for the width of your blade. Save the end plate cutoffs for later.

Wheel Assembly

Start assembling the wheels by screwing two pulley halves into one side of each wheel. Each half-pulley (AndyMark part number am-2234a-half) has one raised screw hole and one recessed screw hole on the bottom. Connect two halves together by lining the raised portion of one half with the recessed hole on the other. The ridged portion of the pulley that the belt will actually ride on should line up across the two pulleys with no gaps or misaligned teeth.

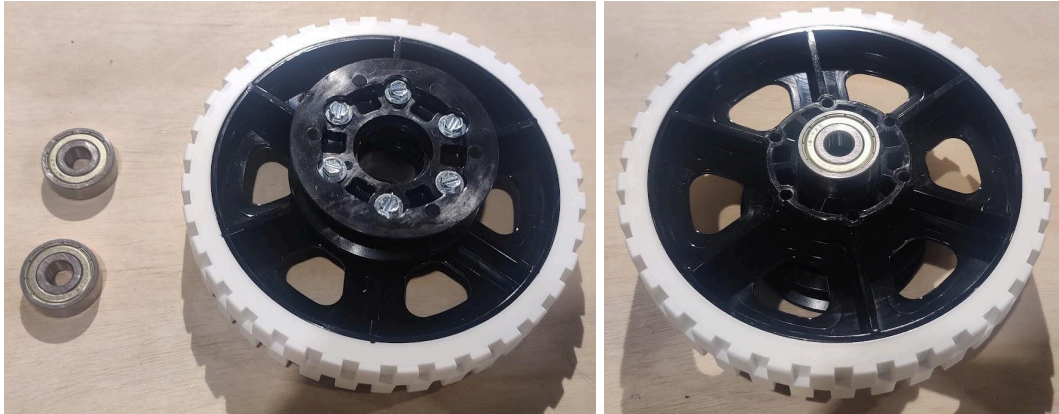


The pulley is then screwed into the matching hole pattern on one side of the 6" HiGrip wheel (am-0940b) using six 10-12 1.5" screws (am-1654). Tighten these bolts in a star pattern like you would when changing a tire on a car to ensure the pulley is aligned evenly on the wheel.

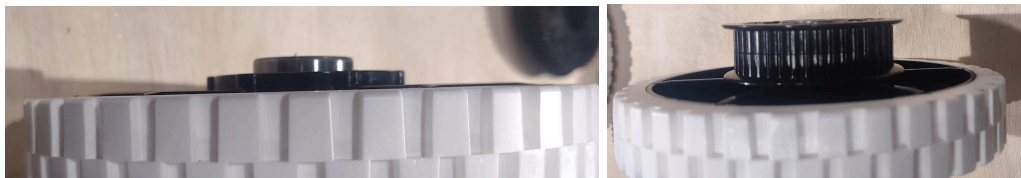


A 1/4" socket driver is preferred over a flat bladed screwdriver for fully tightening these form-threading screws as they will need more force applied to them in order to cut away the plastic hub of the wheel. The socket driver does need to be somewhat thin-walled, as a large driver will foul on the pulley before the screws are fully tightened. A ratcheting driver or a drill will also make the process much faster.

Four of the wheels will have two 1614ZZ 3/8" round inner diameter bearings (AndyMark part number am-0209) pushed into either side. One bearing will push into the open center of the pulley and the other will push into the open center of the wheel. Do not hammer or otherwise harshly strike the sides of the bearings to push them into place as this can easily damage the bearing. The bag that these bearings come in contains two bearings with a flange - a raised ridge around one of the outside edges. Set these bearings aside for later.



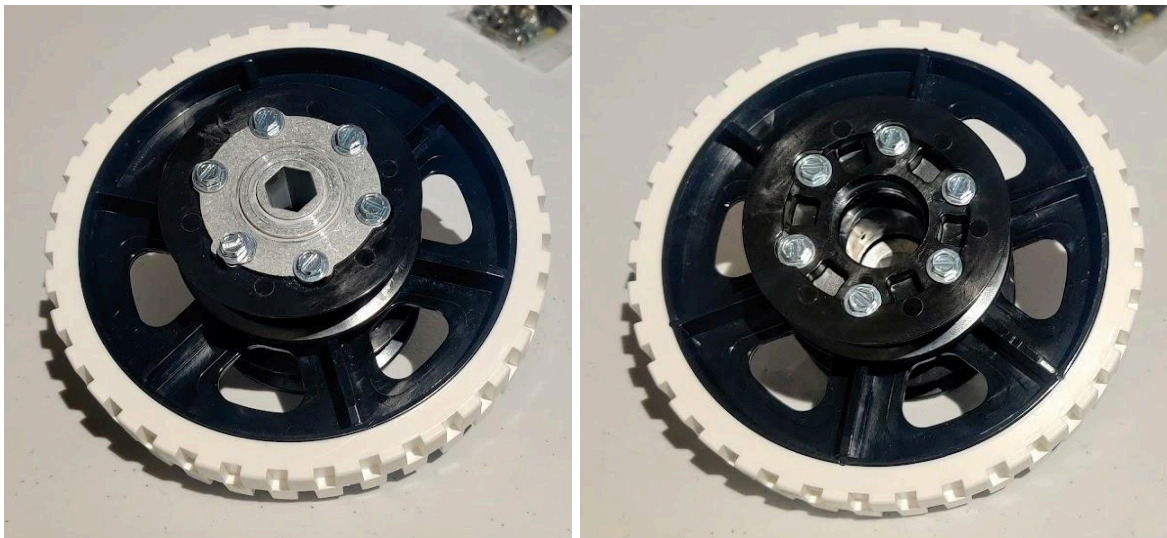
One easy way to make sure they are seated correctly is to line the wheel up on top of the bearing on a table and push the wheel down firmly until the bearing slips into place. The bearings will stick out of the bare half of the wheel slightly and be flush with the top of the pulley. These will be the front and back wheels of the robot.



The other two wheels will have one of the remaining pulleys added to the other side with a 1/2" hex hub inserted inside it. The easiest way to line up the hub is to insert one half of a pulley onto the hub's shaft and line up the screw holes in the hub with the screw holes in the pulley by putting a few of the form-threading screws through the hub and pulley. Push the other half of the pulley down to meet it, matching up the raised and recessed holes as before.



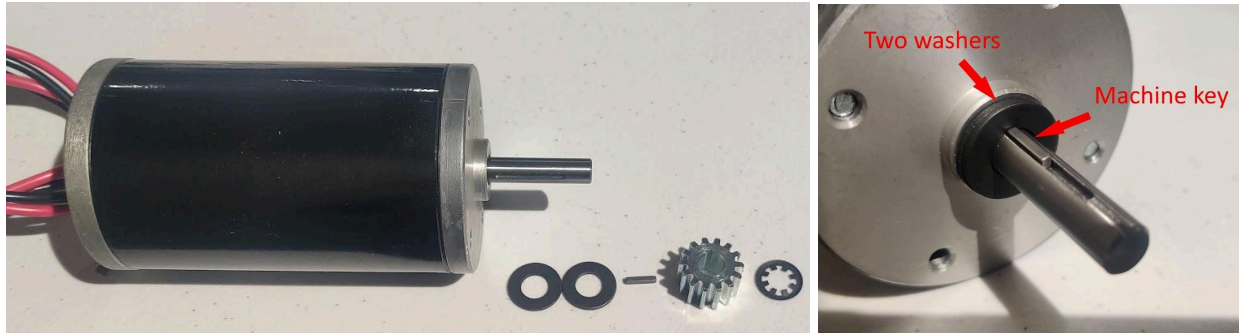
The 1.5" screws included in the 2024 Kit of Parts collide with one another when tightening them into both sides. AndyMark suggests simply continuing to screw them in, pushing the tips of the screws to either side of one another. This may be somewhat hard to do by hand, especially with a flathead screwdriver. If you have wheels from a previous year you may want to take the shorter screws out of them and insert them into the fresh wheels instead. Avoid reusing competition-used wheels as they will probably be worn down and less grippy than fresh wheels.



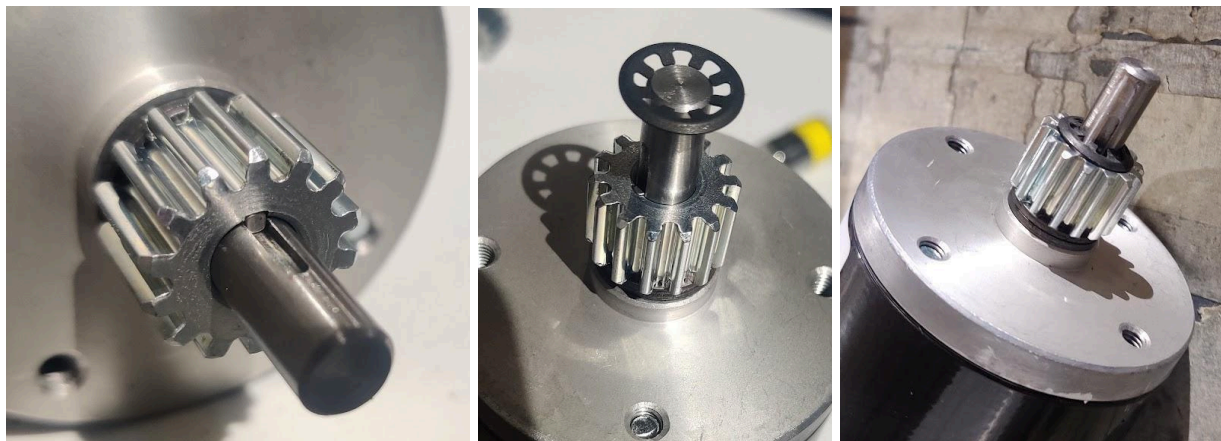
Motor and Gearbox Assembly

For each of your four drivetrain motors, place two 5/16" washers (am-1009a) onto the shaft. If your team is a rookie team, your kit of parts should include six CIM motors. If you are not a

rookie team, your kit will contain only two CIM motors, so you will need to purchase two new motors or reuse two from a previous year (recommended). Two more CIM motors are also used in the KitBot launcher mechanism if your team plans on building it. Install a machine key into the slot in the motor shaft.



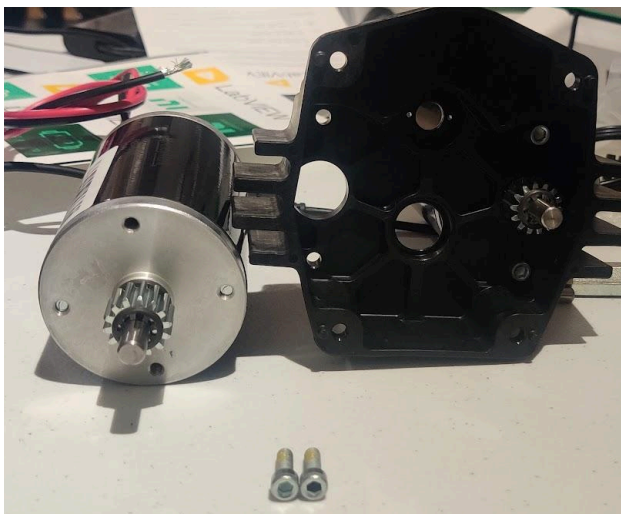
Slide a 14 tooth pinion gear (am-0034) onto the motor shaft, lining up the key with the gear's keyway. Clip the stackup onto the motor shaft using an 8mm retaining clip (am-0033) with the teeth of the clip pointing inwards. Do not push the clip fully down against the gear or it can cause the motor to bind.



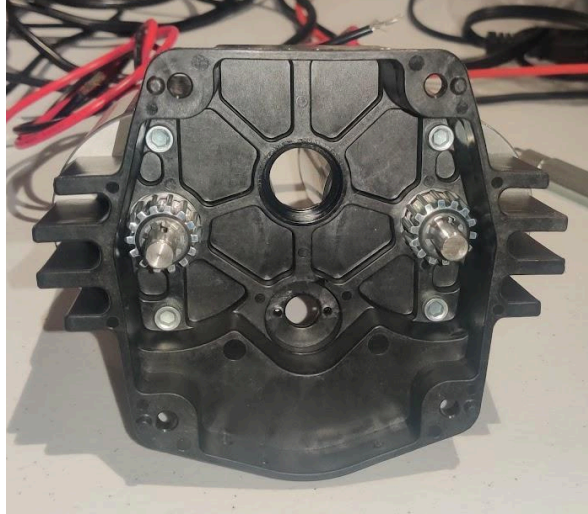
Placing a 7/16" or 3/8" socket over the clip and hitting it with a mallet can assist in pushing the clip down onto the shaft. This can be fairly difficult to do, and if the clip becomes deformed you should try to flatten it back out.



Screw two of the motors into each Toughbox Mini S gearbox housing (am-0650). The output shafts of the motors line up with the two larger holes in the gearbox housing and are screwed in using 10-32 x 0.625" bolts with thread lock already applied (am-1120) through the mounting holes above and below the input shafts and into the two mounting holes in the face of the motor. As these bolts approach fully tightened they become harder to turn. Make sure the bolts are actually fully tightened or the CIM motors will flex and rock around in the gearbox. If you can wiggle the CIM motors by hand then they need to be tightened more.



These bolts can be identified easily by the small patch of yellow or white thread lock on the threads of the bolt. Threadlocker is used on these bolts so that the motors do not vibrate them free over time. They are also shorter than the 10-32 x 0.75" bolts that come in the same bag.



CIMs have four holes in the face of the motor. Two already have long cross-head screws inserted from the bottom of the motor to hold them together, so you may have to rotate the CIM motors around until the two open holes line up with the mounting holes in the gearbox housing.

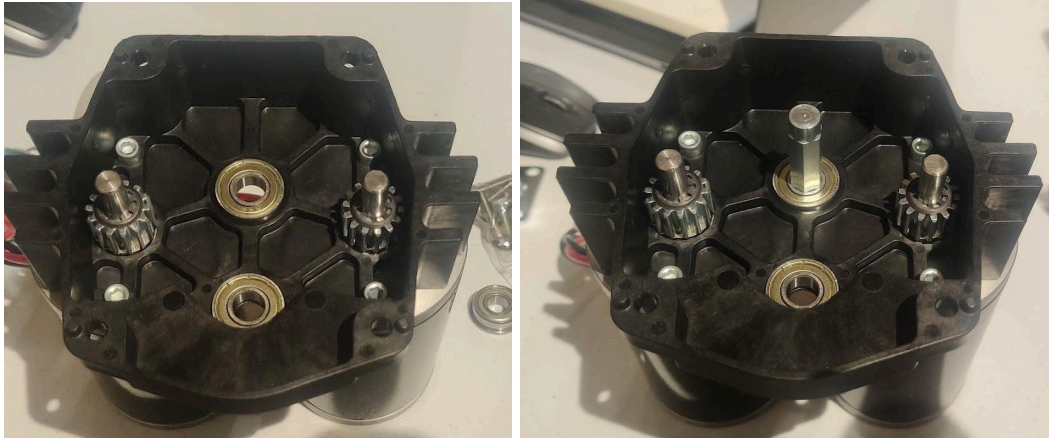


“Blocked” versus open mounting holes

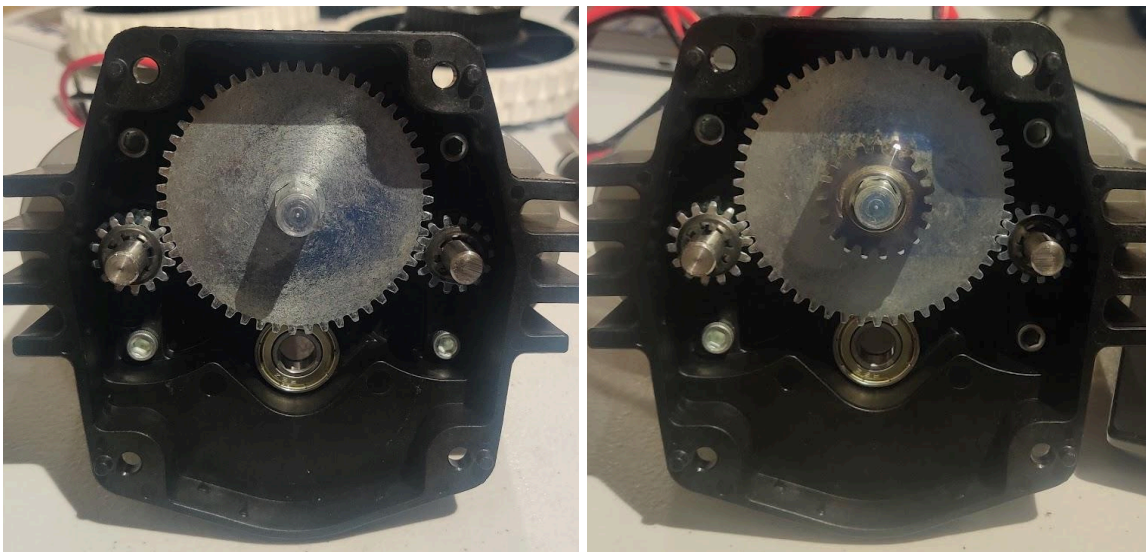
Two of the bearings used in the Toughbox have flanges while the other two do not. A flanged bearing has a small ring extending around it as shown below.



Press two R6ZZ 3/8" round inner diameter bearings (am-0516) without flanges into the two center holes of the Toughbox Mini S housing. Insert the Toughbox small 3/8" hex shaft (am-0152) into the bearing closer to the flat end of the gearbox housing.



Take the 3/8" hex 50 tooth gear (am-4720) and place it onto the 3/8" hex shaft. Then add the 19 tooth gear onto the same shaft so it sits on top of the 50 tooth gear.



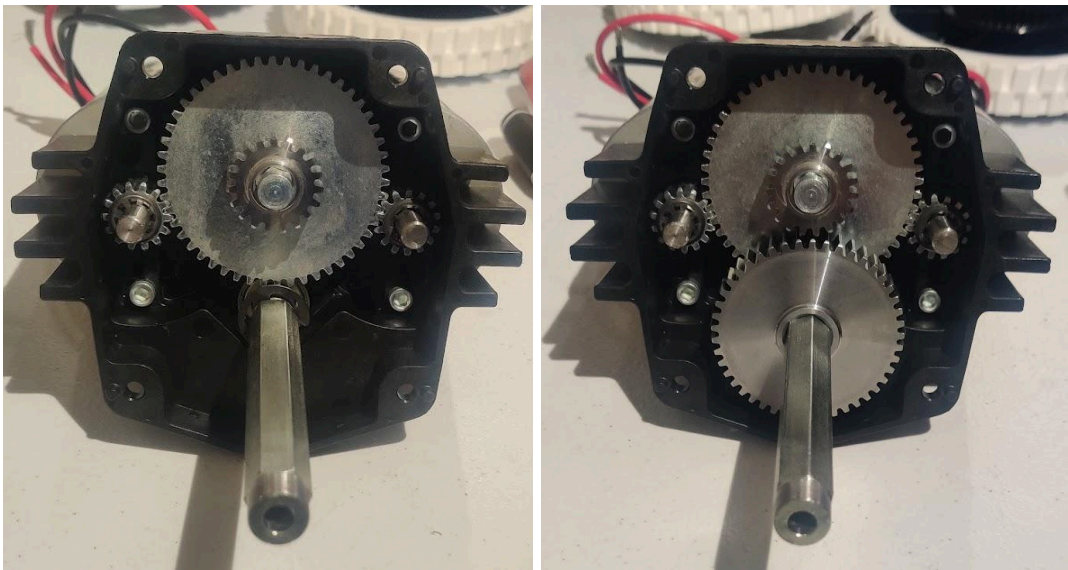
Install the 1/2" E-clip (am-0206) into the groove in the Toughbox 1/2" hex output shaft (am-4722) by pushing the shaft down onto the clip.



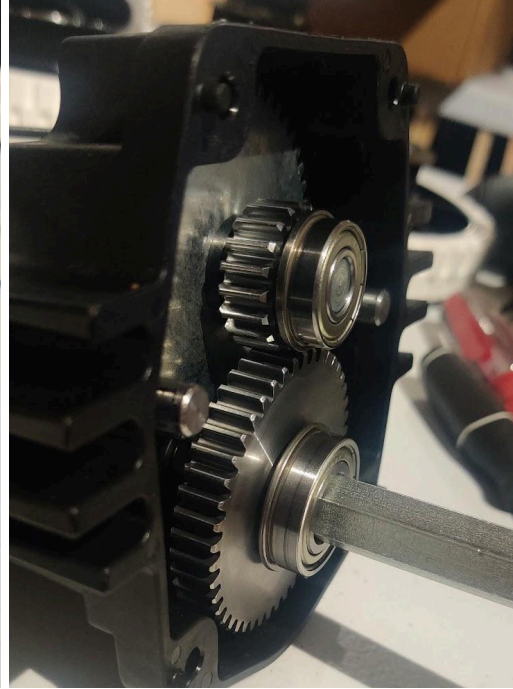
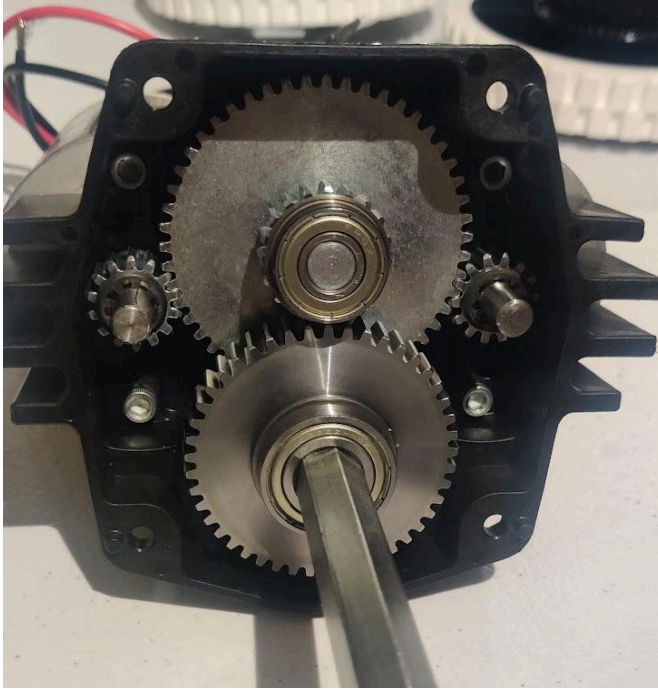
If you plan on adding encoders to the Everybot, install the encoder pin shafts (am-1323) into the 1/2" hex output shaft now. Clean the pins off and super glue them into the holes in the ends of each 1/2" hex output shaft. Let them dry before continuing.



Insert the 1/2" hex output shaft into the other R6ZZ bearing with the E-clip closer to the bearing. Place the 45 tooth 1/2" hex gear (am-4712) onto the output shaft.



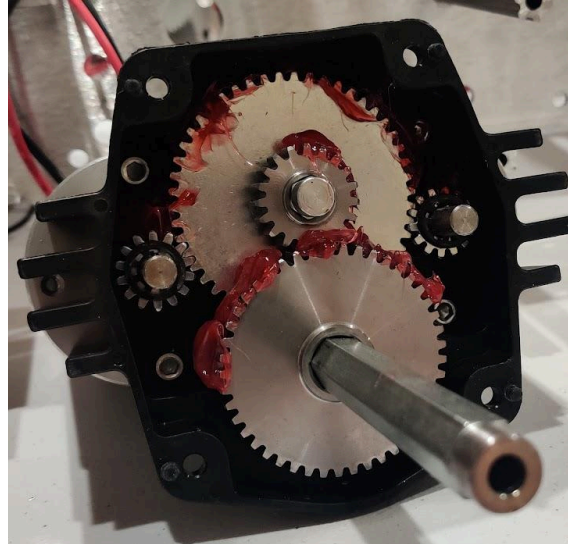
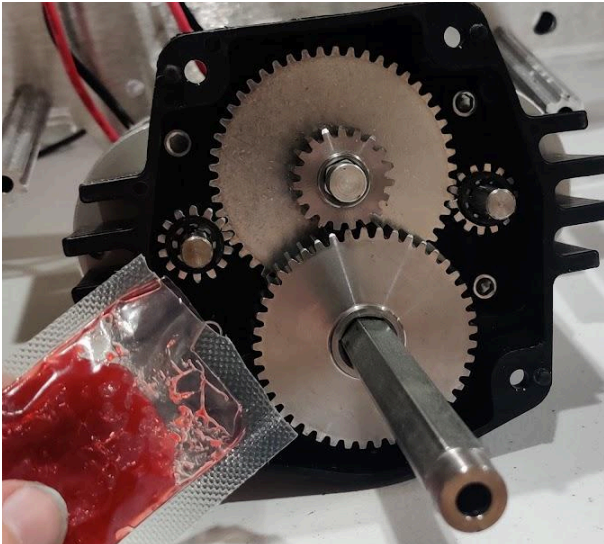
Place the FRZ6ZZ 3/8" round center bearing with flange (am-0028) onto the other end of the short 3/8" hex shaft on top of the 19 tooth gear, with the flange of the bearing closer to the gear. Place the FR8ZZ-HexHD 1/2" hex center bearing with flange on the 1/2" hex output shaft on top of the 45 tooth gear, with the flange of the bearing closer to the gear.



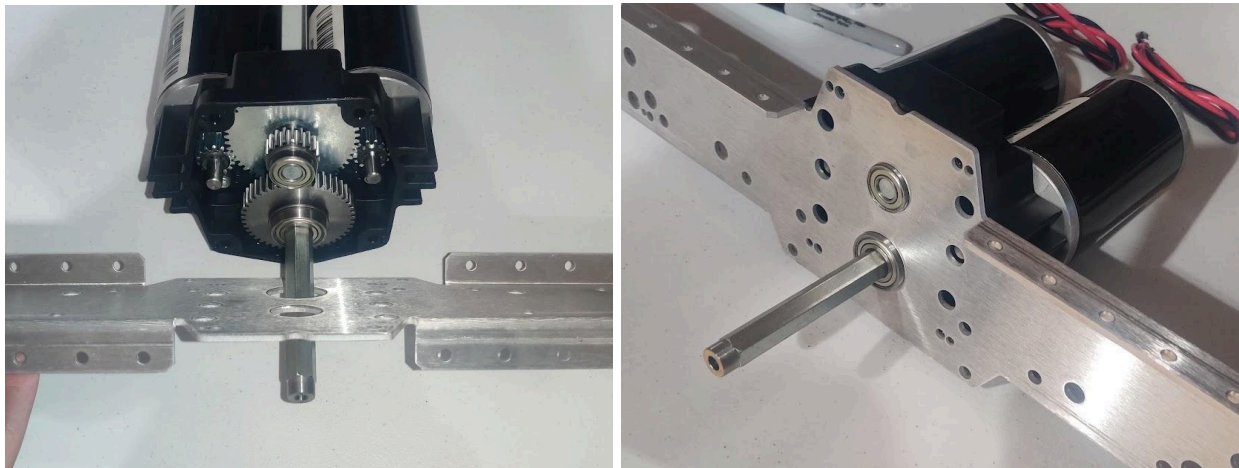
If your team has a convenient way to run your drivetrain motors now, such as an electronics test bed with motor controllers or other method of power delivery or by plugging the motors to a previous year's robot, it is recommended that you run in the gearbox "dry" for thirty minutes at this point. Before greasing the gears inside, attach the Toughbox Mini S to the Chassis Inside Plate as described below and secure it. Connect whatever method you have for powering the motors and turn it on, leaving it to run in for thirty minutes. They may start out loud but should not produce an ear-splitting "squeal" or "screech."



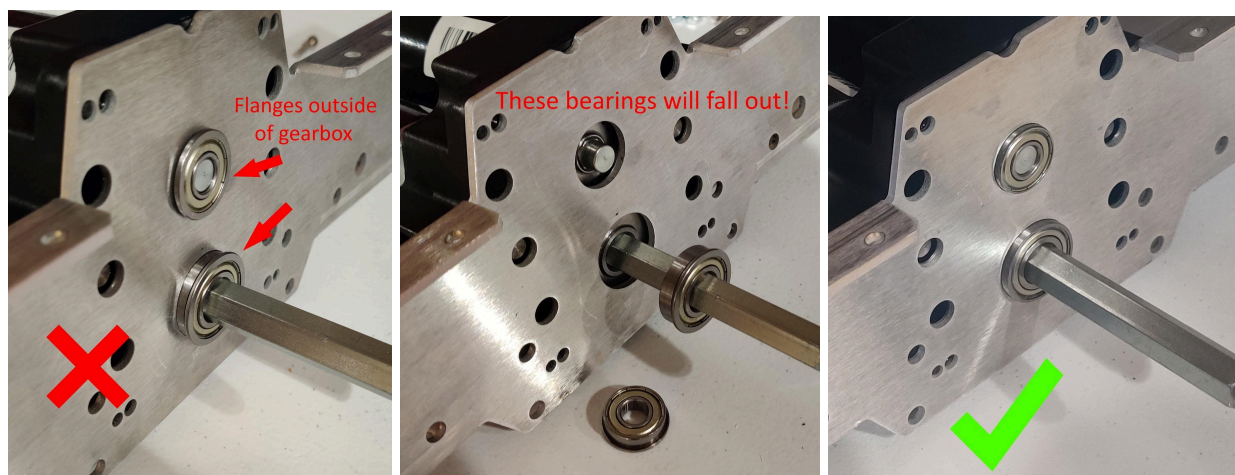
Once you have run in your gearbox, or if you do not have a convenient way to run in your gearboxes right now, apply red tacky grease (am-2768) to all the teeth of the gears. The flat surfaces of the gears are not as important as well-greasing the teeth where the gears actually mesh, and as the gearbox runs it will distribute the grease further.



(Re)attach the Toughbox Mini S to the Chassis Inside Plate of the chassis using four 10-32 x 0.75" bolts (am-1047) and four 10-32 Nylock nuts (am-1042). The flat side of the gearbox lines up with the shorter side of the roughly trapezoidal gearbox mounting area in the center of the Chassis Inside Plates and the tapered side of the gearbox mates with the longer side of the trapezoid. The flanges on the Chassis Inside Plates should face away from the gearbox on the flat side (the top of the gearbox) and towards the gearbox on the tapered side (the bottom of the gearbox).

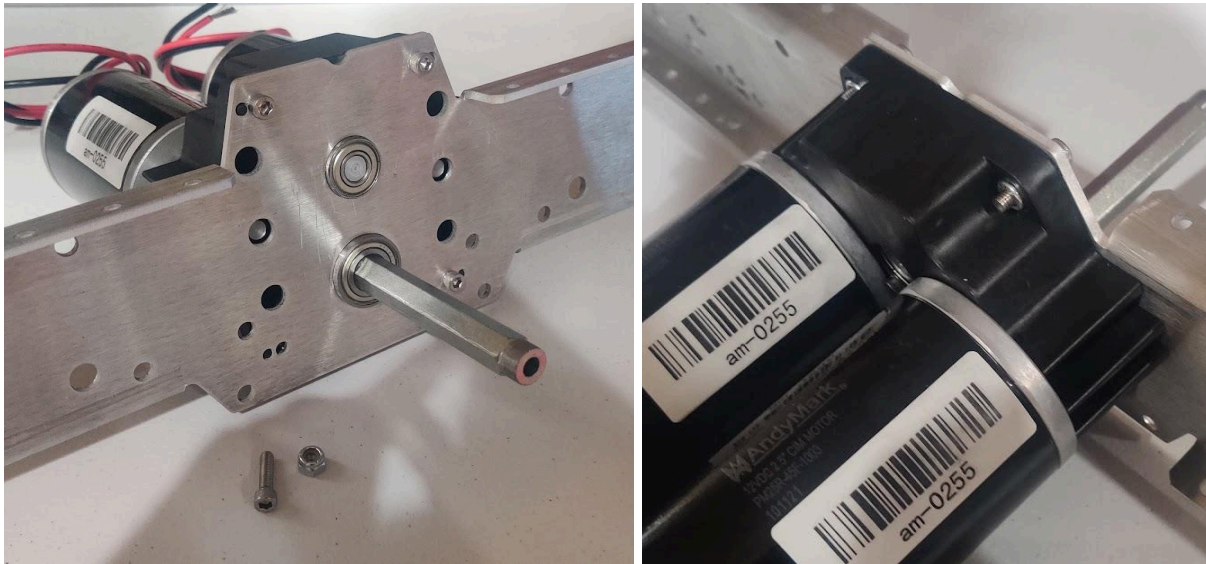


Make sure both of the flanged bearings are correctly "trapped" inside the gearbox by already being installed on the shafts when the gearbox is pushed into the Chassis Inside Plate - taking them out of the gearbox, inserting the gearbox's shafts through the holes, and then sliding the bearings onto the shafts from the other side of the Chassis Inside Plate will leave the bearings able to fall out.



If the bearings do not want to fit in the chassis holes, they can be arbor pressed into place (be sure to get the flange on the correct side of the Chassis Inside Plate so that the flange will end up inside the gearbox!) or the holes can be enlarged slightly with a deburring tool.

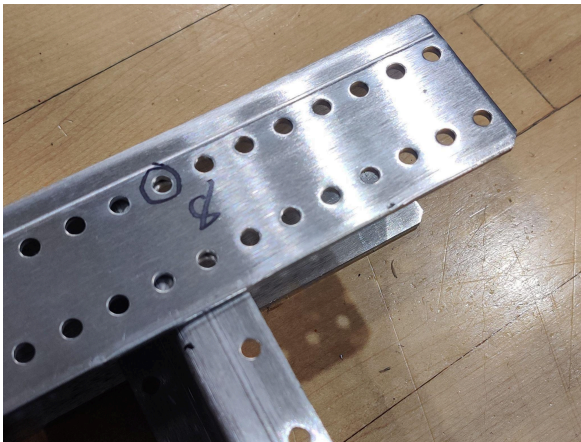
The 10-32 x 0.75" bolts should be inserted into the Chassis Inside Plate and through the gearbox casing with the 10-32 Nylock nuts inserted into the hexagonal holes in the back of the gearbox casing.



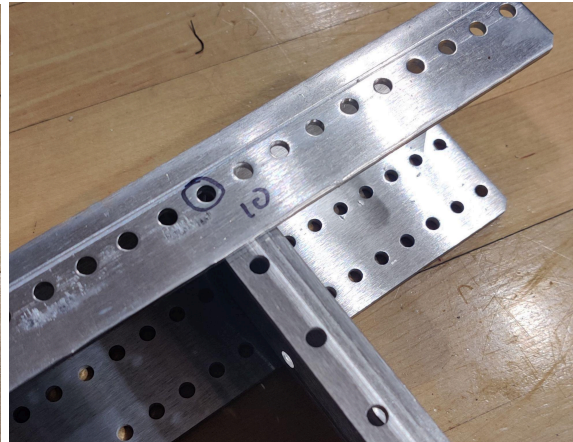
Complete these steps with both Toughboxes, affixing one to each Chassis Inside Plate.

Chassis Assembly

Insert one of the Chassis Inside Plates into one of the Chassis End Plates. The motors sticking out of the gearbox should face towards the middle of the robot with the output shaft sticking outwards. The top flange of the Chassis Inside Plates should point towards the outside of the robot while the bottom flange should face inwards. Line up the outermost hole in the upper flange of the Chassis Inside Plate with the 8th hole in from the edge of the top of the Chassis End Plate, with the first two holes in the bottom flange lining up with the 10th holes in from the edge of the bottom of the Chassis End Plate.

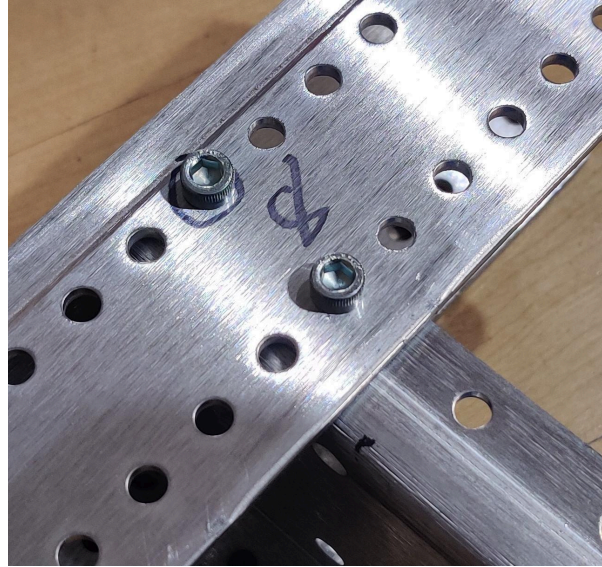


Top view



Bottom view

Attach the Inside and End plates with three 10-32 x 0.5" bolts (am-1002) and 10-32 Nylock nuts (am-1042) with two bolts through the longer top flange of the End Plate and the top flange of the Inside Plate and an additional bolt going through the bottom of the End Plate and the bottom flange of the Chassis Inside Plate. Mirror these steps with the other Chassis Inside Plate to attach the second side rail and gearbox to the Chassis End Plate.

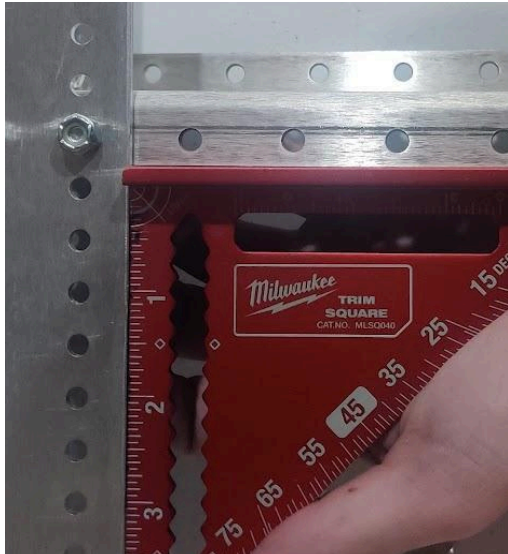


The other End Plate is similarly attached to the Inner Side Plates with the holes in the top flanges lining up with the eighth holes from the edge of the top of the end plates.

If you can, prepare the electronics bellypan out of 0.5" thick plywood and slide it into place in the chassis now before the second end plate is installed.

TODO: [link to electronics section for bellypan](#)

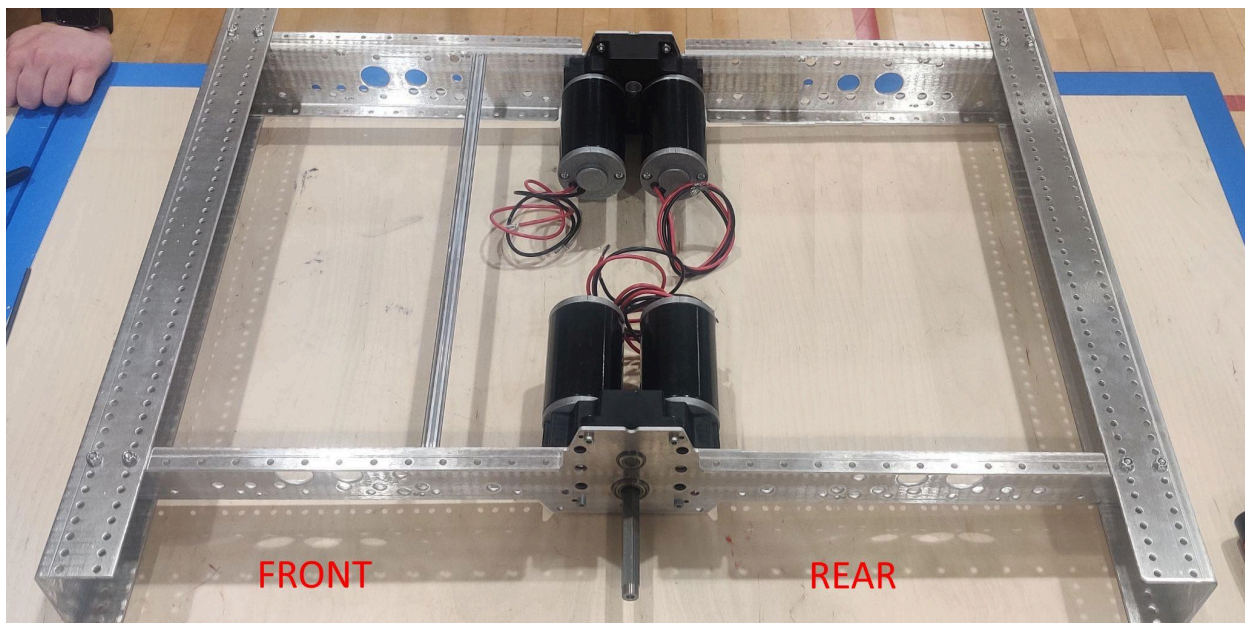
Using a carpenter's square or similar tool, check that the frame of the chassis is "square" - that is, check that all four of the corners of the chassis form 90 degree angles. If your chassis is "bent" or otherwise off-angle it will have problems driving correctly and it will be difficult to complete the rest of the robot. If necessary, loosen the bolts in the offending corners and shift the plates until they form right angles with each other.



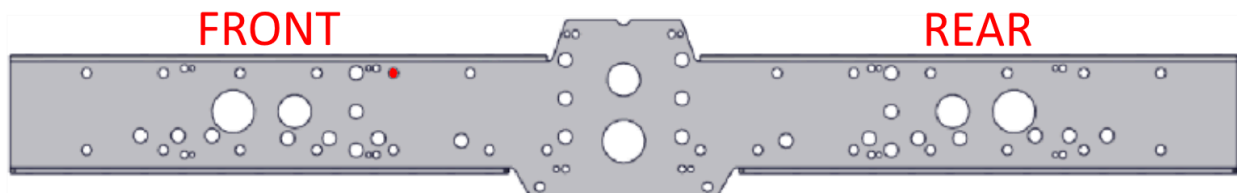
Squared corner



Not squared corner



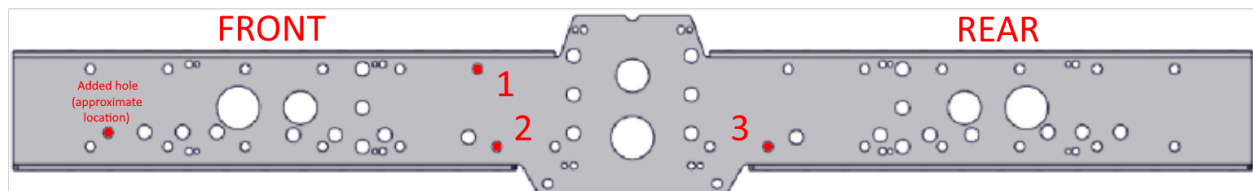
The churros can be installed in the AndyMark recommended locations. Leave the rear churro out if you plan on adapting the KitBot into an Everybot as it will be replaced by and get in the way of one of the Everybot mechanisms.



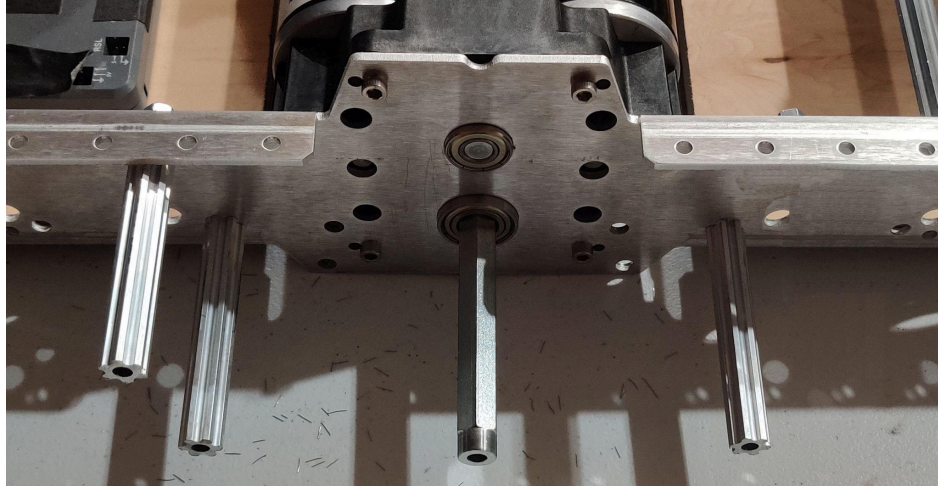
Your chassis will now have a front (the side with the churro) and a back (the other side with no churro). It is probably a good idea to label the chassis with front and back so your team can keep it straight when assembling the rest of the Everybot.

At this point, follow the [FIRST KitBot](<https://www.firstinspires.org/resource-library/frc/kitbot>) plans to machine and assemble the launcher and frame, and attach it to the chassis, making sure the front of the mechanism is on the side with the churro closer to the center of the frame. After the hole attaching the front of the superstructure to the frame is added in step 4 of section 6.2.10 and the fitment of the mechanism is satisfactory the mechanism can be removed if desired.

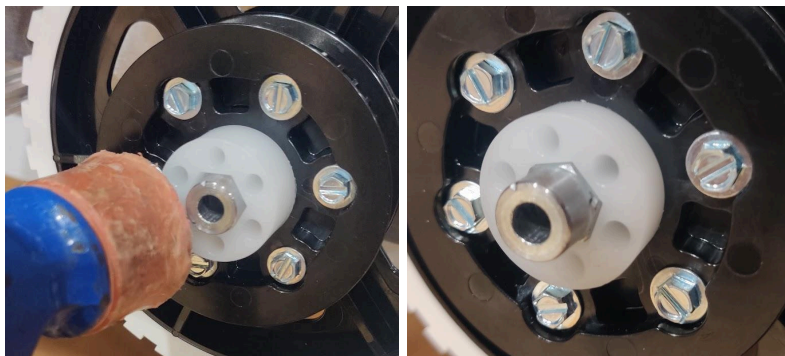
Attach three of the 3.375" long churros to each side of the chassis using 1/4-20 x 0.75" form-threading bolts (am-1591 or am-1310) so that the churros extend outwards from the Chassis Inside Plate like the gearbox output shaft. Typically, four churros are installed on each side, but the angled portion of the KitBot mechanism mounts to one of these holes. Make sure that the installation of these churros is mirrored between the sides rather than rotated.



A 1/2" hex wrench can be used to hold churro in place while tightening the bolts with a 3/8" wrench or ratchet. These bolts will require additional force to cut the threads into the churros. If desired, the 3.375" churros can be pre-tapped for a 1/4-20 bolt on both ends.

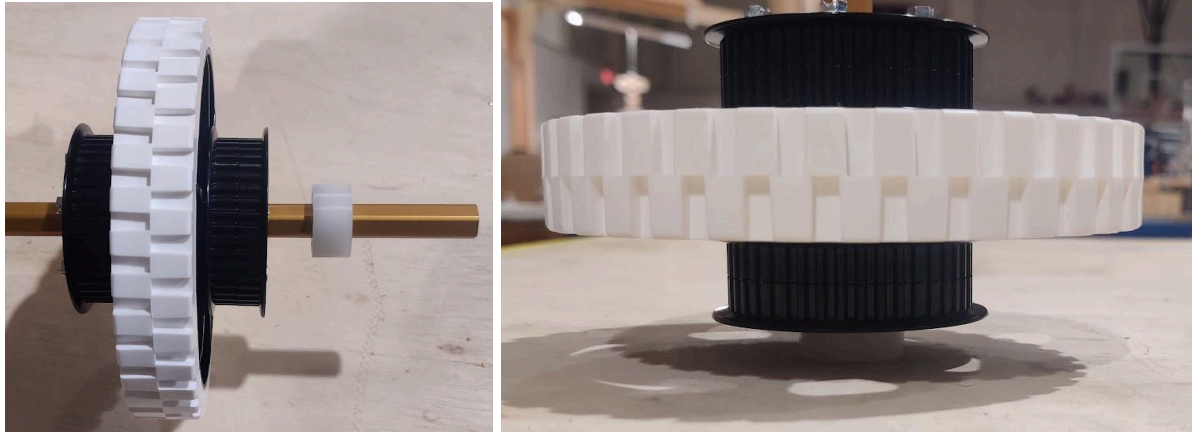


Place a center wheel with two pulleys on the Toughbox output shaft with the aluminum hex hub facing the gearbox. Place a nylon hex spacer (am-1305) onto the output shaft and press or tap it into the hole in the end of the pulley. The shaft will keep the spacer's hexagonal bore aligned with the hex hub's bore.

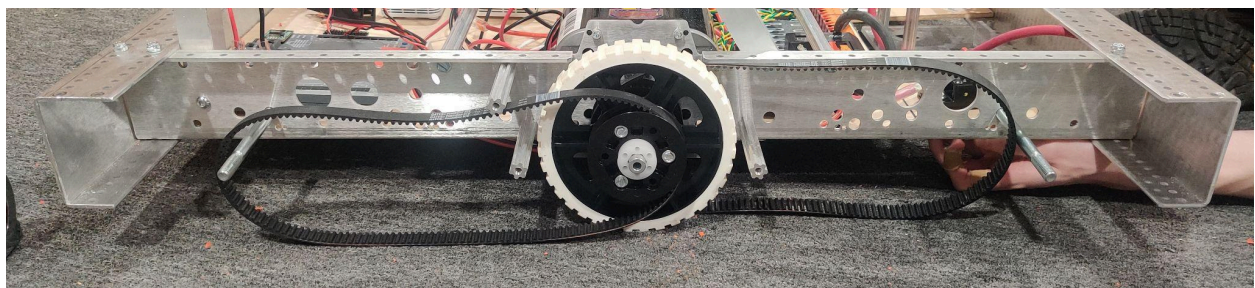
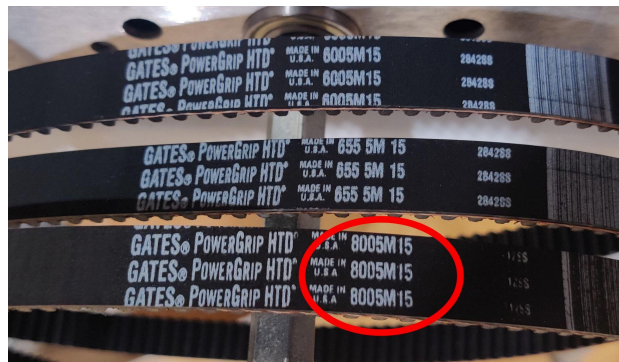


When the spacer is fully inserted into the wheel, the entire round portion at the end of the output shaft should be outside of the spacer.

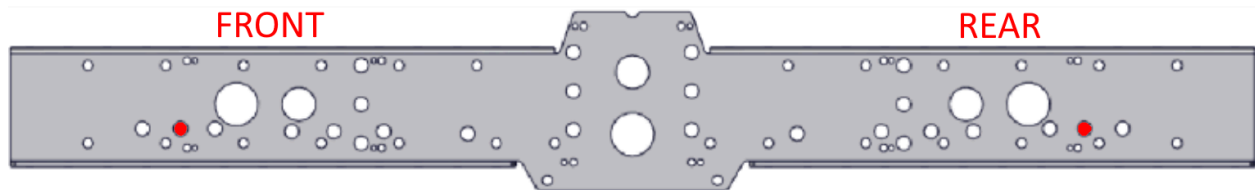
If the spacer can not easily be pushed or tapped into place with a rubber mallet, you can remove the spacer and wheel and push the spacer into place by lining up the center hex patterns of the hub and spacer with a small piece of hex shaft or a churro and pushing the wheel down onto the spacer, similar to the way that the bearings were previously pushed into the front and rear wheels.



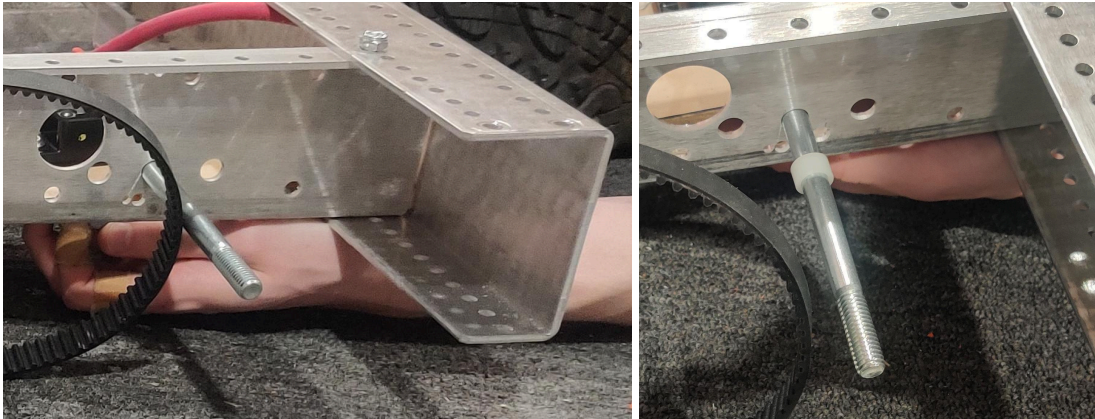
Loop two of the 160 tooth belts (am-2266, marked as 8005M15 on the belts themselves) around the center wheel. The belts will be stretched towards the front and back of the frame to couple the front and rear wheels to the driven inner wheel. The belt going towards the front of the chassis is looped around the lower churro and under the upper one, with the belt towards the rear looping around the single lower churro.



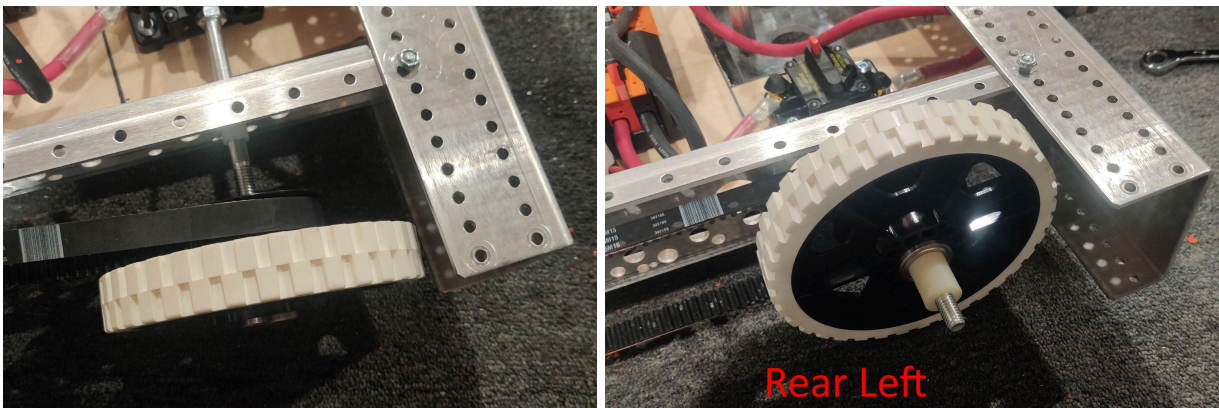
The photos in this section show the left side of the chassis with the front of the chassis to the left. The rear belts are to the inside of the chassis with the front belts closer to the outside of the frame. Unlike some previous Everybots, the orientation of the drive belts within the frame does not matter for the 2024 Everybot.



Insert one of the 3/8-16 4.25" bolts (am-1297) through the rear axle hole in the diagram above from the inside of the chassis so that it sticks out similar to the churros and gearbox output shaft. Slip a short 0.28" nylon spacer (am-1306) over the bolt.

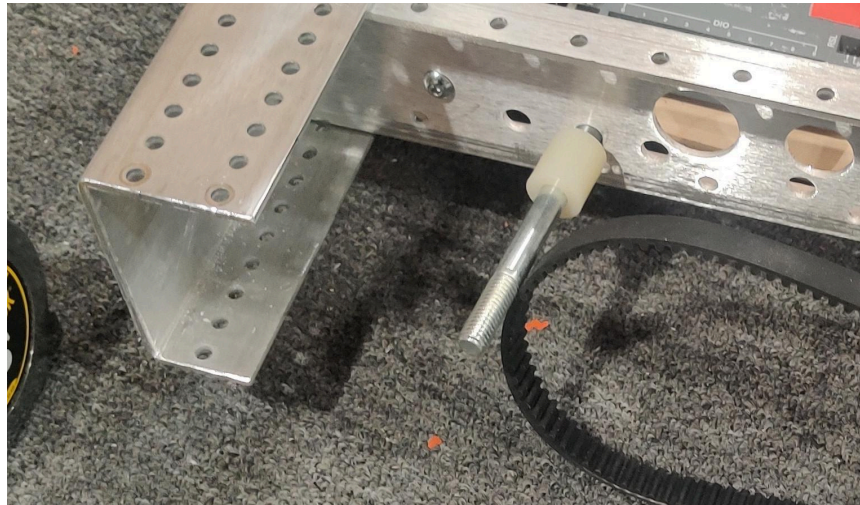


Take one of the four outer wheels and loop the belt around its pulley, making sure the pulley is towards the inside of the chassis and that the belt will run parallel with the side plates. Push the bolt through the two bearings in the wheel. You may find it is easier to pull the bolt slightly back into the chassis, line up the wheel on the end of the bolt, and then push the bolt all the way back through. Add a longer 0.85" nylon spacer (am-1307) onto the end of the bolt.

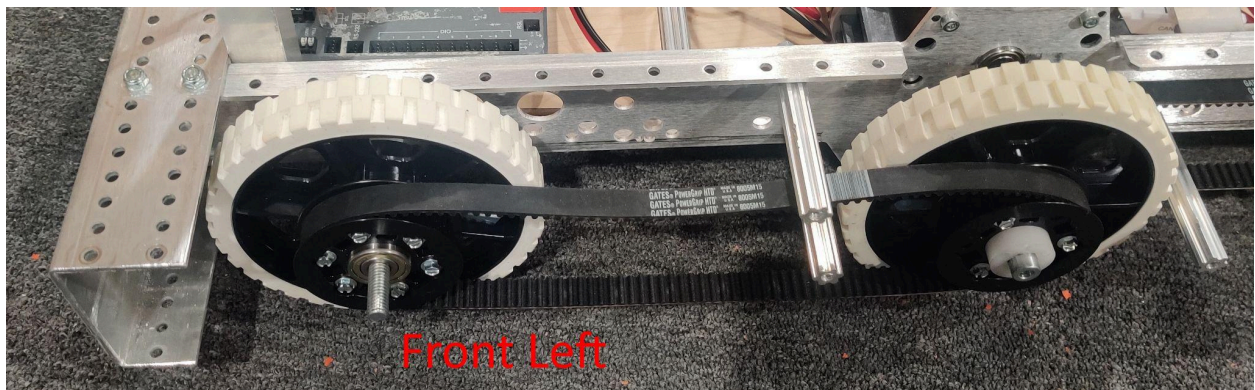


A 3/8-16 nut can be finger-tightened to the end of the axle to hold this assembly in place while setting up the other wheel on this side if desired.

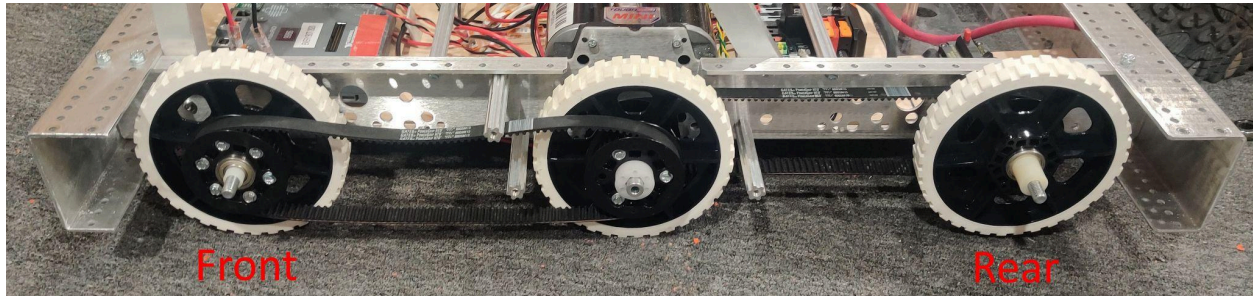
Insert another 3/8-16 4.25" bolt (am-1297) through the front axle hole in the diagram above from the inside of the chassis so that it sticks out similar to the churros and gearbox output shaft. This time, put a longer 0.85" nylon spacer onto the end of the bolt first.



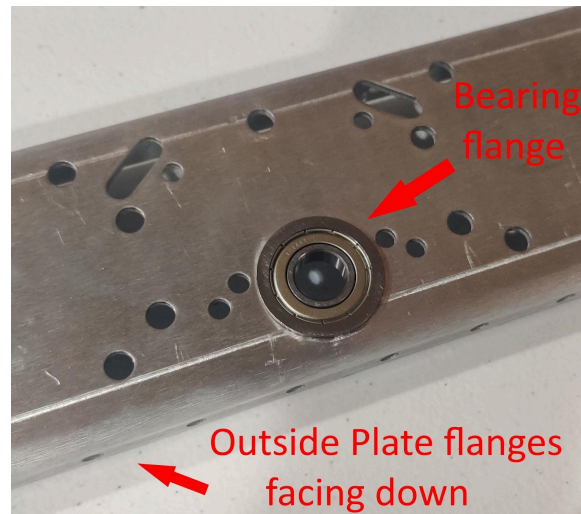
Pull the other 160 tooth belt towards the front of the robot, making sure it fits over the middle wheel's outer pulley. Take another wheel and put the belt around its pulley, making sure the pulley is toward the outside of the chassis this time so that it is similarly parallel with the Chassis Inside Plate when the bolt is pushed through the wheel's bearings.



Now slip a short 0.28" nylon spacer over the end of the bolt. A nut can be tightened by hand to hold the stackup in place if necessary. With the churros, belts, wheels, and axles all in the correct position, the Chassis Outside Plate can be added.



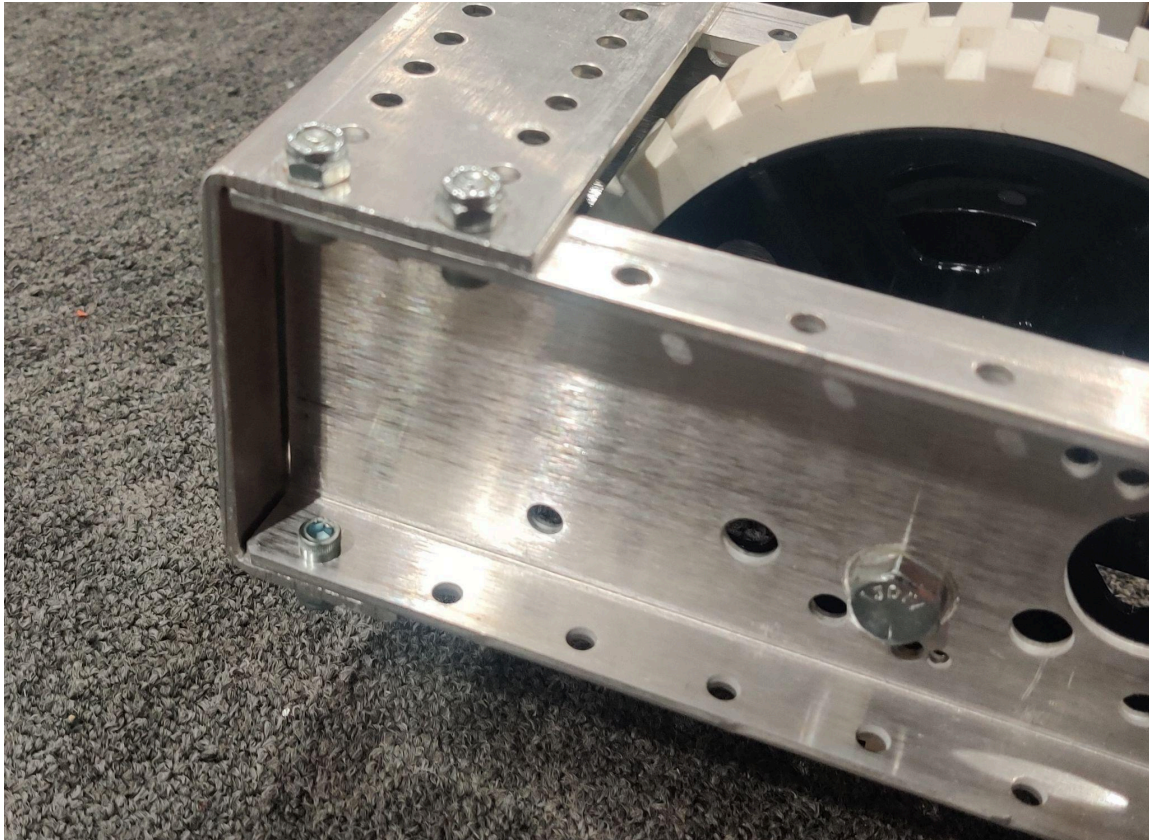
Press a FR8ZZ 1/2" round bearing (am-0030) into the center hole of each Chassis Outside Plate, being sure to press it in from the opposite side of the Outside Plate's flanges so that the bearing will be trapped in place correctly. Remove any nuts from the end of the front and rear axles and make sure that none of the spacers fall off the ends.



With the Outside Plate's flanges pointing down, line the bearing up with the Toughbox output hex shaft and hold the front and rear wheels in place so the axle bolts line up with the matching holes in the Outside Plate. Push the Chassis Outside Plates into the front and back chassis end plates so that the holes in the Outside Plate's flanges line up with the outermost holes in the Chassis End Plates.



Secure the Chassis Outside Plates in place using six 10-32 x 0.5" bolts and 10-32 Nylock nuts each. Secure the front and rear axles by tightening the 3/8-16 nuts onto the axle bolts so that the wheels can still spin. The axle bolts and nuts are both tightened using a 9/16" socket or wrench. Attach the four 3.375" churros to the Chassis Outside Plate using 1/4-20 x 0.75" form-threading bolts (am-1591 or am-1310).



The same steps are followed on the other side of the chassis to complete the drivetrain. Both sides can be assembled simultaneously as long as your team has enough space, tools, and people.

Everybot Roller Claw

Roller Claw Architecture

The Everybot roller claw uses a motor and pulley assembly and small compliant “squishy” wheels in a polycarbonate claw to intake a Note from the Source, store it when traveling across the field, and score it into the Amp.

The Everybot’s claw mechanisms can be adapted for a variety of different robot designs other than the KitBot or the “full” Everybot. A hole pattern that lines up with the KitBot launcher mechanism is included, but additional holes can be added or match-drilled into a different support structure. Please visit the [Everybot Discord](<https://discord.com/invite/b3GbxFzkt>) if you have specific issues or questions about using the claw in a different robot design.

Required Tools

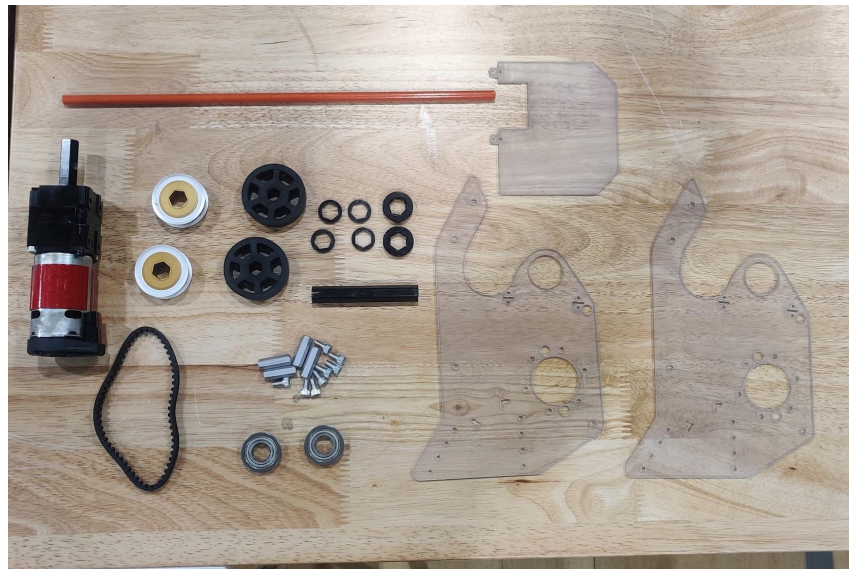
- 3/8" wrench or T-handle
- 5/32" Allen wrench or ratchet
- Hacksaw or bandsaw

Roller Claw Materials

- Qty(1) x 775-class motor (RedLine, 775pro)
- Qty(1) x ~16:1 small planetary gearbox
- Qty(2) x Roller Claw Plates
- Qty(1) x Roller Claw Side Plate
- Qty(3) x Small Zip Ties
- Qty(4) x 1" long 10-32 standoffs
- Qty(8) x 0.5" long 10-32 bolts
- Qty(4) x 10-32 1.5" bolts
- Qty(1) x Fiberglass Driveway Marker
- Qty(2) x 2" "Squish"/Compliant Wheel
- Qty(2) x 24 Tooth HTD Pulley
- Qty(1) x 9mm 60 Tooth HTD Belt
- Qty(2) x 1/2" Hex Bearings (Round 13.75mm bearings can be used with rounded 1/2" hex shaft)
- Qty(2) x 1/2" Hex Shaft Collars
- Qty(4) x 1/8" (0.125") 1/2" Hex Spacers

Cut components:

- Qty(1) x 2.75" long 1/2" Hex Shaft



Roller Claw Machining

A 2.75" long 1/2" hex shaft is used to run the roller claw's two compliant "squishy" wheels. The roller claw mounts onto the KitBot superstructure in place of one of the corner gussets provided in the Kit of Parts to hold the superstructure together, so no additional box tube machining is necessary if you are building the Everybot from a completed KitBot.

Cut a 14" section from the fiberglass driveway marker to use as a support for the Note in the roller claw. Use a hack saw or band saw with a good blade to avoid fiberglass dust.

Roller Claw Gearbox and Motor

The Everybot roller claw gearbox is a small planetary gearbox with a ratio around 16:1. The Everybot roller claw plates have mounting holes for 775Sport, Max Planetary, and VersaPlanetary gearboxes. A 775-class motor like a RedLine or 775pro is recommended for its relatively small size and weight.

A NEO 550 could also be used but the motor controller would need to be relocated relatively close to the motor to be able to plug in the hall effect sensor cable and require power and CAN extension cables to the motor controller itself. Due to the lower speed of the NEO 550, a gearbox closer to a 10:1 would be preferred. 9:1 and 12:1 are both common gearbox options that will work. Make sure your gearbox choice works with (or can be adapted for) the NEO 550 (check the product page and manual usually found there carefully).

Roller Claw Assembly

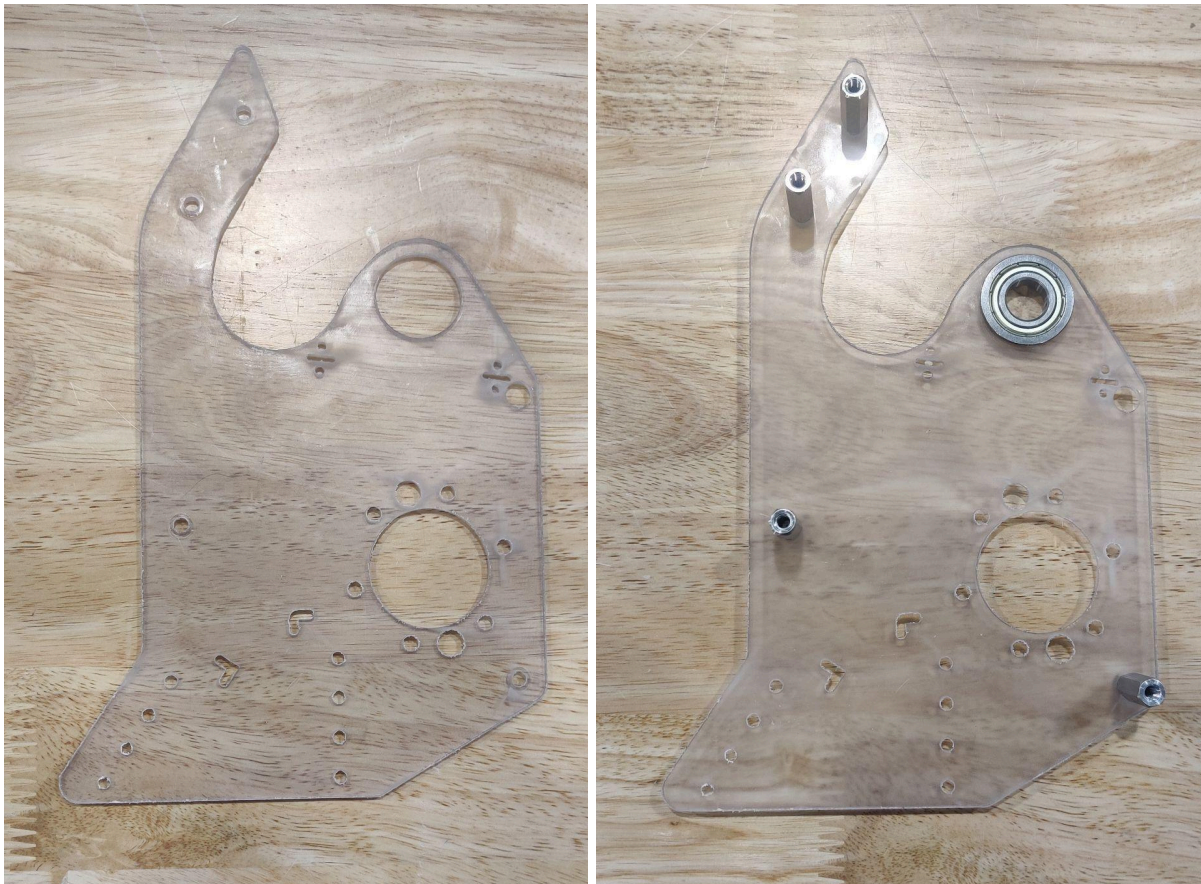
If you do not have access to a CNC mill, router, or other similar computerized manufacturing process it is recommended that your team purchase a pair of roller claw side plates from one of the manufacturers that have agreed to produce and sell them directly to teams. A DXF of these side plates can be found

[here](https://drive.google.com/file/d/1UQrz02eukxNCq5t4sMpPU92qqvWHli1/view?usp=sharing) with the horizontal support plate

[here](https://drive.google.com/file/d/1LvSxkTAAT8KFWu26xsgYczYrWR-_NkR6/view?usp=sharing).

Start with one of the claw plates sitting flat with the claw opening to the right. Install four 1" standoffs sticking up from the plate in the marked holes using 10-32 1/2" long bolts matching the threading of your standoffs. These standoffs will hold the two plates apart at the correct

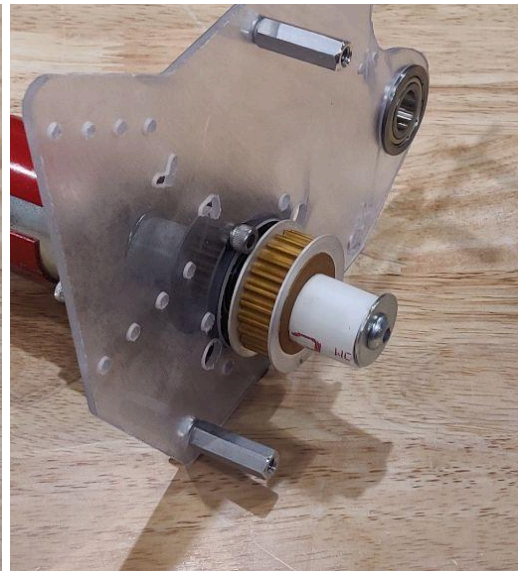
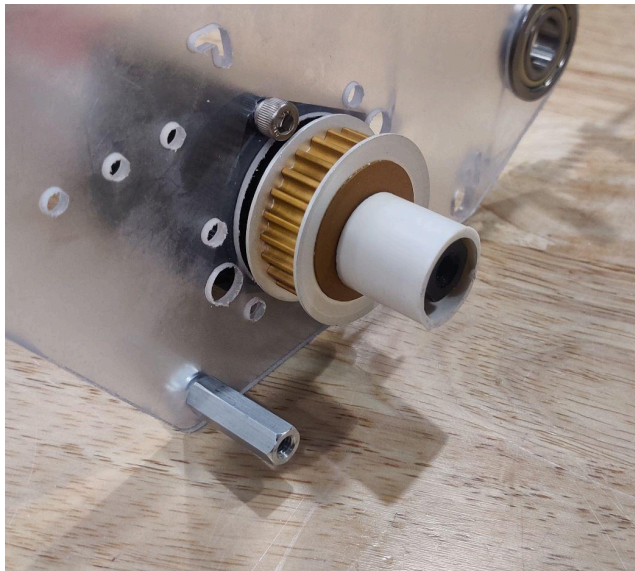
distance. Insert a flanged 1/2" hex bearing into the roller claw plate with the flange on the same side as the standoffs.



Insert the gearbox assembly into the larger hole so the gearbox and motor stick out the opposite direction from the standoffs and screw it in place using bolts suitable for face mounting your gearbox of choice (10-32 1/2" bolts should work). Insert a 1/8" hex spacer and a 24 tooth pulley over the end of the gearbox output shaft (If your pulley is able to rub against the roller claw side plate, add a second 1/8" spacer).



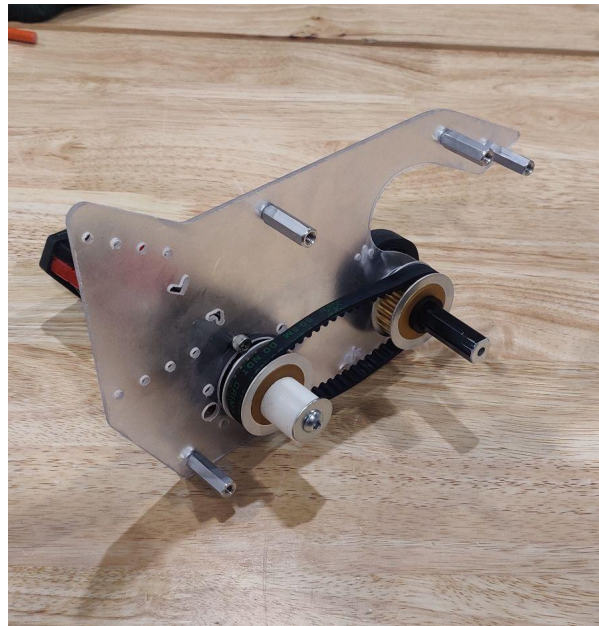
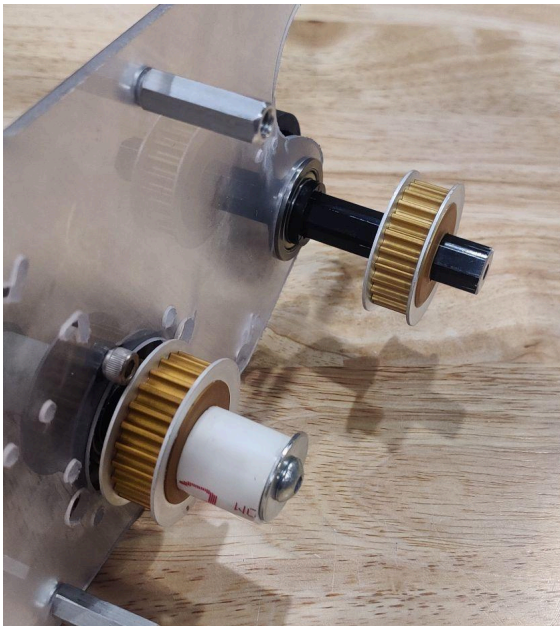
Cut from PVC, 3D print, or otherwise procure a spacer the correct length to cover the rest of your gearbox's output shaft minus the width of a shaft collar. Add the spacer and cap off the shaft with shaft collar (we used a washer and bolt, but these larger washers are not used elsewhere on the Everybot. If your team has some larger washers, a washer and bolt can be used instead of an additional shaft collar).



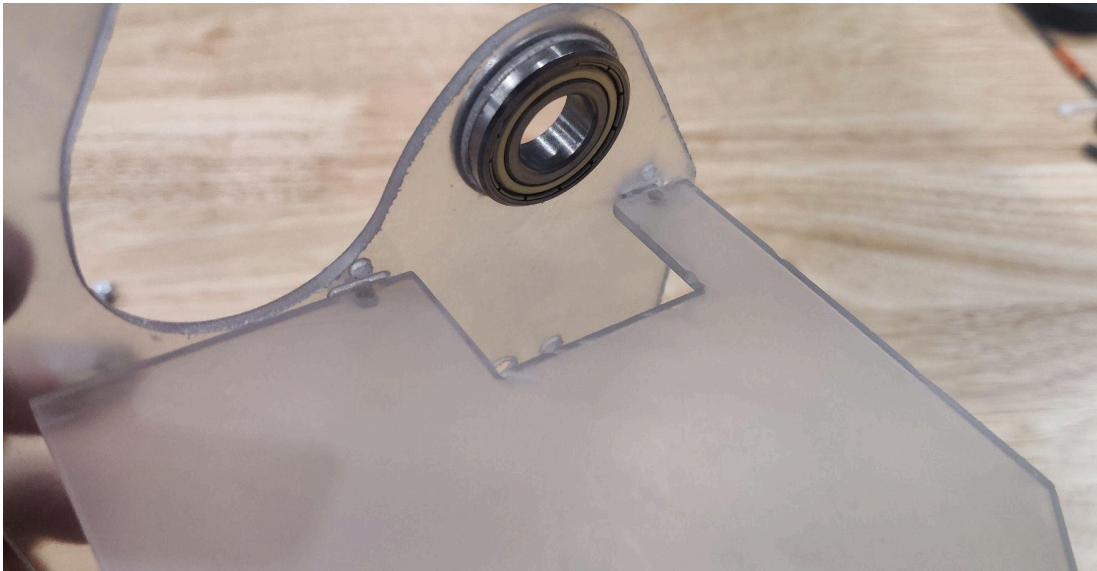
Install a shaft collar on the end of the 2.75" hex shaft, as close to the end as you can reasonably get it. Flex one of the squish wheels over the short shaft and work it down until it sits against the shaft collar and add a 0.125" spacer.



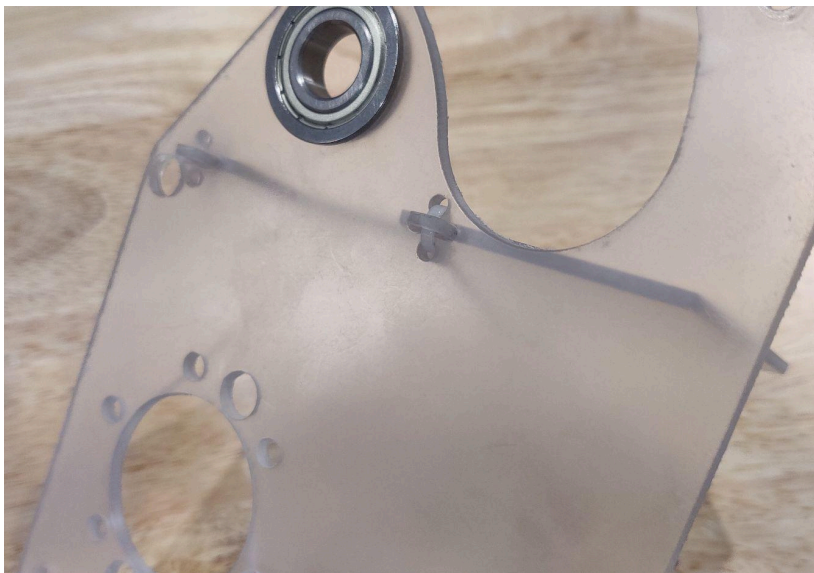
Insert the hex shaft into the bearing so the wheel and spacer are on the outside of the plate. Add a 1/8" spacer, second 24 tooth pulley, and additional 1/8" spacer over the end of the shaft and loop the 60 tooth belt over and around both pulleys.



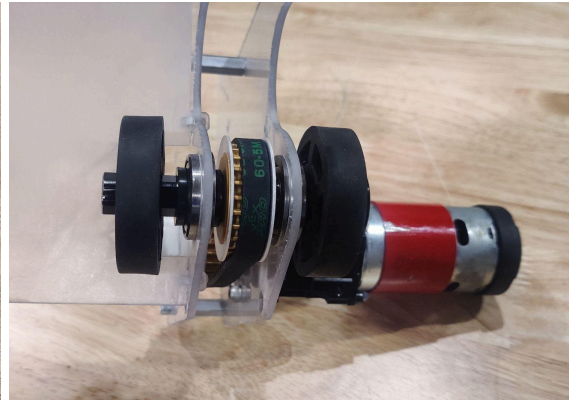
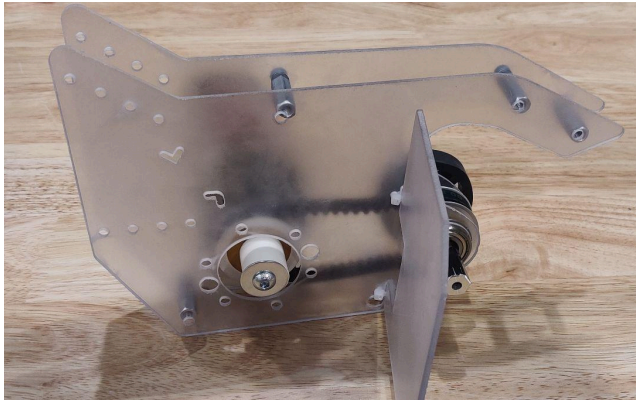
Position the other roller claw plate so it opens up to the left and install a 1/2" hex bearing. Flip the claw over and position the horizontal support plate so it is in the designated slots and the zip tie holes line up.



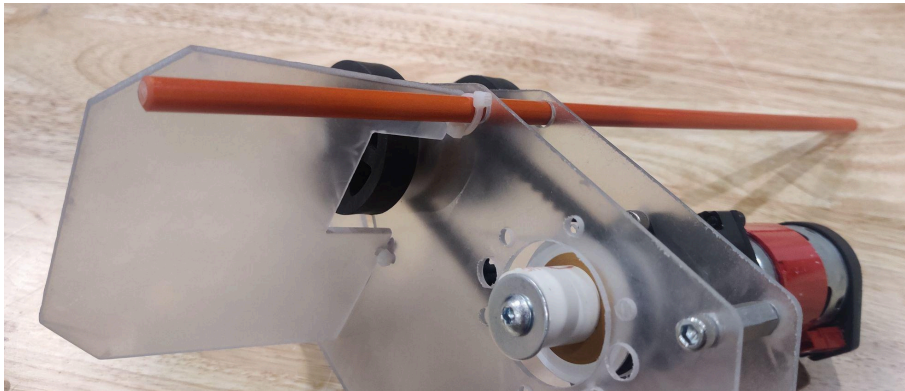
Take two small zip ties and feed them through the four holes at each joint. Leave the front zip tie slightly loose so that another zip tie can be fed through it to hold the fiberglass rod in place later.



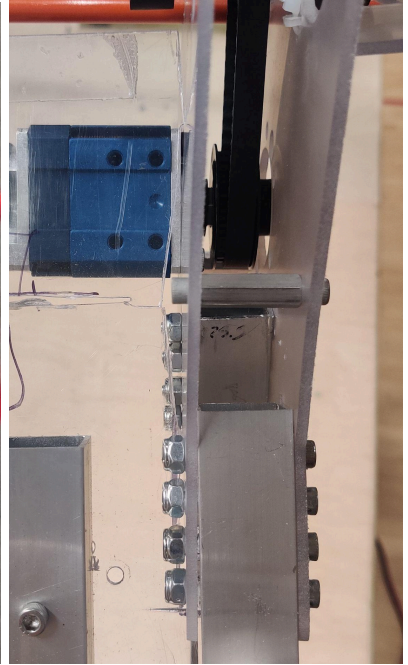
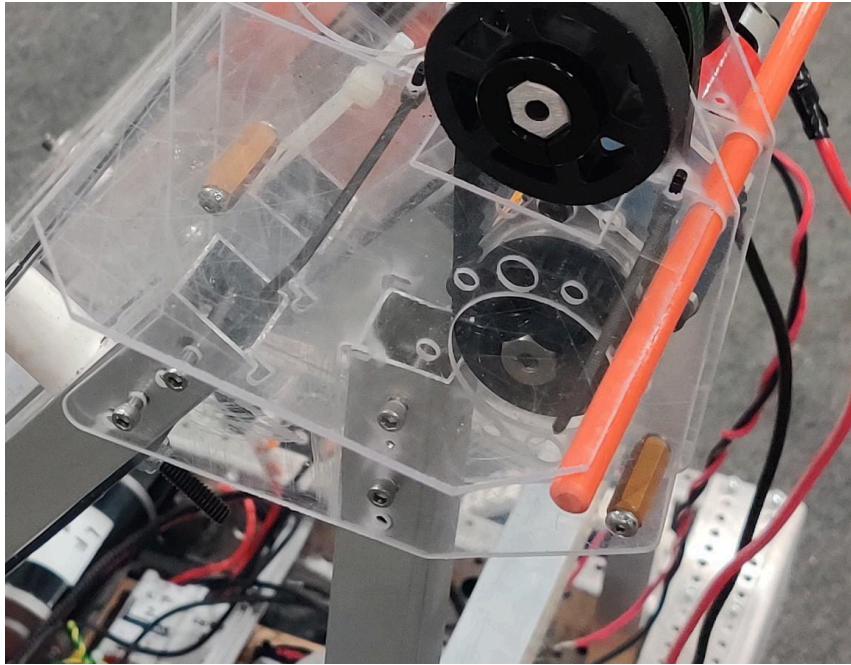
Place the second roller claw plate so the roller shaft fits through the bearing. Screw in the other side of the standoffs using more 1/2" bolts. Add another 0.125" spacer and second squish wheel and cap off the axle with another shaft collar.



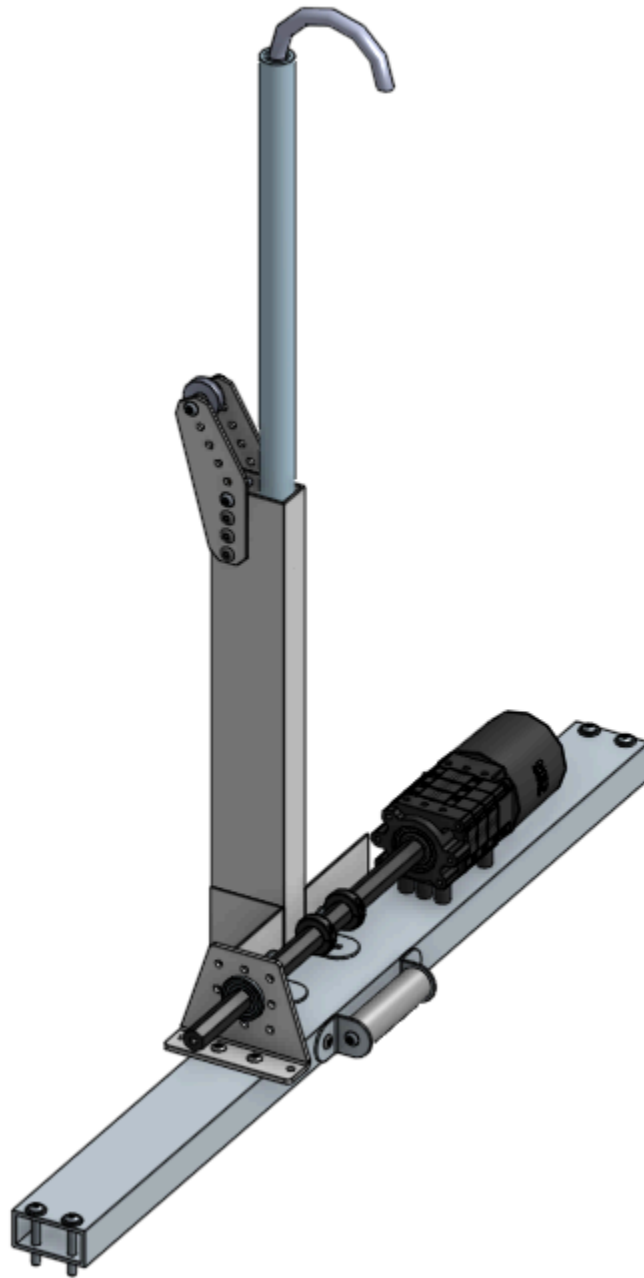
Push the 14" fiberglass rod through its designated holes. Use a small zip tie to tie the fiberglass rod to the zip tie holding the front of the horizontal support plate. A strip of tape is wound around the fiberglass rod between the two plates to hold it in place.



The Everybot roller claw attaches in place of the bracket in the upper right corner of the KitBot launcher mechanism. Remove the bolts or rivets holding it in place and remove the gusset. Cut about an inch off of the right side of the lower launcher plate so that there is room to install it. Position the two plates of the roller claw in position over the same holes the gusset was in, using the alignment slots in the plates to ensure it is positioned correctly. Attach the claw with at least four 10-32 1-1/2" bolts, two in each support, through both plates and both pieces of box tube.



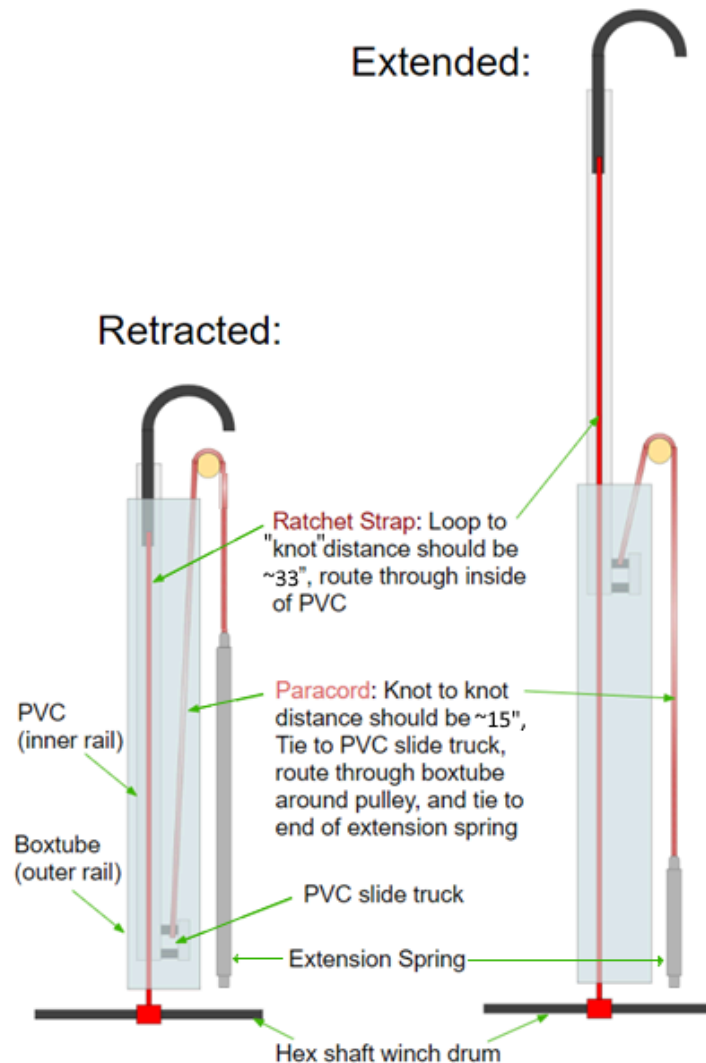
Everybot Climber



Climber Architecture

The Everybot climber uses a 2" x 1" box tube as the outer tube of a telescoping system to lift a hook up to the Stage chain. The inner tube is a 1/2" schedule 40 PVC pipe, pulled upward by

extension springs routed around the top of the robot by paracord. The height restrictions of this year's game allow for the climber to start the match already extended upwards and remain that way for the entire match until the robot goes to hang at the end of the match, where the winch winds the ratchet strap up and pulls the hook down (and itself up). The spring pulls the hook back up when the winch unwinds, allowing the robot to retry a missed climb. It is recommended that you generally leave the climber extended so the spring does not wear out over time.



A similar mechanism with different dimensions was used on the 2020 Everybot.

The Everybot's climbing mechanisms can be adapted for a variety of different robot designs other than the KitBot or the "full" Everybot. Considerations may need to be made for the location of the center of gravity of your particular design and how the robot will tilt when the climber begins to lift it. Please visit the [Everybot Discord](<https://discord.com/invite/b3GbxFzkt>) if you have specific issues or questions.

Required Tools

- 3/8" wrench or T-handle
- 5/32" Allen wrench or ratchet
- Drill press (preferred) or hand drill
- Band saw (preferred) or other type of saw
- Vise (ideal)

Climber Materials

Climber:

- Qty(1) x 1" Wide Ratchet Strap (>3 ft long)
- Qty(1) x Spool of 1/8" Paracord
- Qty(1) x 6" Black Spring Link (Carabiner)
- Qty(1) x 1-1/4" Patio Roller Kit
- Qty(1) x Roll of Linerless Rubber Splicing Tape
- Qty(1) x Everbuilt 4.5" Extension Springs (comes in 4 pack with 6.5" springs)
- Qty(2) x TP 3-1/8 in. x 7 in. 20-Gauge Galvanized Tie Plate or larger 90° gusset
- Qty(2) x TP 3-1/8 in. x 7 in. 20-Gauge Galvanized Tie Plate or angled gusset (~135-150°)
- Qty(1) x 2" 10-32 or 8-32 standoff
- Qty(1) x 3" 10-32 or 8-32 standoff
- Qty(4) x 0.5" 10-32 or 8-32 bolts (matching standoffs used)

Winch:

- Qty(1) x NEO motor (or CIM, MiniCIM, etc)
- Qty(1) x 64:1 to 100:1 gearbox (64:1 - 80:1 probably preferred for speed and strength)
- Qty x Gearbox and Support Plate Spacers (if necessary)
- Qty(1) x 1/2" Hex Shaft Coupler (if necessary)
- Qty(4) x Bolts suitable for mounting gearbox
- Qty(2) x 1/2" Hex Collar (two-piece type preferred for at least two)
- Qty(1) x 1/2" Hex Bearing
- Qty(1) x Bearing Support Plate
- Qty(2-4) x Bolts suitable for mounting Bearing Support Plate (10-32 1.5" probably)
- Qty(6) x 10-32 1.5" Bolts
- Qty x #10 washers (4 + quantity for gearbox spacers if not using nylon or similar spacers)

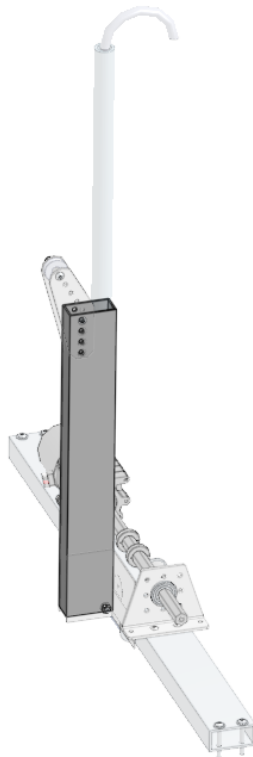
Cut components:

- Qty(1) x 04_Climber_PVC_14"
- Qty(1) x 04_Climber_PVC_Holder
- Qty(1) x 04_Climber_Mount_Beam
- Qty(2) x 1/2" diameter 3" long PVC roller
- Qty(1) x 1/2" Hex Shaft 10" to 12" long

Climber Machining

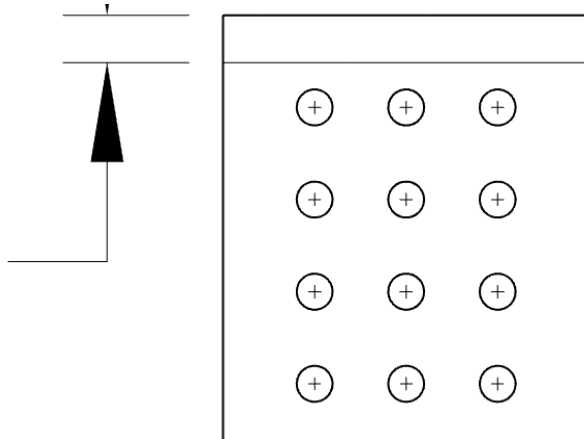
The climber is made from two pieces of 1x2 box tube, some sections of PVC, and some hex shaft, brackets, and whatever motor and gearbox your team has selected. If you are using the suggested pre-drilled box tube, you will not have to add any additional holes but a few holes may need to be widened.

04_Climber_PVC_Holder is the upright portion of the climber and is 14 inches long and cut from the thinner 1/16" box tube. This box tube will hold the 04_Climber_PVC_14" slider.

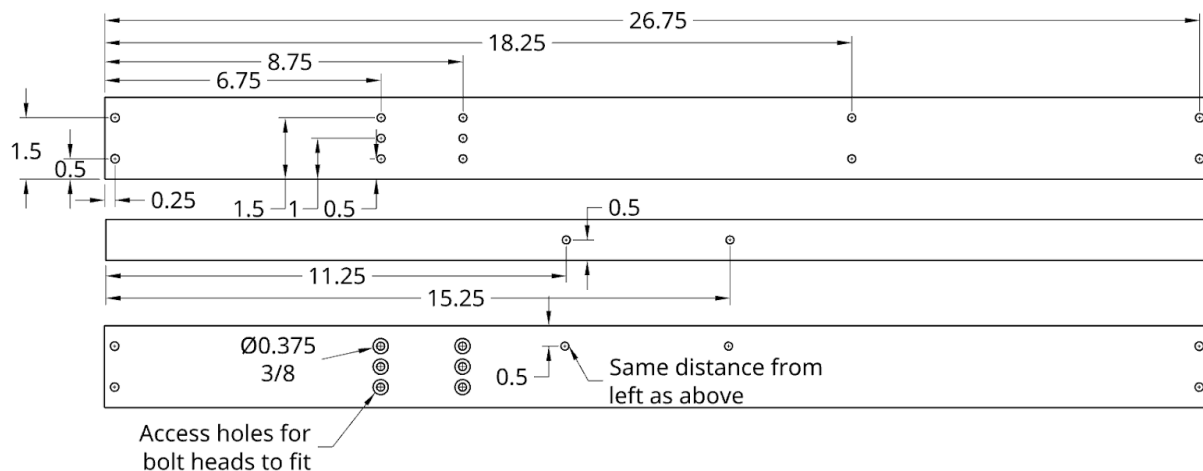


04_Climber_Mount_Beam is the horizontal portion of the climber that mounts to the chassis and holds the gearbox and winch for the climber as well as guides for the ratchet strap. It is 27 inches long and cut from the thicker 1/8" thick box tube. Ideally, this component is made from one of the styles of pre-machined box tube with a hole pattern in it from the factory. If you have this pre-drilled style of box tube, cut it down to 27 inches so that there is a complete set of holes centered 0.25" in from each end (these holes will be used to attach the climber to the frame of the chassis).

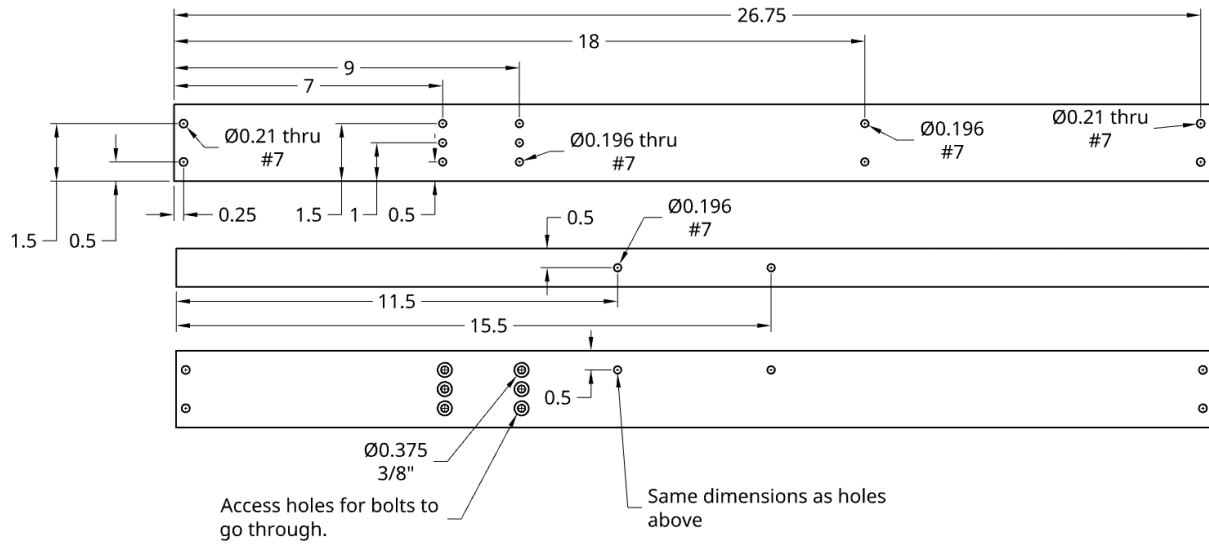
0.25



The positioning of the gearbox and winch support and the two 3" PVC spacers is shown below. The winch and spacers will not be perfectly centered as a result of the hole pattern but as long as the ratchet strap rides over the spacers and up to the winch without pulling to the right or left this will not matter.

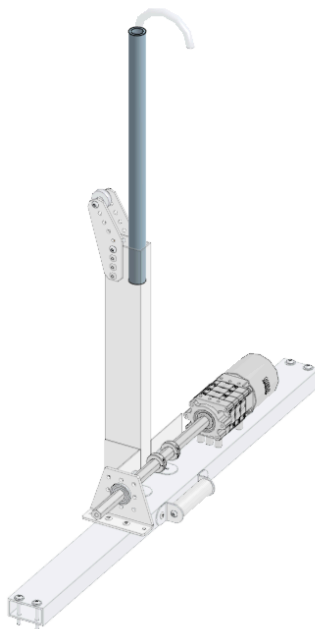


If you are not using pre-patterned box tube, below is a part drawing showing the location of holes for the chassis side rail mounting points, PVC spacers, and suggested gearbox and bearing support locations. The necessity of these holes varies with the exact style of gearbox your team is using (there is no central mounting holes on the sides of CIMSport and VersaPlanetaries, for example). These holes can be properly centered compared to the offset premachined holes above. The exact positioning is less important than making sure the gearbox is well-supported and that the motor and hex shaft are not hanging over outside of the frame perimeter. These gearbox mounting holes should be drilled out to 3/8" on just the bottom face of the box tube so the entire head of the 10-32 bolts used to attach the gearbox can fit freely past the bottom face and clamp the gearbox to just the top face.



Longer (~2") bolts could also be used to mount through both faces of the box tube, but these bolts are not used elsewhere on the Everybot and could crush the box tube if overtightened. If your team prefers, and has some two inch or so 10-32s, you can try mounting the gearbox with bolts through the entire box tube.

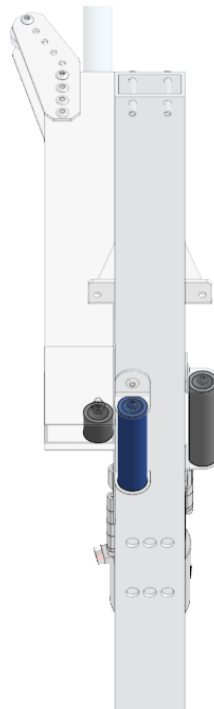
04_Climber_PVC_14" is, as the name suggests, a 14" section of 1/2" schedule 40 PVC. This is the extending section of the climber that the carabiner hook rides in.



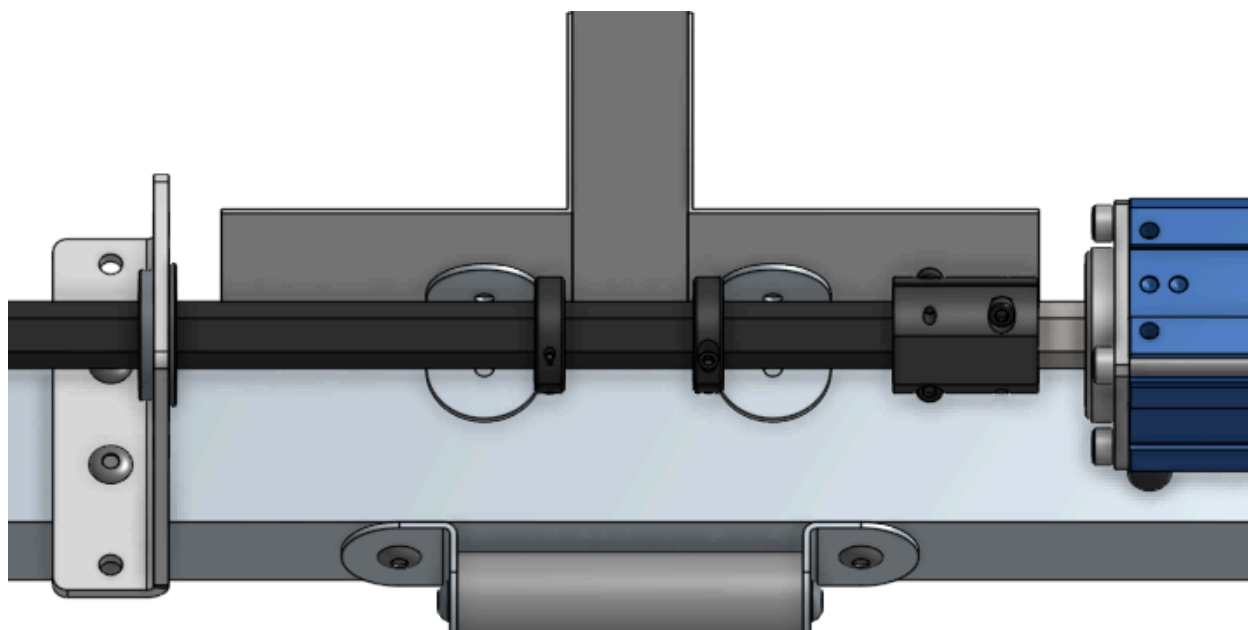
An inch long section of PVC is cut in half and forms part of the sliding mechanism with 04_Climber_PVC_14".



Three PVC spacers are used to guide the ratchet strap around the bottom of the climber and to the winch. Two are three inches long and one is about 0.8" to fit inside the 04_Climber_PVC_Holder (manufacture it to fit snugly inside your box tube for 04_Climber_PVC_Holder). (We used a 2" and 3" roller, but the exact size does not really matter as long as it is wide enough for the ratchet strap plus some travel room side-to-side).



A 10 to 12 inch section of hex shaft will be used for the winch of the climber. If you are using a Max Planetary gearbox, one side of the shaft can be tapped for a 10-32 bolt to affix it to the MAX Planetary output stage. Alternatively, a shaft coupler can be used with the provided output shaft of the Max Planetary. A shaft coupler is also required for the AndyMark CIM Sport gearbox as well as the VersaPlanetary if using the 1/2" hex output instead of the universal female output shaft.



(Example with AndyMark CIM Sport gearbox)

Climber Gearbox and Motor

The climber gearbox can be made from a variety of common FRC gearboxes and powered by a range of motors. CIM Sport, MAX Planetary, and VersaPlanetary gearboxes can all be used, with a handful of variances between setups. Different brackets can also be used to hold the 1/2" hex bearing used to support the other side of the climber winch shaft. As long as a decently long portion (four inches should be more than enough) of the shaft in the middle of the overall 04_Climber_Winch_Beam is open for the ratchet strap to be anchored around and held in place using split hex collars, the exact positioning of the gearbox and bearing support is not critical to functionality.



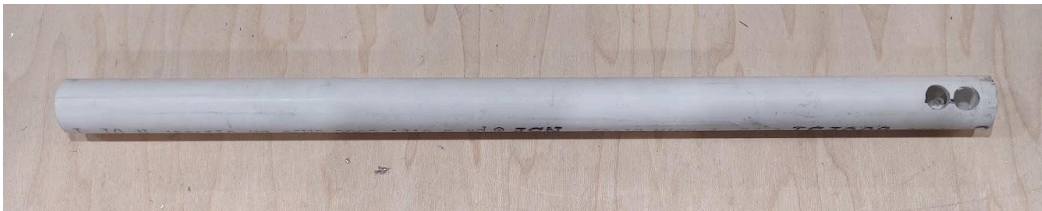
If you are using a REV MAX Planetary gearbox, tap one end of the winch hex shaft for a 10-32 bolt and bolt it into the output stage of the MAX Planetary. The gearbox will remain attached to the shaft throughout the rest of assembly, which is not shown in the photos below (we used a CIM Sport gearbox). Alternatively, a 1/2" hex shaft coupler can be used. A shaft coupler is required to connect the AndyMark CIM Sport gearbox to the hex shaft. A VersaPlanetary Universal Female Output Shaft and 1/2" hex adapter or a 1/2" hex output and 1/2" hex shaft coupler can be used with the VersaPlanetary. A VersaPlanetary Parallel Mount may be used to face mount the gearbox (as well as being one option for the bearing mount on the other side of the winch shaft).

Climber Assembly

On one end of the 04_Climber_PVC_14" pipe drill two $\frac{13}{64}$ " holes approximately $\frac{1}{2}$ " apart. The best way to ensure these holes remain straight and go directly through the center of the pipe is to clamp it into a drill press and look from the side to ensure you will be drilling directly through the center of the pipe.



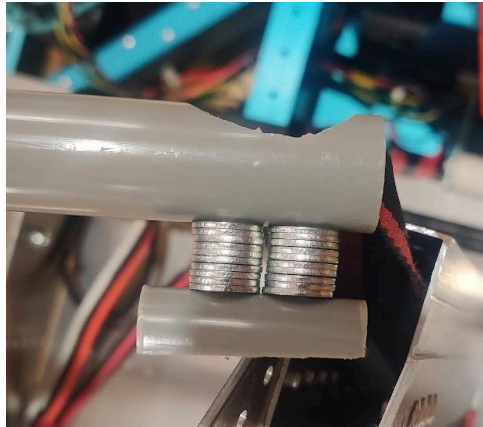
On one side of the PVC, drill these holes out to $\frac{3}{8}$ " to fit the heads of a 10-32 1" bolt. If desired, these two larger holes can be combined into one larger slot for convenience.



Cut an inch or so section of $\frac{1}{2}$ " PVC pipe and then cut it in half down the diameter of the pipe so it forms a half circle. Drill the same two $\frac{13}{64}$ holes $\frac{1}{2}$ " apart in this small piece of PVC.



Insert two 10-32 1" bolts through the large holes in the 04_Climber_PVC_14" and stack up approximately 10 #10 washers on each bolt. Insert the cutoff half PVC section over the ends of the bolts so it curves away from the longer PVC pipe. Bolt the short section into place. This will form a "slider" that will ride inside the 04_Climber_PVC_Holder. Check that the slider does not bind up with the box tube and if necessary add or remove some washers from each bolt.



Cut the hook off the end of the ratchet strap using a bandsaw and vise grips or a hacksaw and a vise, or pull the loop of the hook open enough to be able to pull the strap out of the hook. Leave the pre-sewn loop in the end of the strap as it will be used to attach the ratchet strap to the winch hex shaft. Cut the ratchet strap down to about 35" long from the unlooped side, erroring on the side of being longer.



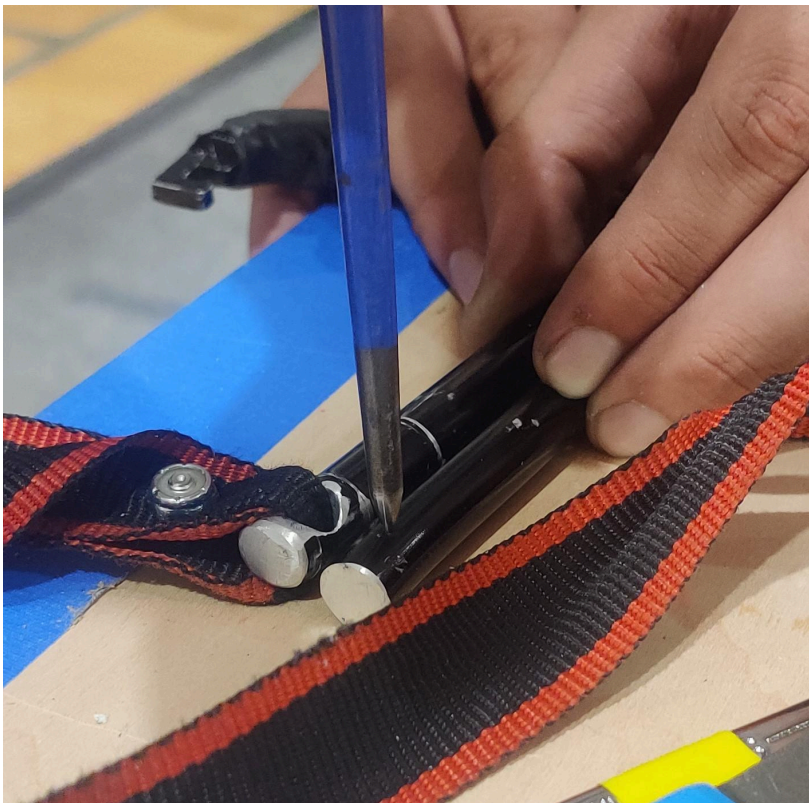
Feed the ratchet strap up through the 04_Climber_PVC_14" so the end with the loop ends up near the slider at the bottom of the 04_Climber_PVC_14" and the free end is sticking up out of the top of the PVC. Leave some slack on both ends so the strap does not accidentally pull back through the pipe.



Cut the carabiner hook off towards the bottom of the spring-loaded side of the carabiner, leaving a hook shape. This can also be done in a vise with a hacksaw.



Mark a divet about half an inch up from the cutoff end of the carabiner.



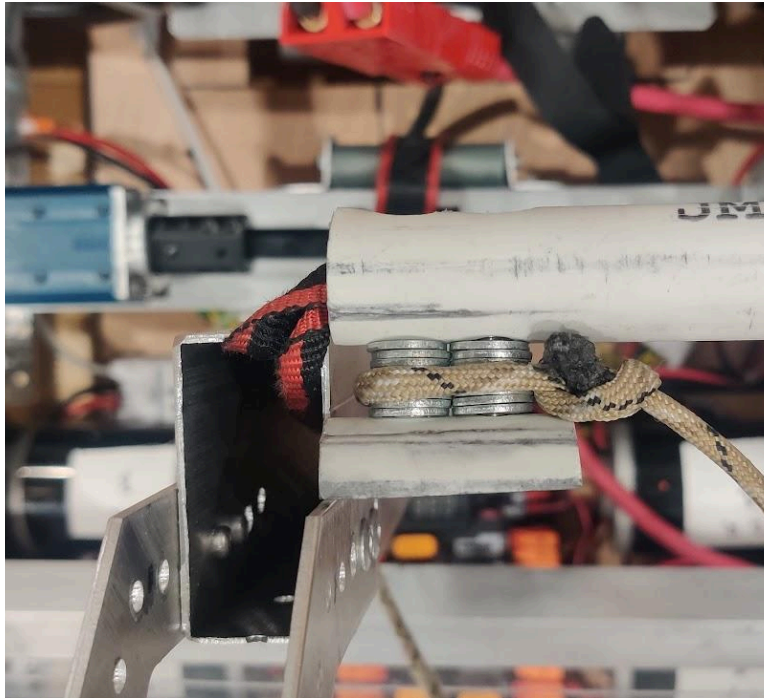
Clamp the hook in a vise and drill out a $\sim 9/32$ " hole at the marked location. Make sure to keep the hole relatively centered and straight so it does not break through the side of the carabiner.



Feed the strap through the hole in the hook and loop it back through. Poke or drill a hole in the two layers of strap and bolt the two layers together with a button head 10-32 5/16" bolt with #10 washers on both sides so that the bolt does not pull through the strap. Wrap the hook with linerless rubber splicing tape to prevent it from slipping on the chain.

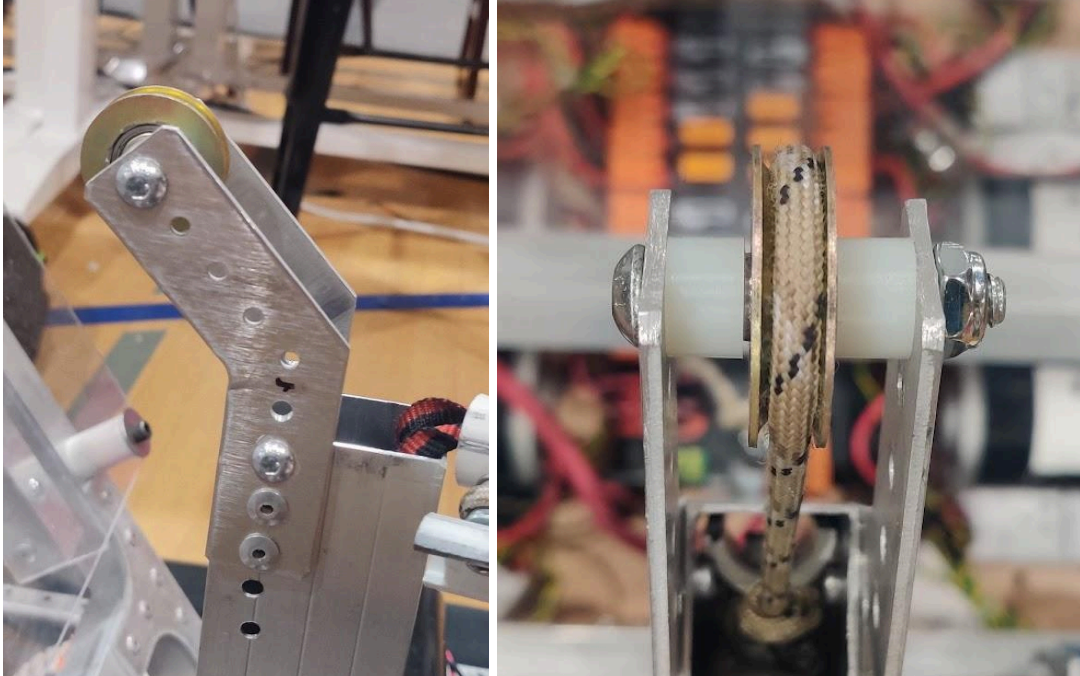


Tie one end of the paracord around the bolt and washer stackup in the PVC slider. Feed the assembly down through the 04_Climber_PVC_Holder so that the slider and looped end of the ratchet strap end up at the bottom of the box tube and the hook and the loose end of the paracord are hanging out of the top of the PVC and box tube.

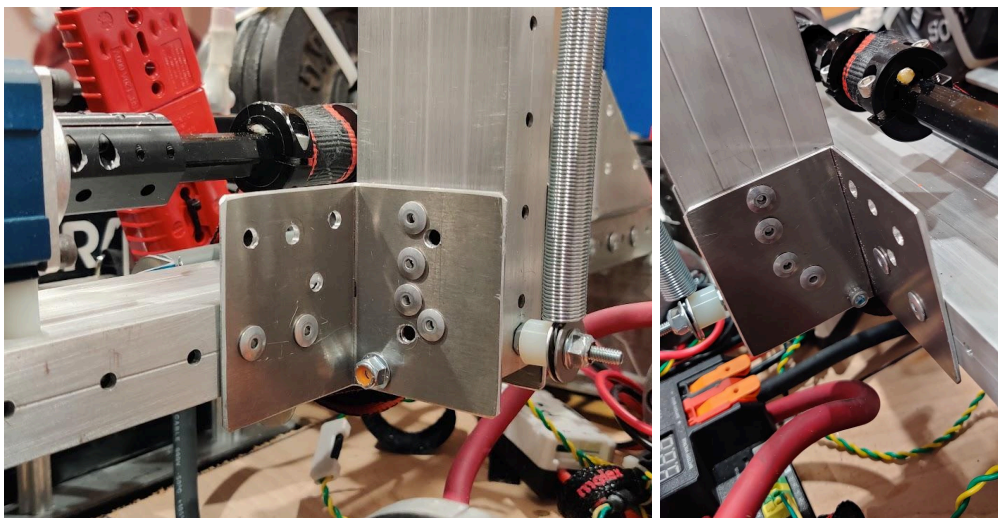


Thread the winch hex shaft through the ratchet strap loop. Later on this loop will be held in place to prevent it from just spinning freely around the shaft.

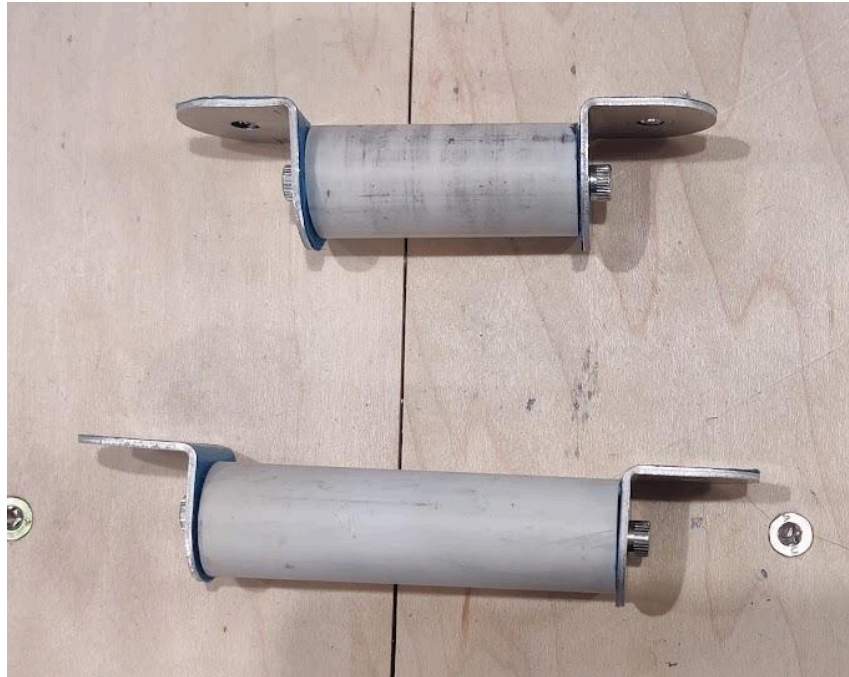
At the top of 04_Climber_PVC_Holder attach a pair of cut-off tie plates or angled gussets and install the patio door roller between them on a 10-32 1.5" bolt with two 0.3" spacers so that the paracord has a pulley to ride over. If you install a 10-32 1.5" bolt as the top mounting point in these brackets it will hold the climber slide inside the tube and prevent it from accidentally coming out, as well as making the slide a little bit more stable in the tube.



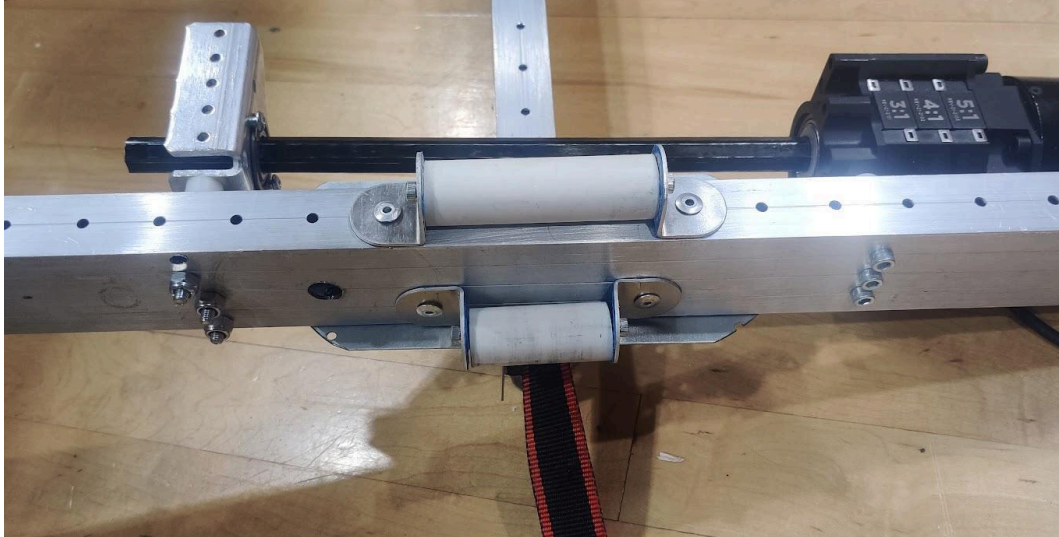
The 04_Climber_PVC_Holder can be attached to the 04_Climber_Mount_Beam using bent tie plates, purchased gussets, or angle stock with holes drilled through them. Be careful to hold the ratchet strap out of the way when drilling so it does not get drilled through or tangled up in the bit. The upright box tube does not actually support the weight of the robot when climbing, it only serves to keep the PVC slider and ratchet strap vertical, and once the ratchet strap is taught the weight of the robot is being transmitted through the strap. A 10-32 1.5" bolt with the ~0.8" PVC spacer cut previously at the bottom of the tube will help the ratchet strap roll around the bottom of the climber.



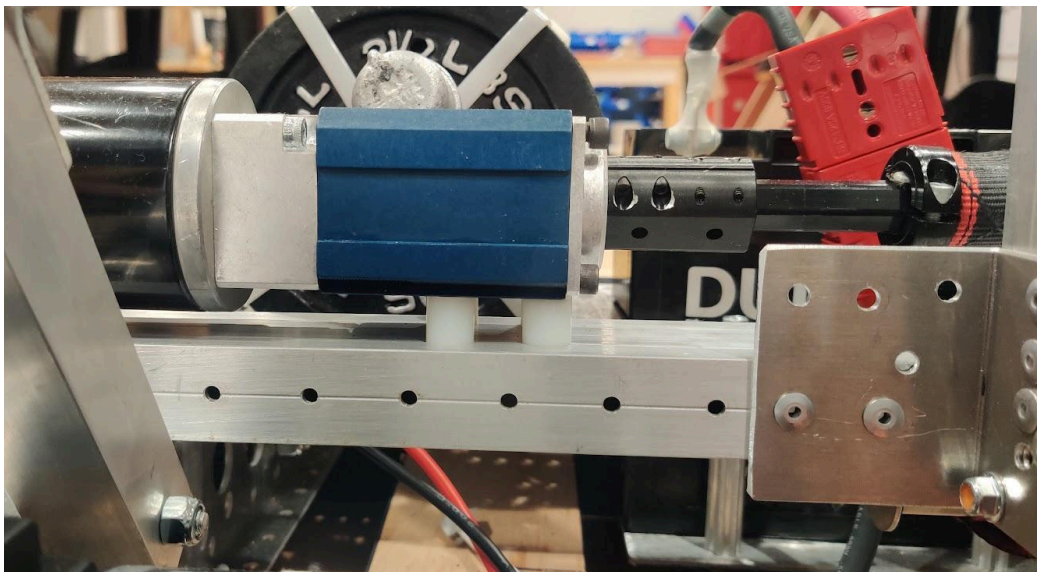
Construct the two other PVC spacers for the ratchet strap to ride around. We used a two inch and three inch spacer, but two three-inch spacers are recommended. The spacers have three inch long 10-32 standoffs inside with two 90 degree brackets bolted to each side with two 10-32 0.5" bolts. These spacers should ideally not roll.

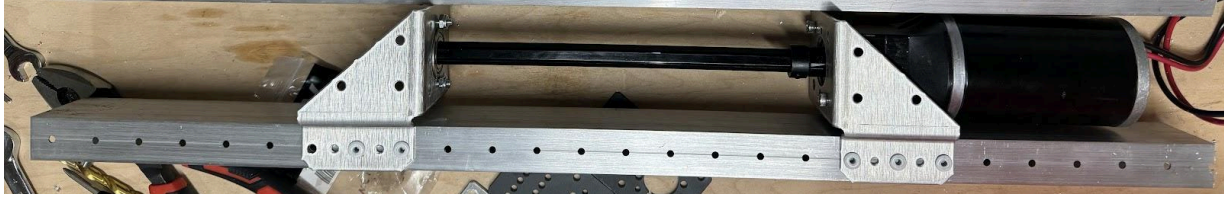


One spacer sits under the 04_Climber_Mount_Beam towards where the ratchet strap exits the box tube on the two inch face. The other spacer is mounted to the rear face of 04_Climber_Mount_Beam so the ratchet strap can be fed around it and to the winch mounted on the top. If you are using pre-patterned box tube, center the spacers as best you can in the existing holes so the ratchet strap will not hang over on either side. If not using pre-drilled tube, drill two #7 holes half an inch up from the front side of the box tube where the 04_Climber_PVC_Holder will be mounted that are four inches away from each other and rivet the brackets on the spacer into place. On the opposite side face from where the 04_Climber_PVC_Holder is mounted, drill out two #7 holes four inches apart and centered across the 1" face of the 04_Climber_Mount_Beam so the roller is approximately centered along the long face and is in line with the 04_Climber_PVC_Holder. Rivet the spacers into place.

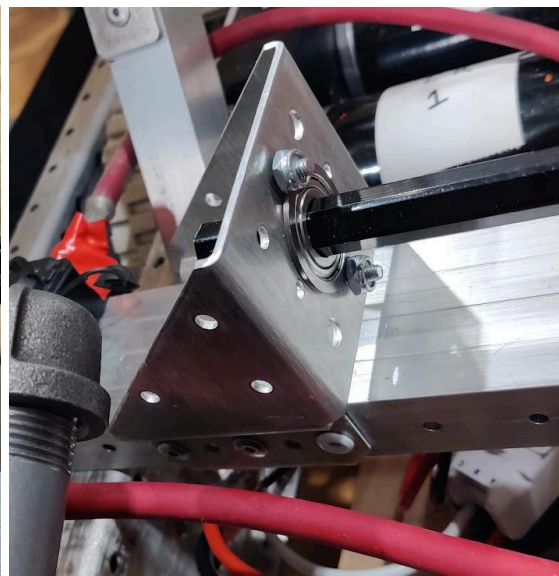


Whichever gearbox your team is using can also be bolted down to the 04_Climber_Mount_Beam. If you have not already done so, make sure the loop of the ratchet strap is through the winch hex shaft. If you are using pre-machines box tube, there should already be appropriate holes in a serviceable location on 04_Climber_Mount_Beam. Widen the holes on what will become the bottom face so that the bolts can be floated through the bottom face and clamp against just the top face. (Alternately, your team can use longer (~2") bolts to mount the gearbox through both faces of the box tube, being careful to not crush the box tube inwards when tightening it) Add spacers or washers to the bolts to bring the gearbox up to an appropriate height to mount horizontally on the 04_Climber_Mount_Beam. An alternate gearbox mounting bracket may also be used for some gearboxes like the VersaPlanetary.

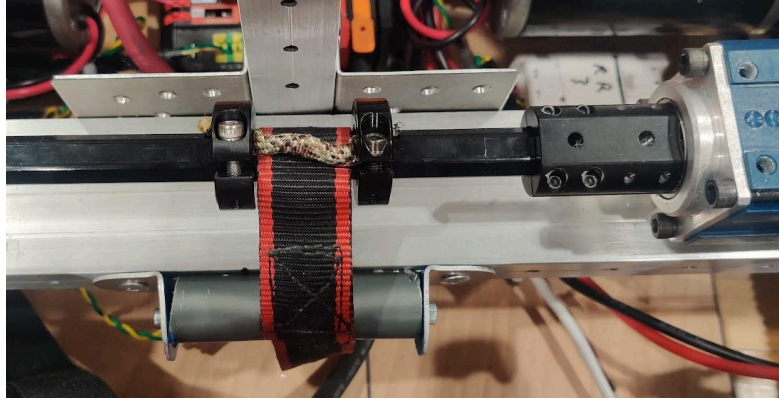
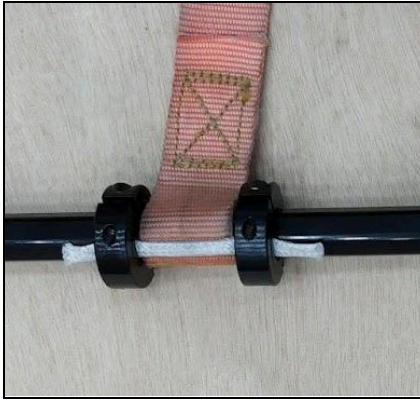




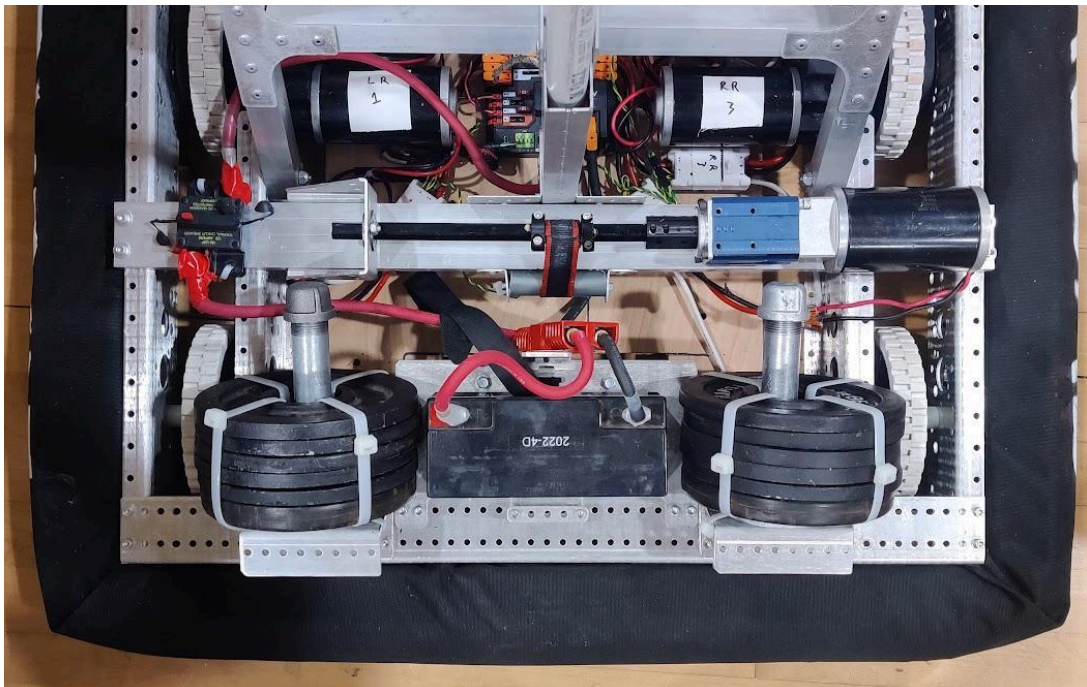
Whatever hex bearing support bracket your team has purchased or made can be installed towards the unsupported end of the hex shaft. Clamp the bracket in place and match drill out appropriate mounting holes if they do not already exist. Add spacers or washers if necessary to bring the hex bearing up to the correct height, insert the bearing over the hex shaft and into the hole, and trap it in place using a shaft collar, rivets, bolts, or similar means.



Position the loop of the ratchet strap on the hex shaft so it is in line with where it comes out of the tube. Cut a short piece of paracord wider than the width of the ratchet strap and sandwich it over the ratchet strap and between the hex shaft and two clamping hex shaft collars. This paracord will stop the ratchet strap from just spinning freely around the winch when the winch runs.



The 04_Climber_Mount_Beam is bolted to the frame using four 10-32 1-1/2 bolts, two on each side, in the 10th and 11th holes from the back of the chassis. Use #10 washers to help prevent these bolts from pulling through or crushing the box tube. If you are using pre-machined box tube, these holes should already be in place. If not, mark two holes an inch apart and half an inch in from either side of the two inch face that are 0.25" in from the open end. It may end up lining up better if you drill out the two holes on one side, bolt that side in place, and then match drill up through the bottom of the chassis, removing the climber assembly and drilling up through the top face if your drill can only reach the bottom face through the chassis.



The climber motor is plugged into a motor controller that we positioned under the 04_Climber_Mount_Beam. In our provided code this is a Spark MAX with the CAN ID 7. If using the NEO in the Rookie kit of parts (or purchased separately), a Spark Max is required to control it and must be located close enough to plug in the hall effect sensor cable from the motor into the

controller. When the motor controller is set to brake mode, we found that a CIM motor in a 64:1 CIMSport had sufficient resistance to hold the robot up without any ratcheting mechanism. If your robot droops down on the chain when powered on and in brake mode, a 1/2" ratcheting wrench (preferably with a reversible ratchet pawl so it is easier to reset) can be added to the hex shaft to hold the robot up when climbed, as long as you are careful to not continue to run the climber too far past its end of travel as the ratchet will begin to bind.

The winch should be unwound to the starting configuration after every match that a climb is attempted. Do not attempt to enable the robot directly after a match, please wait until you return to your pit. Whenever enabling the robot inside your pit, make sure to chock up the robot such that the wheels are not touching anything. Even if you do not expect to use the drivetrain, an accidental stick press or dropped controller could result in injury.

Everybot Electrical

The Everybot electrical system can be wired using wire and connectors included in the Kit of Parts, with the electrical components coming in the Rookie Kit of Parts or retained from previous seasons for non-rookies. Two additional Spark Max or other motor controllers are necessary to power the additional Everybot motors added to the FIRST KitBot's six motors. The electrical system can be wired using whatever legal combination of newer REV and older CTRE control system components your team has. Rookie teams receive a full system of the newer REV control system components which this guide will primarily focus on because it is assumed that teams with older control systems have some experience with FRC wiring.

[How to Wire a Robot video from FIRST](<https://www.youtube.com/watch?v=IGglhxYuSHM>)

For more visual aid we highly recommend watching this video. Wiring a battery, main breaker, motor controllers, the roboRIO, RSL (Robot Signal Light) and CAN bus is covered.

[Introduction to FRC Robot Wiring](<https://docs.wpilib.org/en/stable/docs/zero-to-robot/step-1/intro-to-frc-robot-wiring.html>)

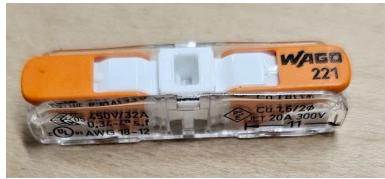
A that FIRST linked that we also want to echo. Here are two large pieces of information when using this resource:

- Use CAN over PWM, we have had issues with SPARK MAXs in PWM mode and found CAN to be significantly more reliable
- We heavily recommend using inline

[WAGO](<https://www.andymark.com/products/wago-221-series-inline-splicing-connector-with-lever>) [connectors](<https://www.revrobotics.com/rev-15-2491/>) over the quick disconnect crimps included in the Kit of Parts as they are easier to implement and require less training and no crimping.

tip

****If you plan on using the quick disconnects included in the kit, please see our [video](TODO: add crimping video) on crimping them****



WAGO (requires no crimping)



Quick disconnect (requires crimping)

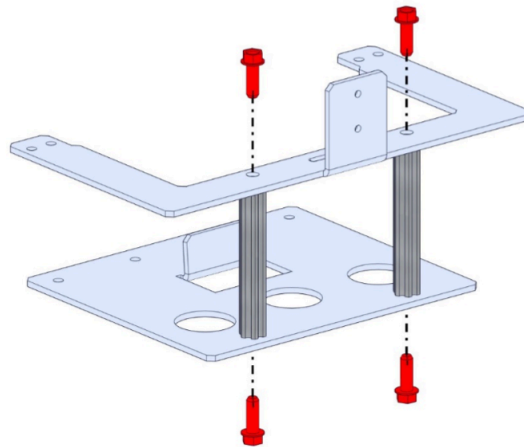
tip

For more tips on navigating this resource please the Everybot Evergreens electrical section.

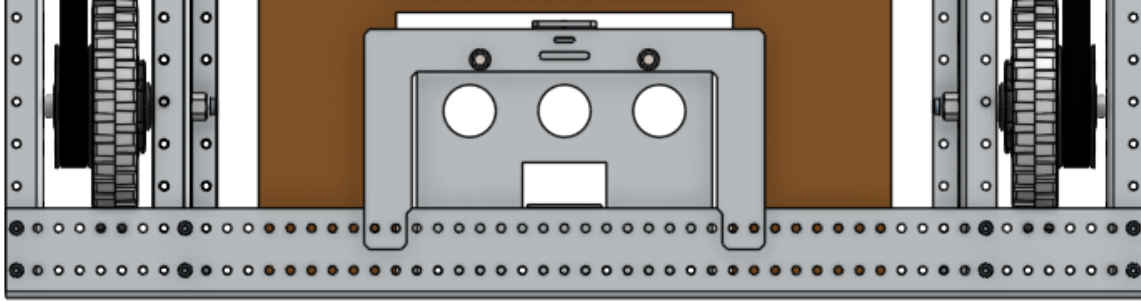
Battery Bracket

The battery bracket is included with the AndyMark Kit of Parts Chassis that you most likely received in your kickoff kit on kickoff. We will include instructions for assembling the battery bracket but the [official AndyMark instructions](<https://cdn.andymark.com/media/W1siZiZlsljWmJAvMDEvMDMvMTgvMjgvNDUvYmFhYmY4ZTUtZjEzNC00ZDRILTg3MTMtOWM0ODMzNzQ4OTJjL0FNMTRVNCBCYXR0ZXJ5IFRyYXkgQXR0YWNobWVudC5wZGYiXV0/AM14U4%20Battery%20Tray%20Attachment.pdf?sha=362671bd2d9d78da>) can be found in the linked text. Some of the images and text in the following section come from the AndyMark manual.

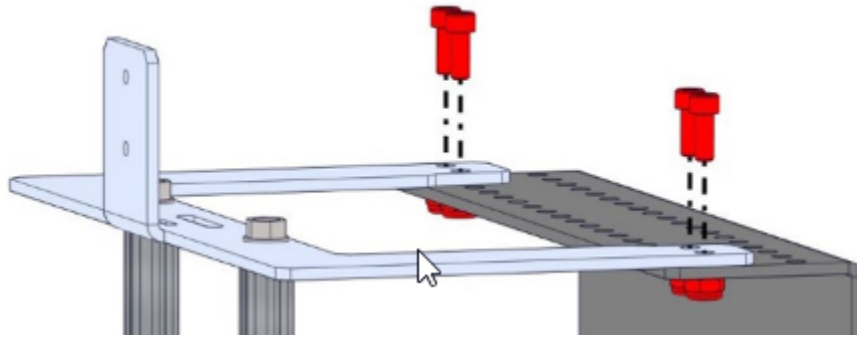
“Place two 3.375” Churros (am-2569) between the Bottom Plate (am-3959) and the C Plate (am3958). Secure the Churros to the plate with four 1/4-20 x 0.750” Thread Forming Screws (am-1310). Make sure the tabs on both plates are pointing upwards.” - AM instruction



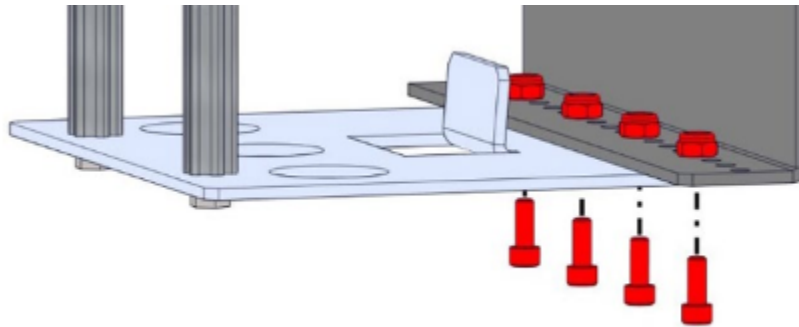
The bracket is installed slightly off center in the back of the robot (the opposite side from the scoring mechanism). Looking at the rear Chassis End Plate from behind the robot, the leftmost hole in the top plate of the AndyMark Battery Bracket should be located in the 18th hole along the Chassis End Plate top flange when counting from the left edge to the right. This will be 8.75” away from the left side of the chassis when viewed from the back. Make sure the top plate is on top of the Chassis End Plate upper flange and the lower plate is below the Chassis End Plate lower flange.



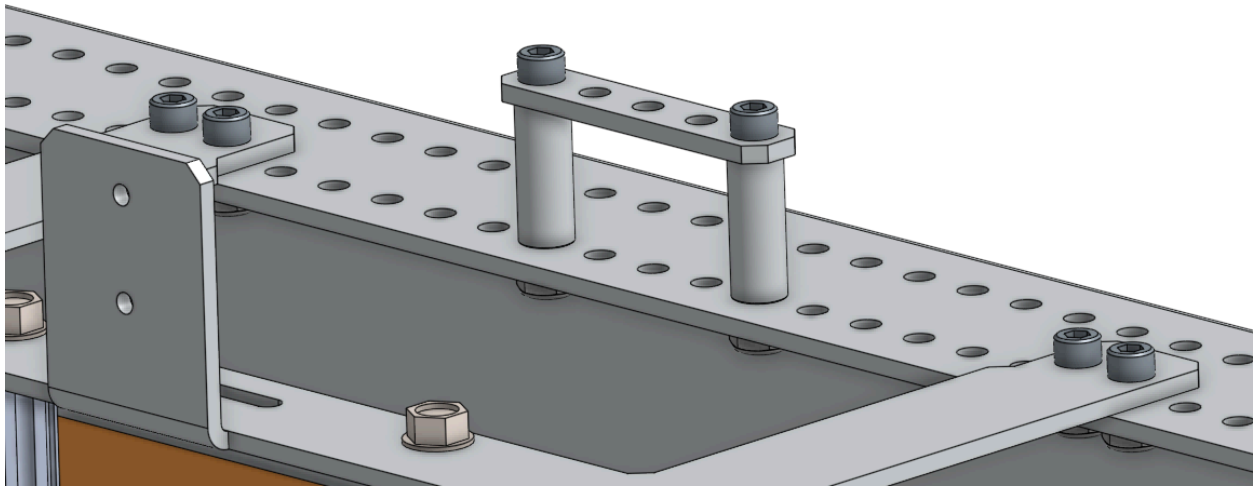
Use four 0.5" 10-32 socket head bolts to secure the top plate to the chassis. The socket head should be pointed up, with the nylock nuts on bottom. The bolts use a 5/32" allen key and the nuts require a 3/8" wrench, ideally a ratcheting one.



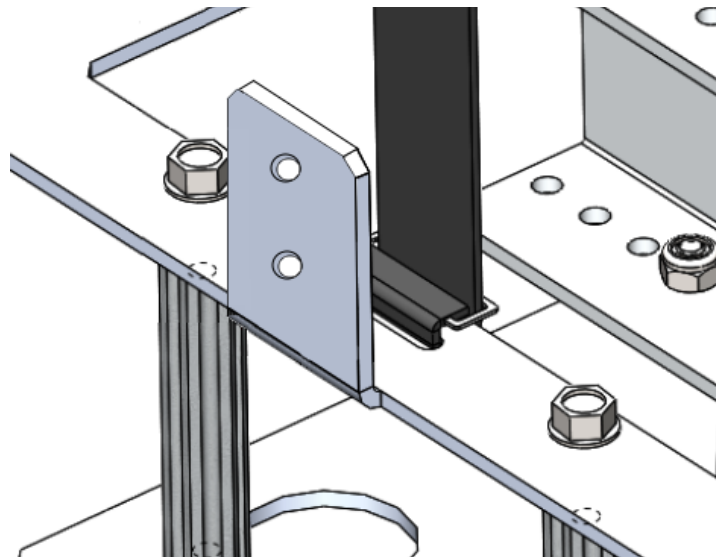
Use four 0.5" 10-32 socket heads to secure the bottom plate to the chassis, this time with the bolt head facing the floor.



Next install the battery clamp, which is the strip with 5 holes, on top of the cylindrical spacers with the 1.5" 10-32 bolts with nylock nuts underneath. There should be five open holes from the plate to one side of the top battery plate to the location of the battery clamp.

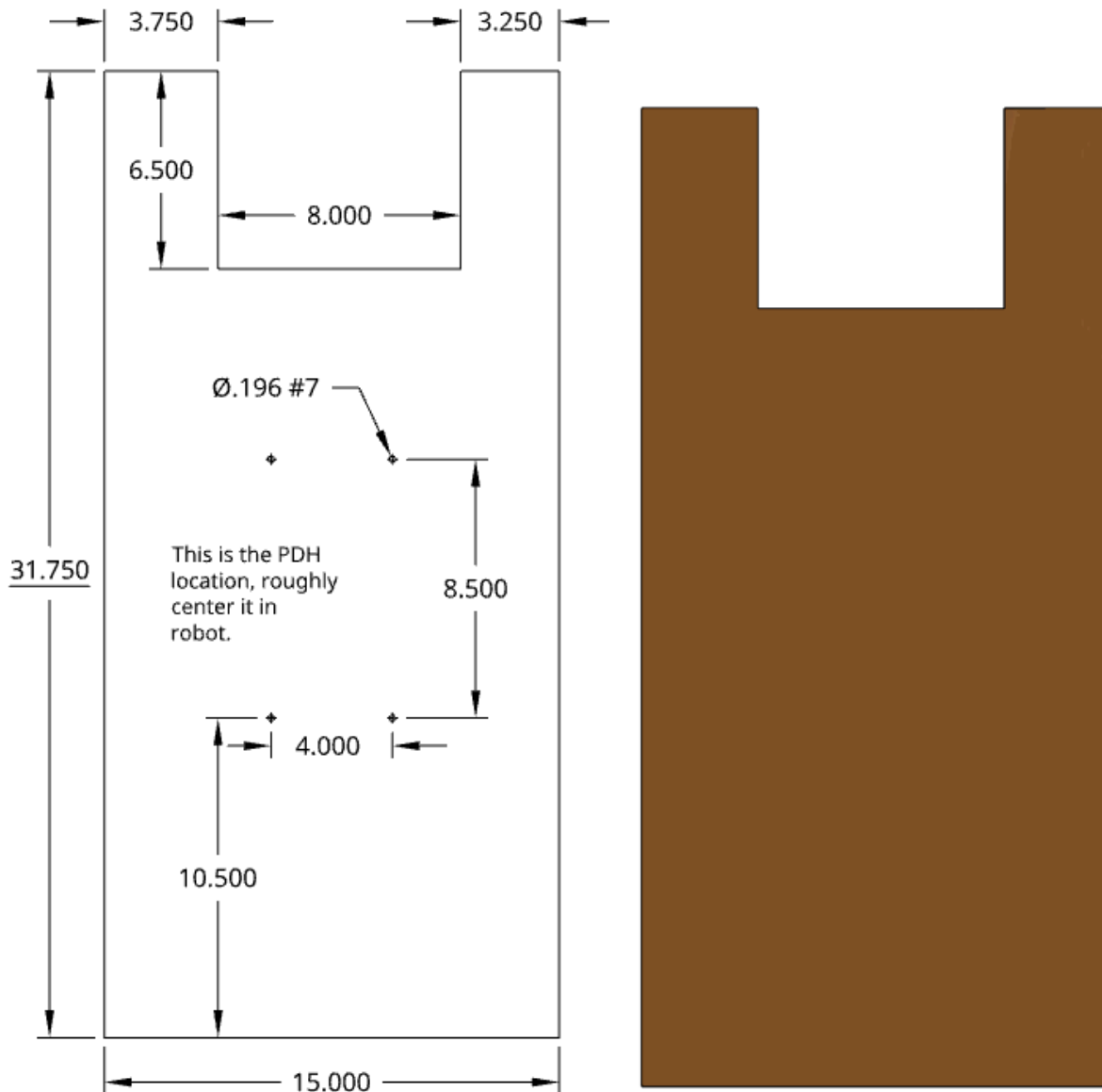


"Feed the battery strap through the top of the slot, loop around and through the buckle. This strap can be left permanently attached to this bracket." - AM instruction

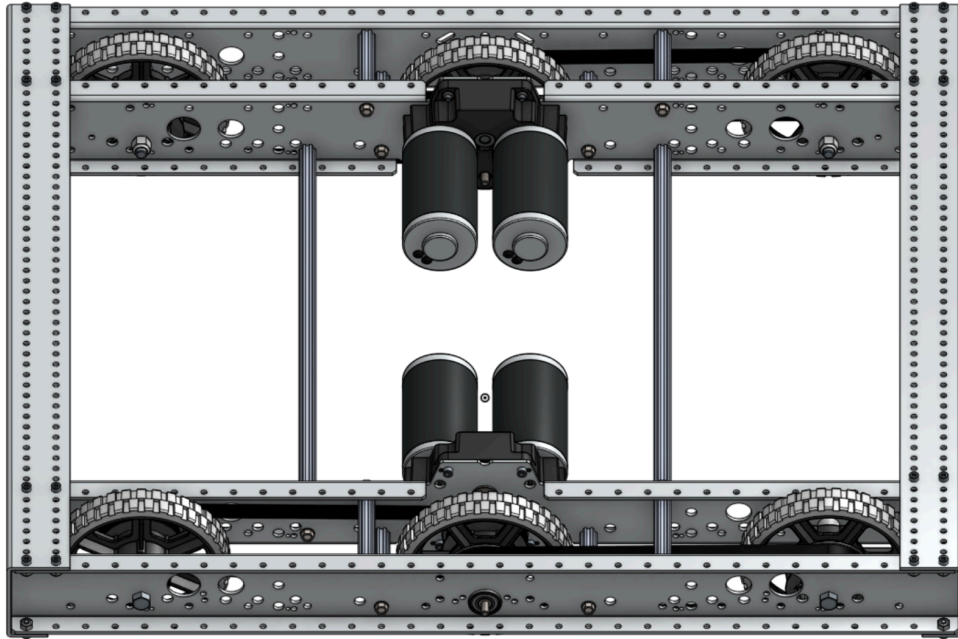


Bellypan

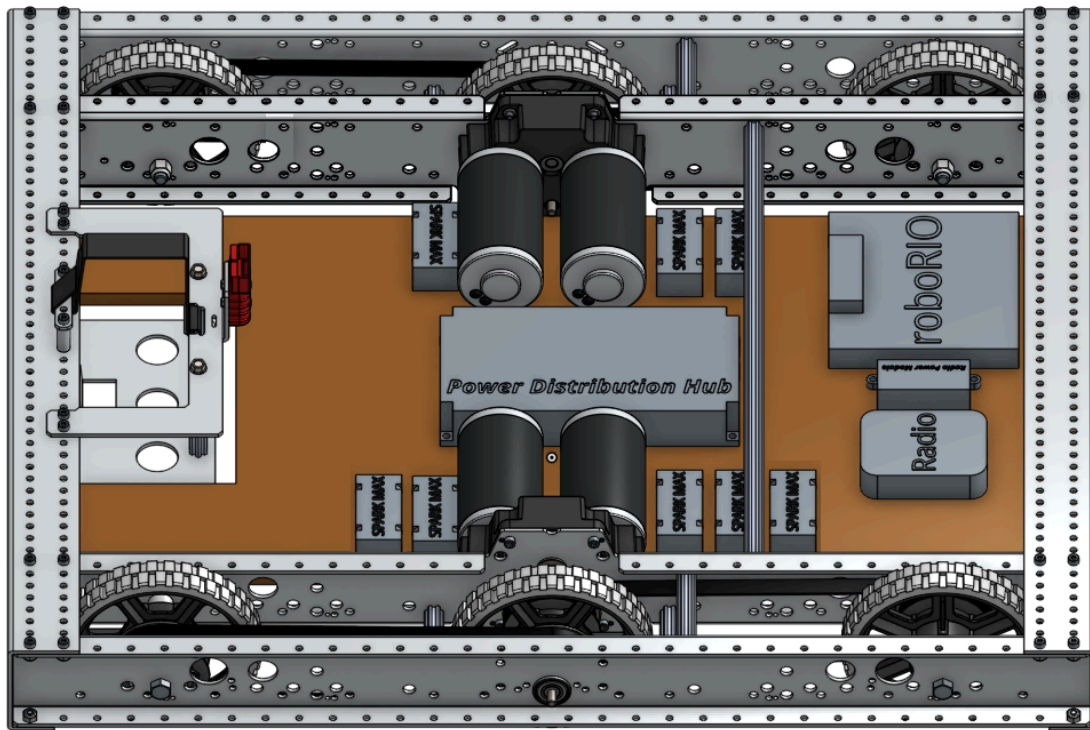
The KitBot shopping list includes a sheet of 1/2 inch thick plywood intended to be cut down to form the bellypan and electronics board of the robot. The plywood sheet should be cut down to 15" by 31.75" to fit within the chassis with an 8" wide and 6.5" deep cutout located 3.75" from one side and 3.25" from the other to fit around the battery bracket.



The easiest way to install the bellypan is to slide it in from the front or rear of the chassis with the front or rear end plate removed. If you have referenced the KitBot CAD, the churros across the inside of the chassis may be positioned too low and interfere with the bellypan. Move the churros up to the Everybot recommended holes to accommodate the Everybot climber.



FIRST official KitBot CAD churro locations
(these have since been moved, but one must still be removed)

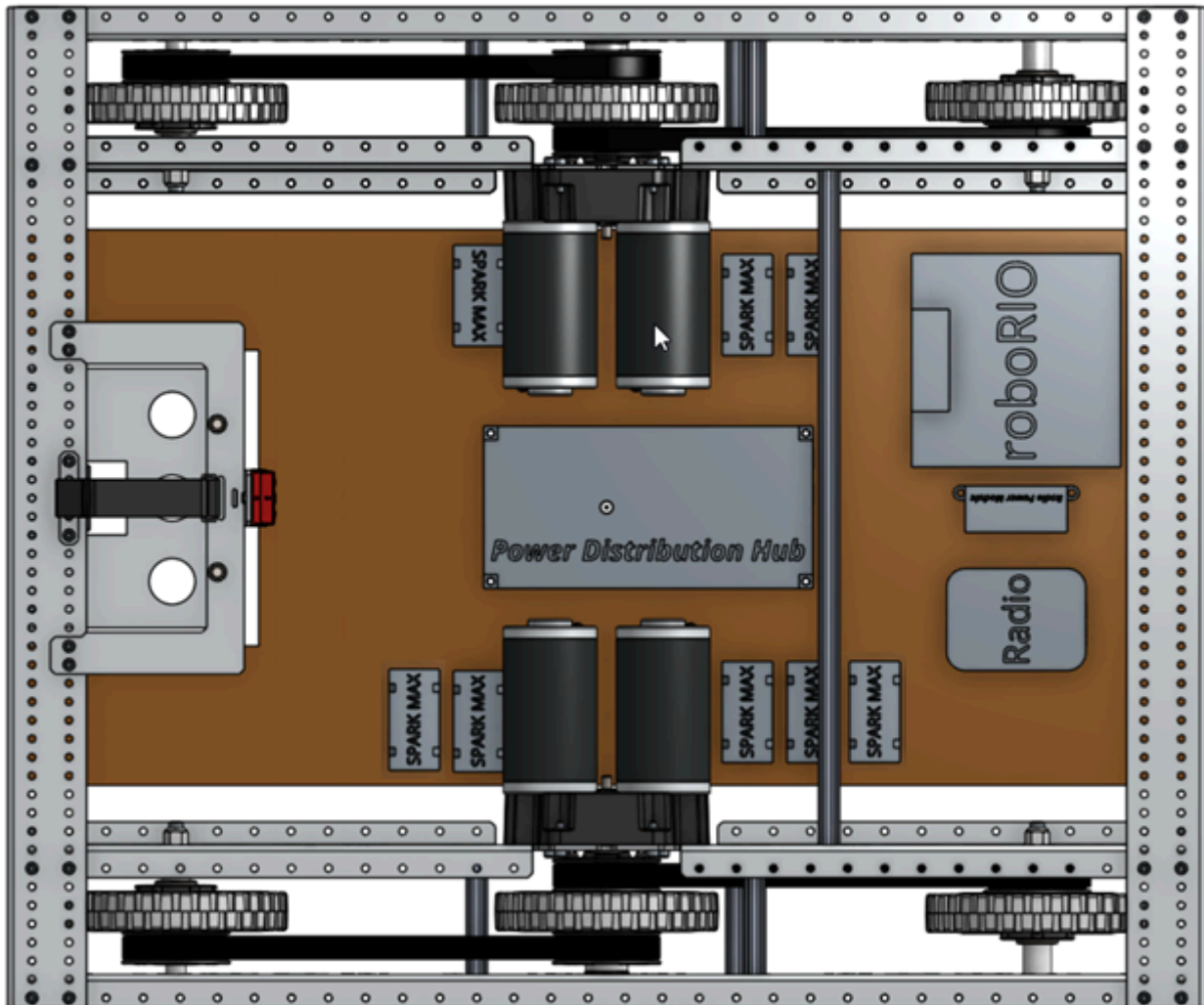


Everybot churro locations

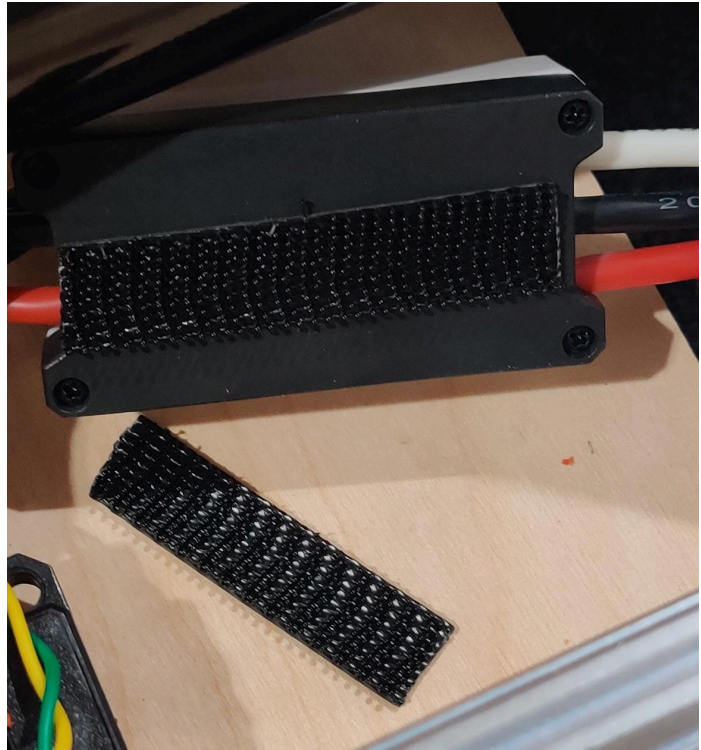
The bellypan should be bolted down to the Chassis End Rails to keep it from shifting around inside the robot. We used four 10-32 x 0.75" bolts towards each of the four corners of the plywood bellypan. The easiest way to do this is to turn the robot on its side and use a #7 drill bit to match drill through a hole in the Chassis End Plate bottom flange where there are no electrical components. Have someone else hold the bellypan down in the frame so that the drill goes directly into the wood instead of pushing the bellypan up into the chassis, being sure to keep their hands away from where the drill bit will come through the wood. Install the bolts one at a time after drilling the holes to ensure all four holes will end up lining up. Insert them from the bottom so just the head of the bolt hangs down below the frame.

Component Layout

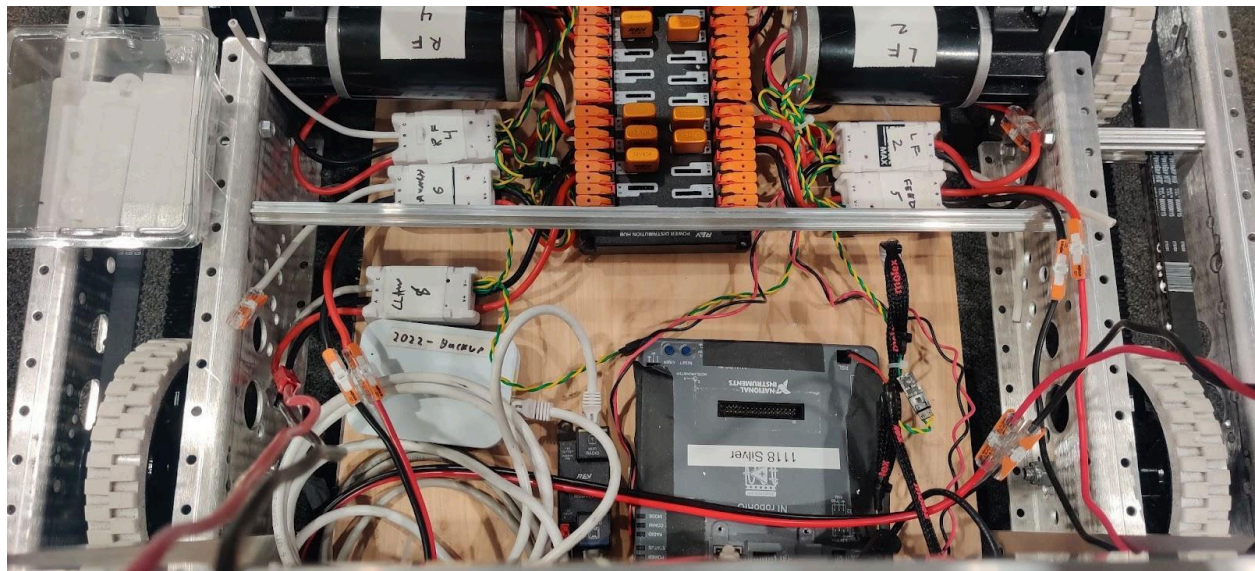
The component layout shown and described here is merely one potential layout and your team can choose to lay out your electrical system in any sensible way you want. The Everybot layout is expanded from the KitBot layout described here.



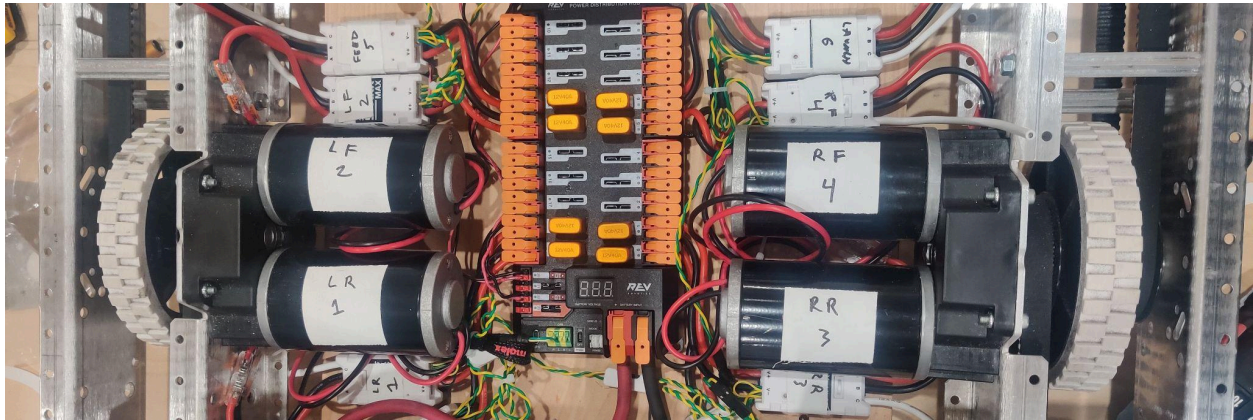
We attached our components using a mix of zip ties through hand-drilled holes in the 1/2" plywood and stickyback dual lock (included in the Kit of Parts) for ease of installation and component removal if necessary. A more secure mounting system may be desirable for a competition robot that will see heavy use and collisions. Zip ties around or through mounting features of components are a good option.



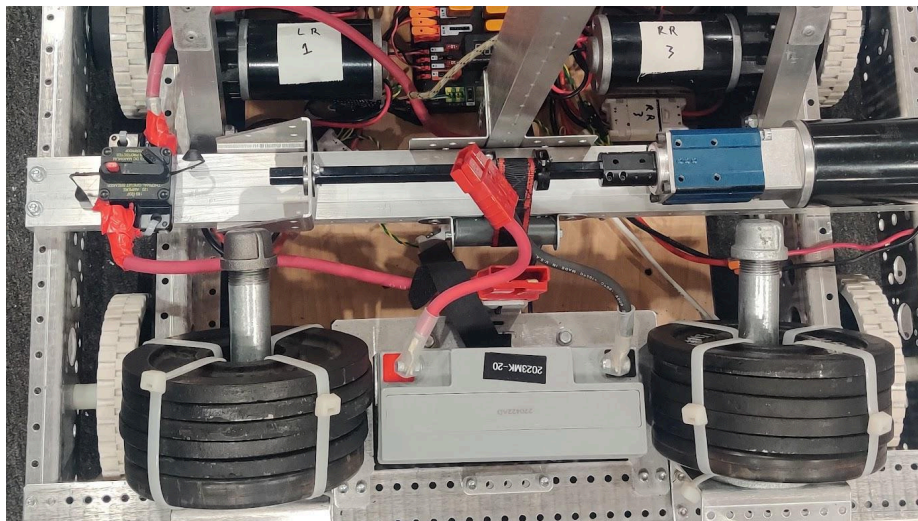
The front of the bellypan contains the roboRIO, radio, and power delivery for the radio (either the Radio Power Module or Voltage Regulator Module). These components had strips of dual lock applied with mating strips on the wood bellypan. The adhesive on the rear of the dual lock may not grip the plywood surface over time, and zip ties or bolts (or a polycarbonate bellypan) would probably hold up better during competition. The two front drivetrain motor controllers, two KitBot launcher motor controllers, and roller claw motor controller are also in the front half of the bellypan.



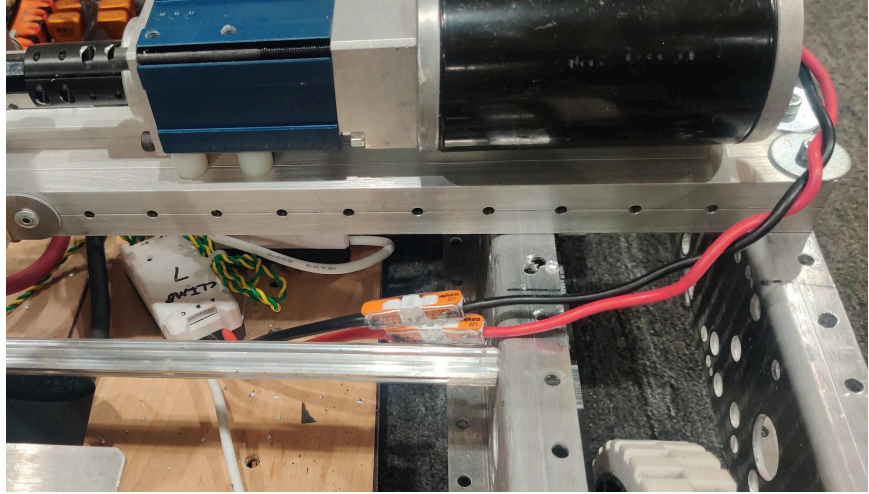
The middle of the bellypan holds the Power Distribution Hub (PDH). The PDH is held down with dual lock to make it easy to lift up to insert and remove wires for the motor controllers. The eight motor controllers sit on either side of the drivetrain motors. The two rear drivetrain motor controllers and the climber motor controller sit behind the motors while the two front drivetrain motor controllers and the feeder, launcher, and roller claw motor controllers are in front of the drivetrain motors.



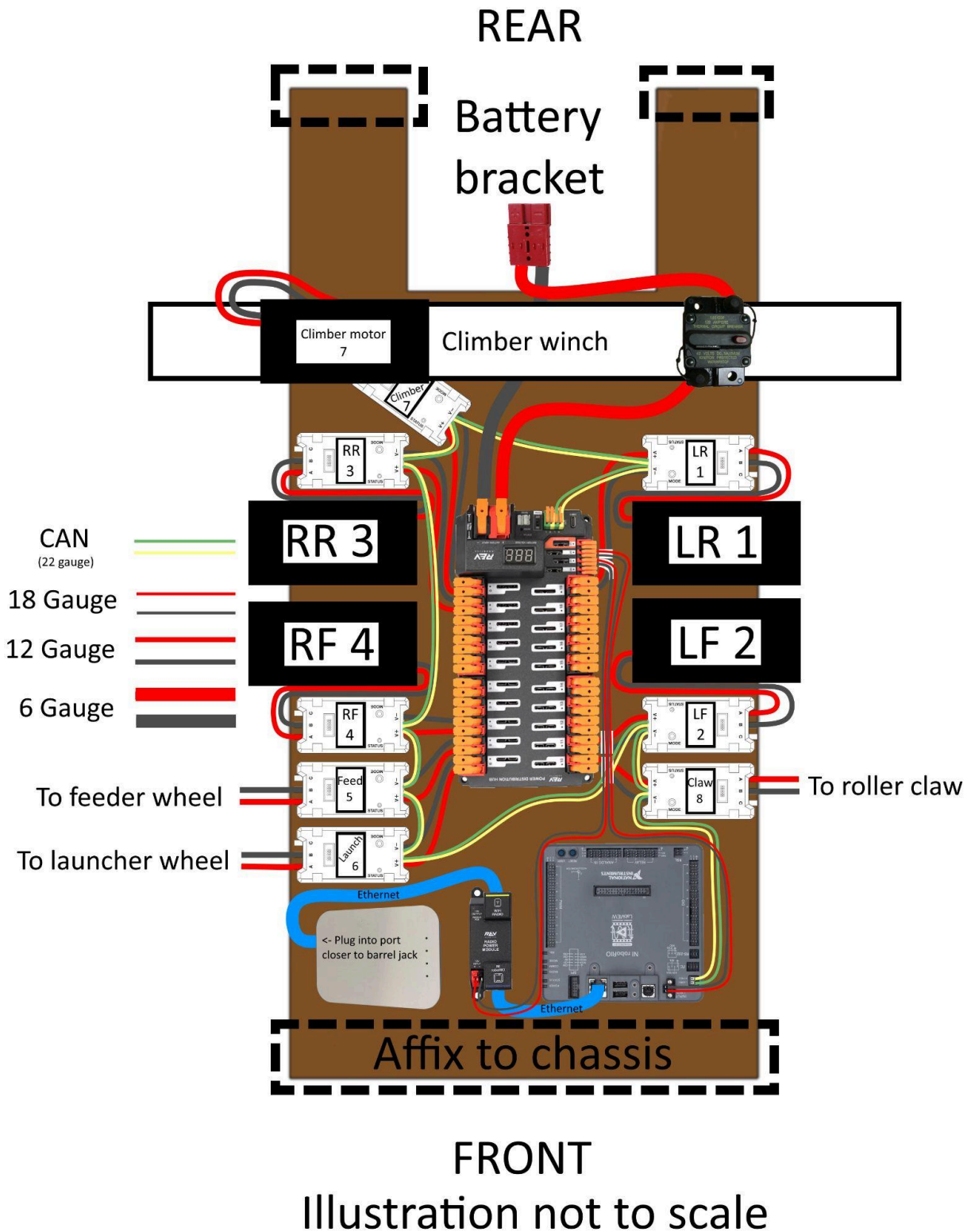
The main breaker is located on part of the structure for the climbing mechanism structure. If your team previously followed the KitBot wiring guide, it will need to be relocated from lower in the bellypan to install the ballast weight in the Everybot.



The climber motor controller sits under the climber and in range of the motor, which may or may not be a NEO that needs a direct connection depending on your team's configuration.

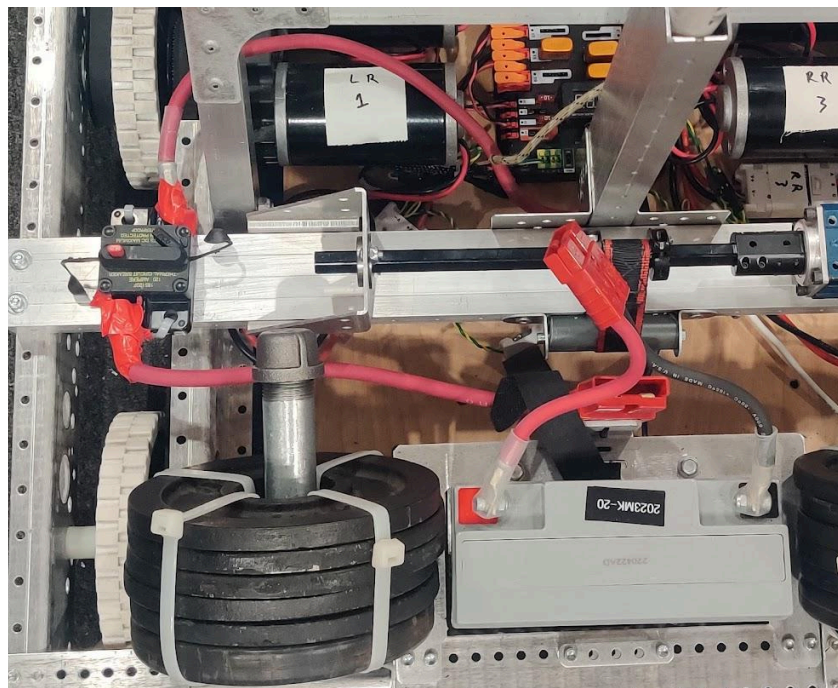


Wiring Diagram



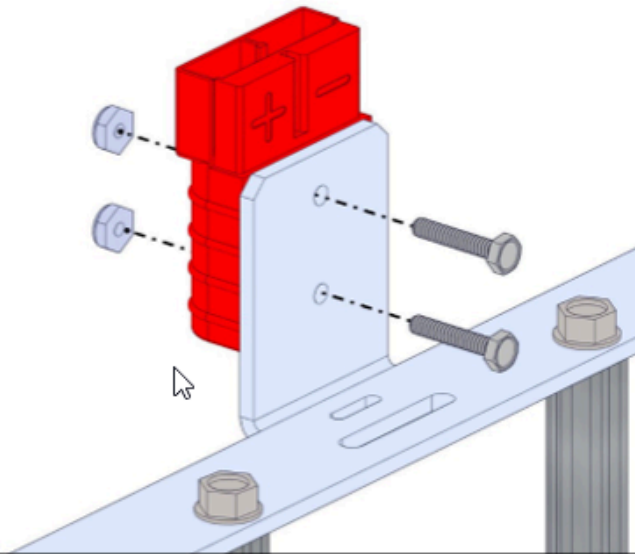
Power Wiring

Thick 6 gauge wire (provided in the [Kit of Parts](<https://firstfrc.blob.core.windows.net/frc2024/KOP/2024KOPChecklist-BlackTote.pdf>)) is used to connect the battery connector to the main breaker and Power Distribution Hub or Panel. Take one of the provided battery cables with a large plastic Anderson connector on one end and crimp a ring terminal to just the red wire if using a newer REV Power Distribution Hub (PDH) or both the red and black wires if using the older Power Distribution Panel (PDP). Eight 6AWG ring terminals are included in the Rookie Kit of Parts that can be used for this. Make sure the crimp is secure by pulling on it after crimping, if these connections are loose they can and will cause your robot to lose power as they are knocked around in matches.



The Anderson Connector can be screwed into the tab on the battery bracket using the provided nuts and bolts and the black wire can be connected to the negative terminal on the power distribution board using either the WAGO lever or the bolt post depending on which version you are using. The red wire on the battery connector should then be attached to the “BATT” side of the main breaker (this is not strictly necessary, either the BATT or AUX terminal will work).

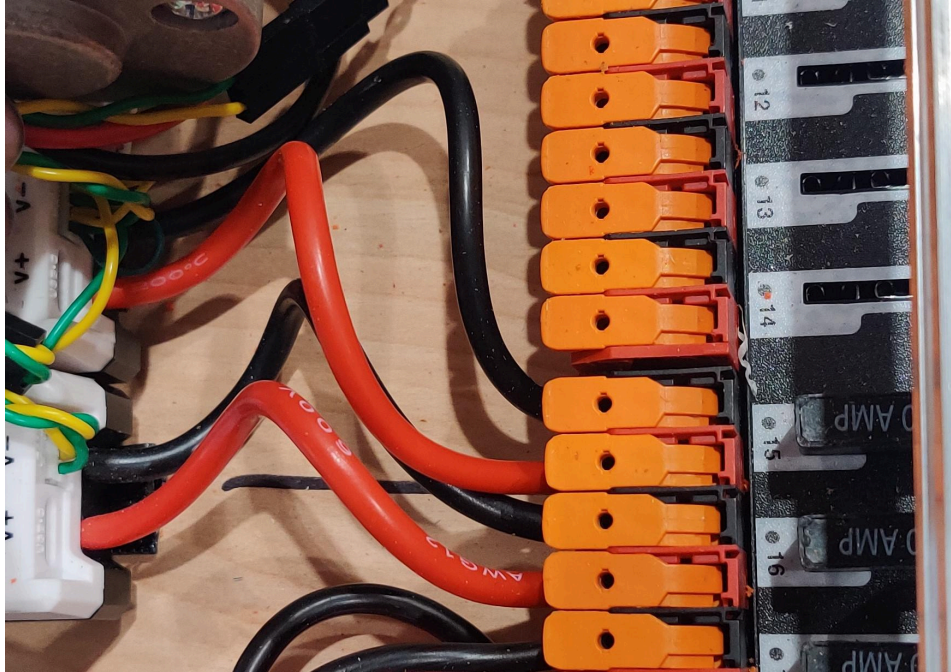
“Secure the Robot Side SB-Series Battery Connector to the tab on the C Plate using two #6-32 x 0.750” Hex Head Screws (am-1424) and #6-32 Nylock Jam Nuts (am-1419). The wires from this connector should go to your main robot breaker and power distribution panel.” - AM instruction



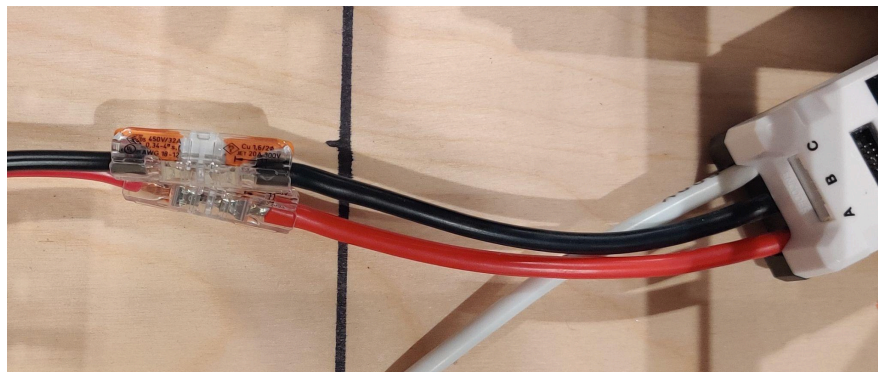
Note: The screws should be oriented such that the heads of the screws are on the Tab side.

Cut a section of the red 6 gauge wire provided in the kit down to an appropriate length and crimp a ring terminal on one end if using the PDH or both ends if using the PDP. Bolt the ring terminal to the AUX side of the main breaker and attach the other side to the positive terminal of the PDH/PDP. Cover any exposed metal on the main breaker connectors with electrical tape.

The eight Spark Maxes should be able to be plugged directly into the PDP/PDH by stripping the red and black wires on the power input side of the motor controllers (the side with only the red and black wire coming out, not the side with red, black, and white wires) and inserting the wire into the PDP/PDH in adjacent red and black ports, inserting the red wire into the red receptacle and the black into the black. The slot used does not matter as long as you remember to place breakers into the slots that are used. If necessary, use 12 gauge wire to make extensions to connect the power input wires to the PDH/PDP outputs, with a WAGO connector or other quick disconnect connecting the controller to the extension wire.



The motors are plugged into their motor controllers by stripping the ends of the red and black motor wires (if necessary) as well as just the red and black wires coming out of the motor output side of the Spark Maxes. Connect the red to red and black to black using WAGOs or another quick disconnect.



Do not worry about the white wire when connecting CIM motors to Spark Max motor controllers. Wrap some electrical tape around the white wire if it is unused to prevent the wire inside from contacting metal components of the robot. It does need to be connected (along with the hall effect sensor cable) if you use the NEO in the Rookie Kit of Parts to power the climbing mechanism.

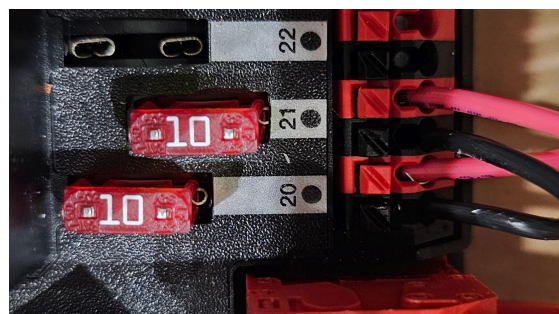




When the motors are plugged in to their controllers, it is probably a good idea to label the motors and controllers with what they are as well as their ID numbers. The numbering for both the default PWM control code and our adapted CAN control code are as follows:

- 1 - Left rear drive motor
- 2 - Left front drive motor
- 3 - Right rear drive motor
- 4 - Right front drive motor
- 5 - Feed motor (lower of two mechanism motors)
- 6 - Launch motor (higher of two mechanism motors)
- 7 - Climber motor (NEO, CIM, MiniCIM, or similar)
- 8 - Roller claw motor (RedLine, 775pro, or similar)

Two pairs of 18 gauge wire run from the PDH auxiliary power slots to the roboRIO power connector and the Radio Power Module or Voltage Regulator Module power inputs. On the PDH the slots numbered 20 to 22 near the battery voltage indicator can be used for the roboRIO or radio power, just install 10 amp fuses in the slots used. The positive red wire screws into the "V" (for voltage) connector of the roboRIO's power terminal and the negative black wire goes to the "C" (for common) connector.



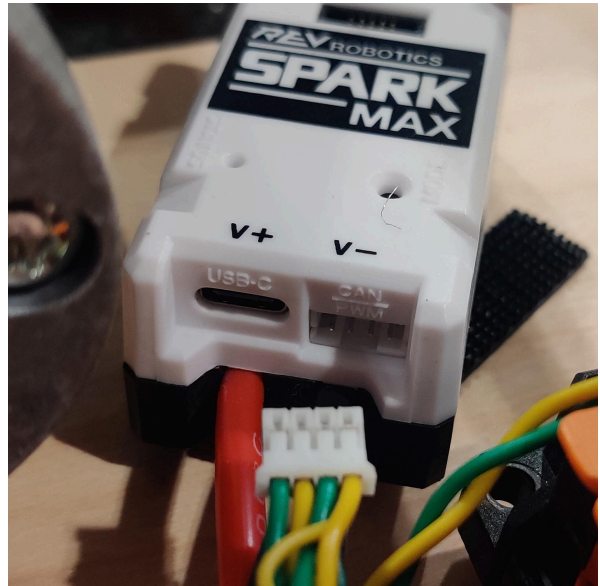
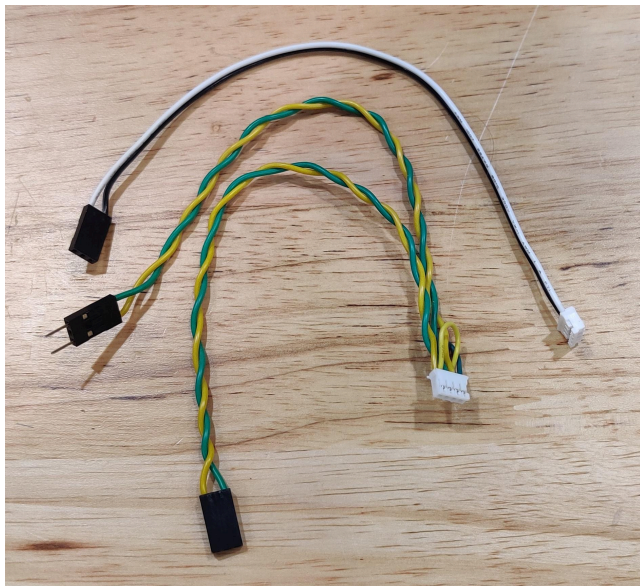
When using the Radio Power Module, the Ethernet cables (covered in the Data section) connecting the roboRIO to the radio through the module will provide the radio with power. If you are using the Voltage Regulator Module, a passive Power Over Ethernet (POE) injector like the orange REV cable included in the kit of parts is recommended. The POE cable should have the red and black wires with ferrules preinstalled inserted into the 12V/2A terminals on the VRM, with the optional barrel jack plugged into the other pair of 12V/2A connectors if desired.



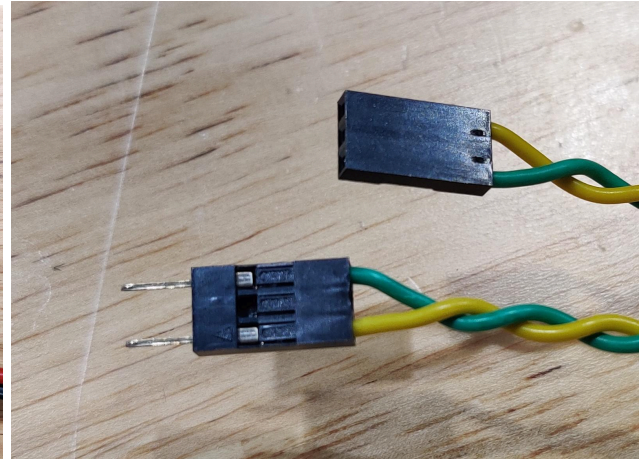
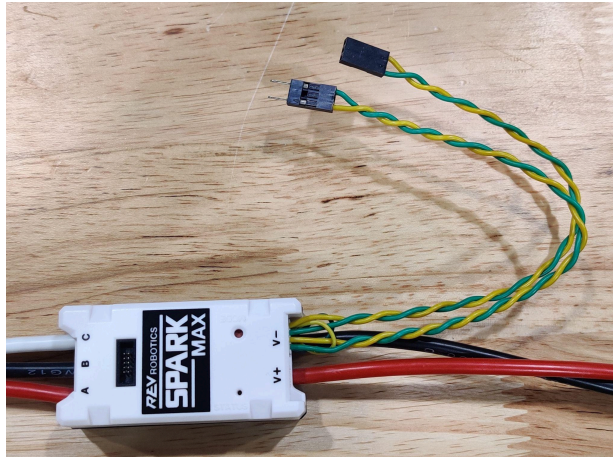
Data Wiring

We suggest using the CAN bus over PWM cables to control the motor controllers as the wiring is neater and there are sometimes issues with using PWM control with Spark Max controllers. The CAN network or “bus” consists of a daisy-chain connecting every component on the bus. The CAN bus begins at the CAN ports located near the power connector on the roboRIO and terminates at the CAN connectors on the PDP or PDH, passing through each of the Spark Max motor controllers on the way.

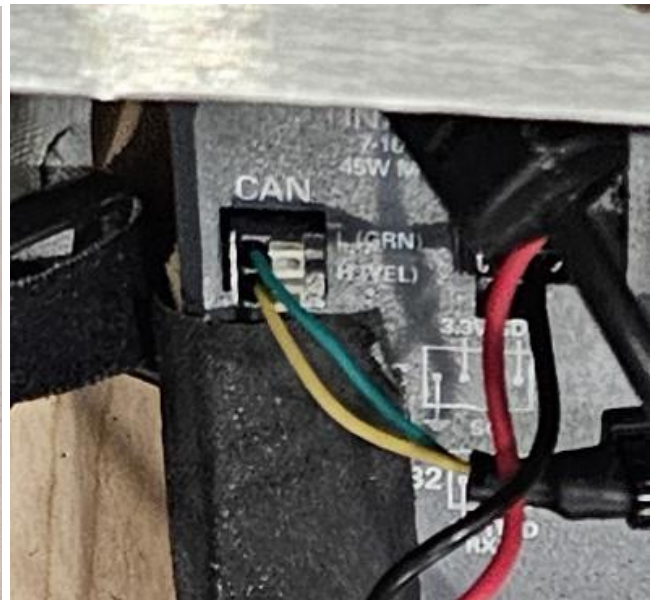
The Spark Maxes come with two data cables, a black and white PWM cable and a CAN cable with two pairs of yellow and green wires which plug into the keyed white connector next to the USB C port on the power input side of the controller. The side of the connector with the small tab faces down when inserting it into the port.



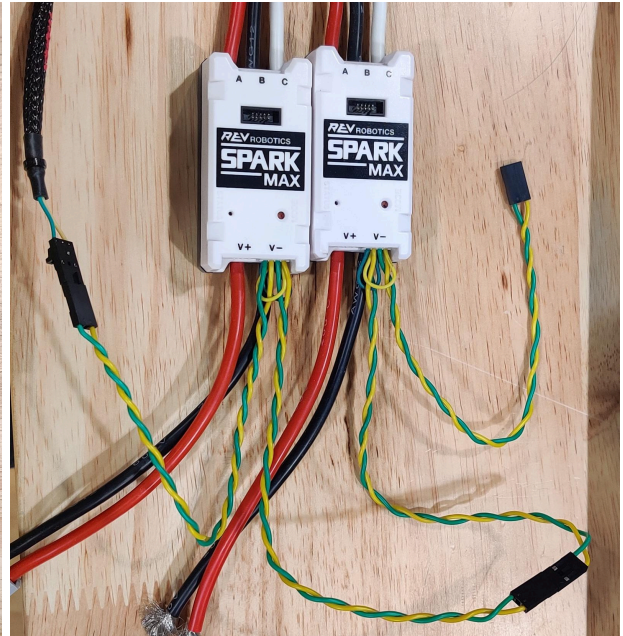
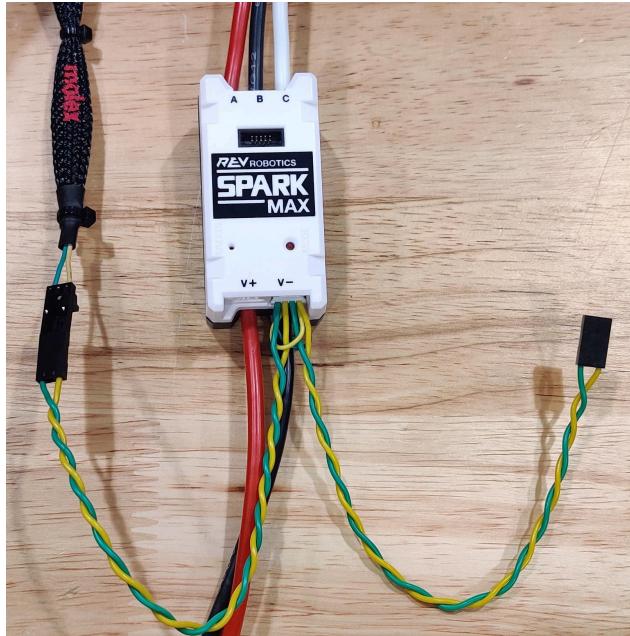
One of the pairs of yellow and green wire will connect to the previous device in the chain and the other will connect to the next, with the order things are plugged in being irrelevant to the function of the bus.



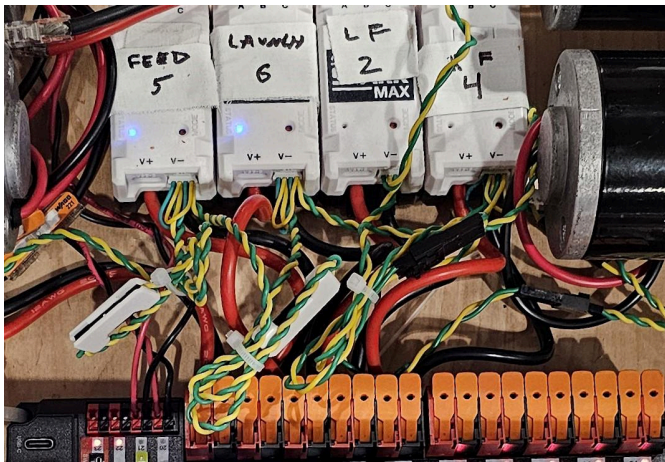
The Spark Max CAN cables come with servo-style pin header connectors. One connector has the protruding pins while the other has the mating receptacle. There is a CAN connection kit provided by Molex in the black Kit of Parts tote that has some cables that can be used to connect these servo-style pin headers to the terminals on the roboRIO and PDP/PDH as they expect a bare wire connection. Take one of these wires and remove the pre-cut section of insulation on the end that does not have a servo connector. Insert the yellow wire into the H (YEL) connector on the roboRIO and the green wire into the L (GRN) port. The other end of the cable can then be plugged into one of the motor controller connectors of the opposite type.



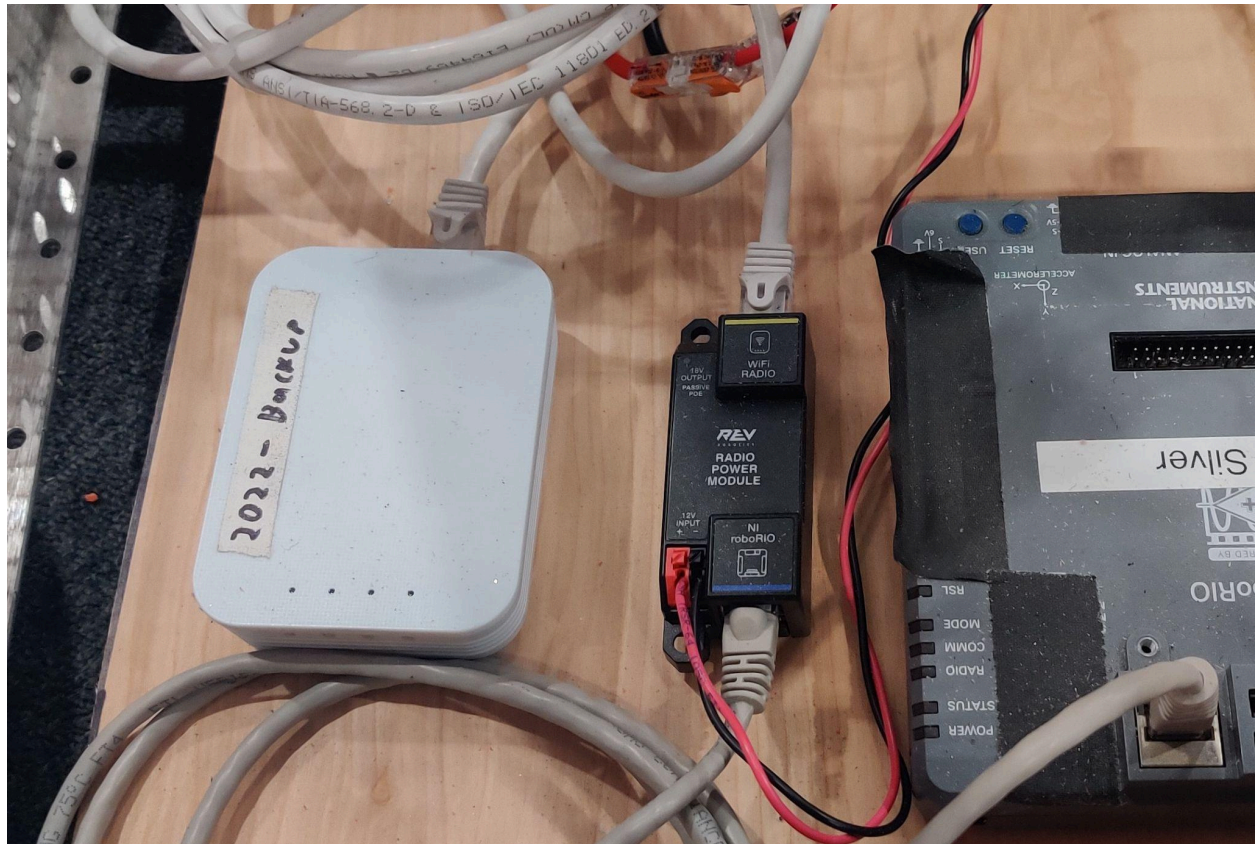
The other connector on that same motor controller can then be plugged into the opposite type on the next controller and so on until the CAN chain has passed through every motor controller, leaving one controller on the “end” of the chain with a free connector. Match the colors of the wires at every connection (yellow to yellow and green to green).



The white clips provided with the Spark Maxes can be used to hold the servo connectors together, and excess wire can be bundled together with zip ties. Take a Molex CAN cable with the opposite connector to the free Spark Max cable end and plug it into the Spark Max. The Molex connectors have tabs for a locking system which the REV cables do not have, meaning the white clips will not fit over the connection, so a strip of electrical tape or other method of holding the two connectors together so they can not be shaken loose during competition is a good idea. Remove the precut section of insulation from the other side of the Molex wire and plug the wires into either the left or right pair of connectors on the PDP/PDH's CAN terminals, making sure the terminating resistor (labeled TERM) is turned on to complete the CAN chain.



The radio needs to be plugged into the Ethernet jack on the roboRIO. If the Radio Power Module (RPM) is being used, run one Ethernet cable from the roboRIO's port to the roboRIO side of the RPM and a second cable from the Radio side of the RPM to the port on the radio closer to the barrel jack.



If the VRM is being used with a Power Over Ethernet cable, plug the Ethernet cable end into the radio port closer to the barrel jack and plug an Ethernet cable between the Ethernet jack on the other end of the POE cable and the Ethernet jack on the roboRIO.

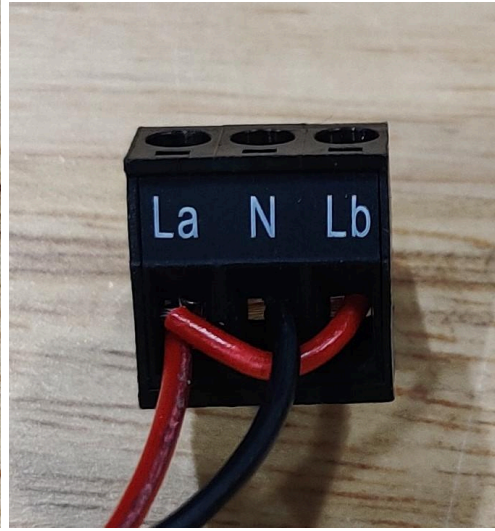
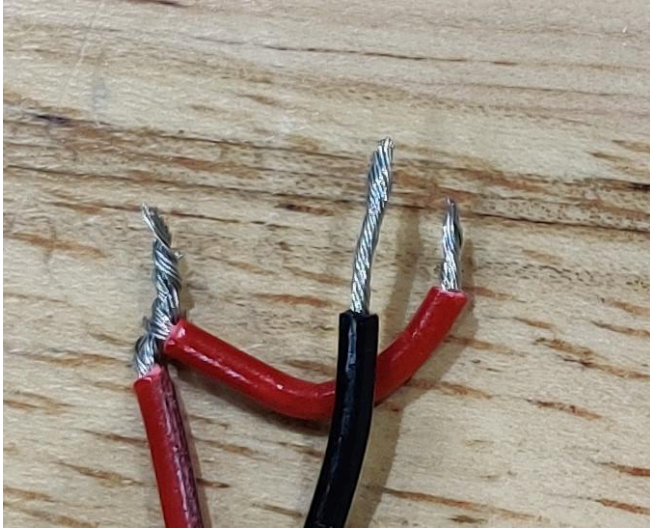
The Ethernet jack closer to the barrel connector is the only port that can accept the 12 volt POE power the robot provides, and plugging into the outer port with either the VRM or RPM will not actually power the radio.

Miscellaneous

The Robot Signal Light (RSL) visually indicates what state of operation your robot is currently in. It is wired into the RSL port on the roboRIO. The Rookie Kit of Parts includes a 2-wire jumper cable that can have one end cut off and the blue Molex sample kit in the regular black Kit of Parts tote includes a 2-wire cable that has a connector on only one end.



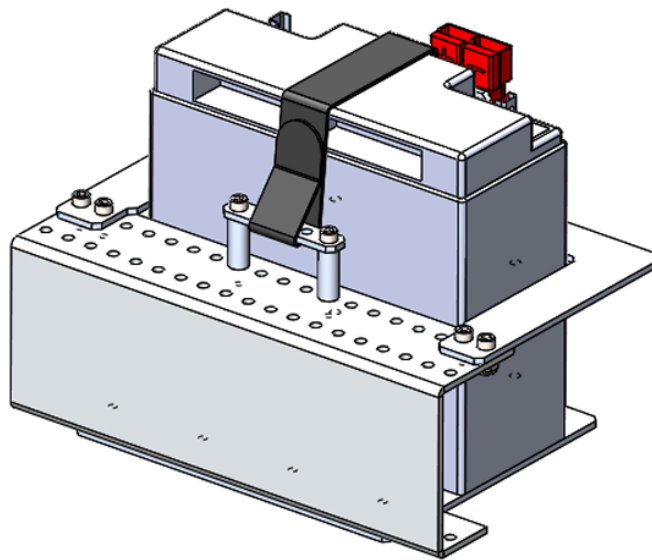
The connector end of either cable is plugged into the RSL port with the red wire in the S position and the black wire in the ground position (the small lines in a triangular symbol). On the chopped off end of the cable, cut off a short section of red wire that will be used to connect the two outer La and Lb terminals. Strip off the ends of the wires and twist one end of the jumper cable with the red wire it was cut off from so that the two wires can be inserted into the same terminal on the RSL. The red wire can then be connected to either outer terminal with the jumper connecting it over to the other outer terminal as well. The black wire is connected to the center N terminal. The screws on the side of the terminal block will clamp down on the wire when tightened. The RSL can be mounted anywhere that satisfies the wording of rule R709, with our suggestion being the crossbar on the front of the KitBot mechanism structure.



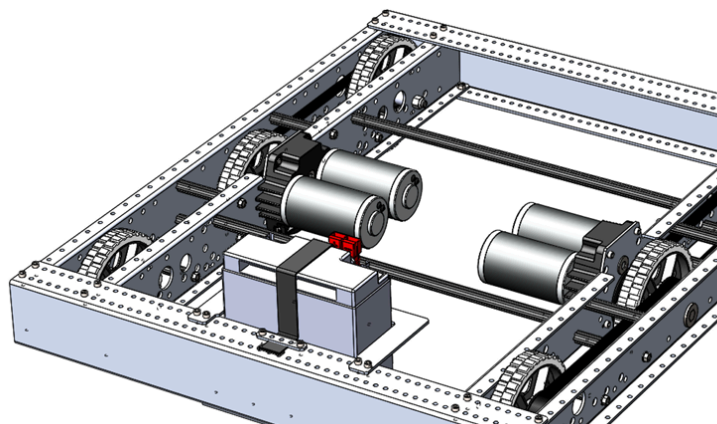
Securing the Battery

Derived from the AM battery bracket manual.

“Insert the Battery into the Battery Tray with leads facing upward and on the same side as the SB Connector. Pull the strap around the center of the battery and underneath the spacer and clamp assembly.”



“Plug the SB connector from the battery into the SB connector mounted to the tray. Secure with a cable tie around both connectors through the small slot in the C Plate to ensure the battery will stay connected during match play.”



Double check that all wires are securely connected with no bare strands of wire showing and that red wires are in red receptacles and black wires are in black receptacles. The main breaker of the robot functions as the power switch, and pushing in the lever on the side of the switch turns it on. Before turning the robot on it is good practice to say "Clear!" and ensure others around the robot are clear of it as it could begin to move unexpectedly when turned on. Assuming everything is wired correctly, the PDH should have its battery level indicator light up, each motor controller should begin blinking, the roboRIO should begin to boot up with status lights, the radio should begin to boot up with blue status lights, and after a moment the robot signal light should turn solid orange. If it does not appear that a component is receiving power, check that its slot in the PDH has a 40 amp breaker (or fuse, for the roboRIO and Radio Power Module) and that the wires are securely plugged in. After wiring, some control system components like the roboRIO and radio will need to be imaged with the correct firmware and the Spark Maxes will need their CAN ID numbers set. See the software section for more details.

Everybot Bumpers

Your team will need to make two sets of bumpers, one for when you are competing on the red alliance and one for the blue alliance. We made a single-piece unibumper with wood that is 4.625" tall and 3/4" thick, which satisfies R408. Keep in mind that your bumpers are allowed to be $5" \pm 1/2"$ in height, so it is critical that the bumper wood is not shorter than 4.5" tall.

This year we decided to prioritize a lower bumper ~0.5" off the floor to prevent the robot from running over notes.

Here is the bumper BOM for a set of two bumpers:

3/4" Thick Plywood:

- Qty(4) @ 4 - 5/8 in. x 32 - ~11/16 in (4.625" x 32.7")
- Qty(4) @ 4 - 5/8 in x 28 - ~7/8 in (4.625" x 28.9")

Home Depot Items:

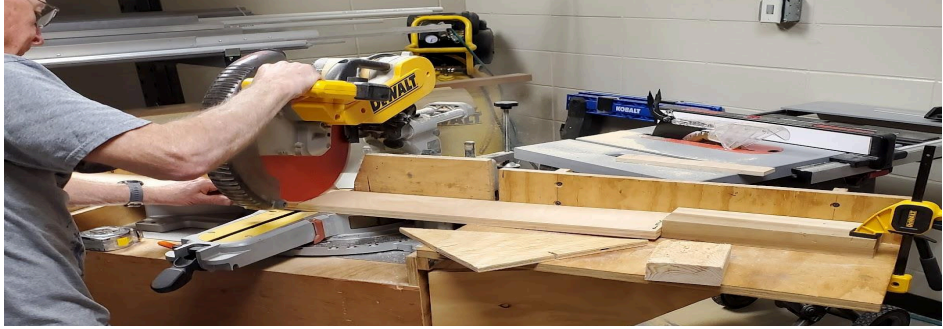
- Qty(8) 1-7/16 in. x 1-7/16 in. x 2-3/4 in. G185 18-Gauge Framing Angle (1-Pack)
- Qty(4) 3 in. Galvanized Flat Corner Brace (4-Pack)
- Flex Seal

Other Items:

- Qty(8) nylock nuts for 10-32 hardware
- Qty(8) nuts for 10-32 hardware (may not be needed)
- Gaffer's Tape
- Qty(8) Bumper Noodles
- Red Bumper Fabric
- Blue Bumper Fabric
- AndyMark Bumper Hardware Kit

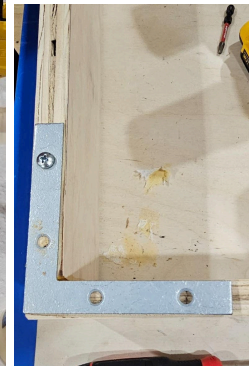
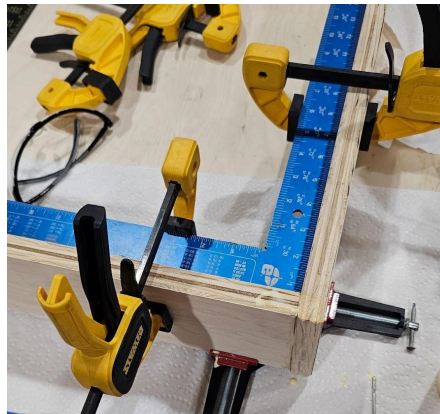
Bumper Rules can be found in Section 8.4 of the [game manual](#).

Starting with the sheet of plywood, cut 8 sections of 4.625" strips. Then using the 4.625" strips create four 32 - 11/16" planks and four 28 - ~7/8" planks.



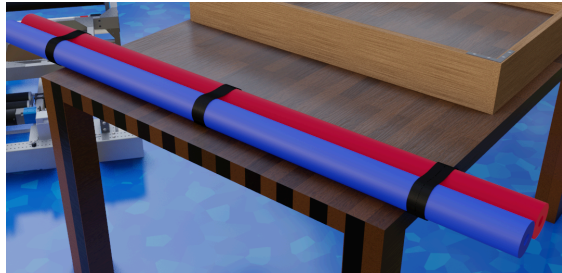
Bumper Assembly

Start construction by butting up a longer plank against the shorter plank of wood. Use a 90 degree angle or speed square to make sure that the wood is a 90 degree angle. Clamp the wood into place once square and install a corner brace. Add wood until you have made a rectangle, making sure to butt the longer planks against the shorter ones (the ends of the 28 - $\sim 7/8$ " plank should be visible while the longer ones should not). Flip the frame over and add another corner brace at each corner. Finish by attaching a framing angle inside each of the four corners with the wood screws from the bumper mounting hardware that come in the chassis box.

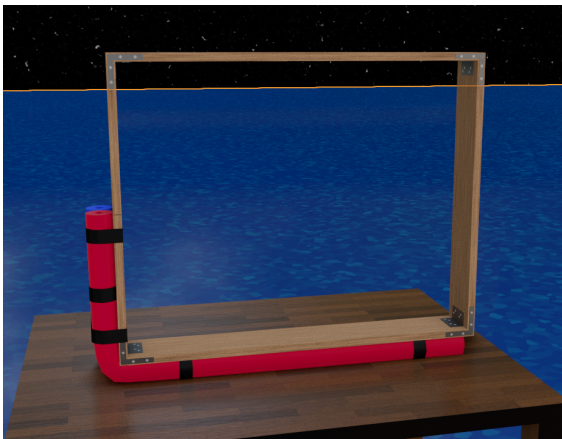


Top and bottom are 28 - $\sim 7/8$ " while left and right are 32 - $\sim 11/16$ " in the above image

Next take two pool noodles of equal length and bundle them together with 3 single wraps of tape as shown in the image on the right. Make sure not to compress the noodles.



After making your first bundle of noodles, find the midpoint of one of the shorter sections of wood. Mark the midway point with a marker and then line up the end of the pool noodle bundle with the midpoint as shown below. With the noodle centered under the short side, bend the noodle around the corner and run it along the long side. Avoid joining noodles at the corners, if the noodles end around 2-3" from the start of a corner then it is better to shorten them and use additional noodles. If the noodles come 4" or more past a corner then there should be enough room to leave the noodle as is.

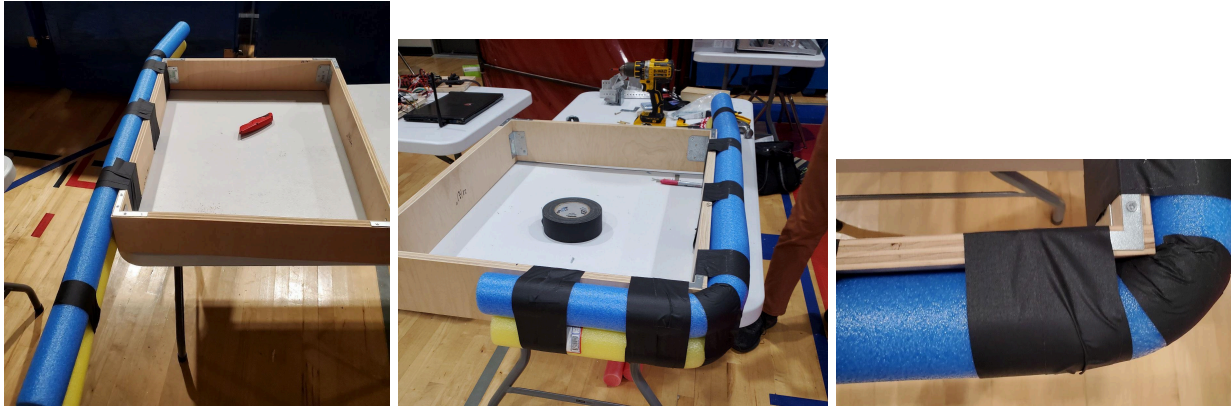


Bad corner join length

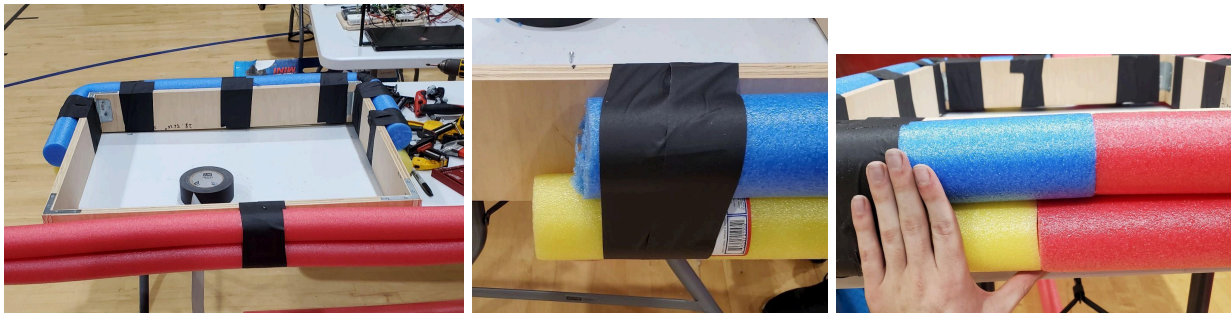


Allows for better corner joins but uses more noodle

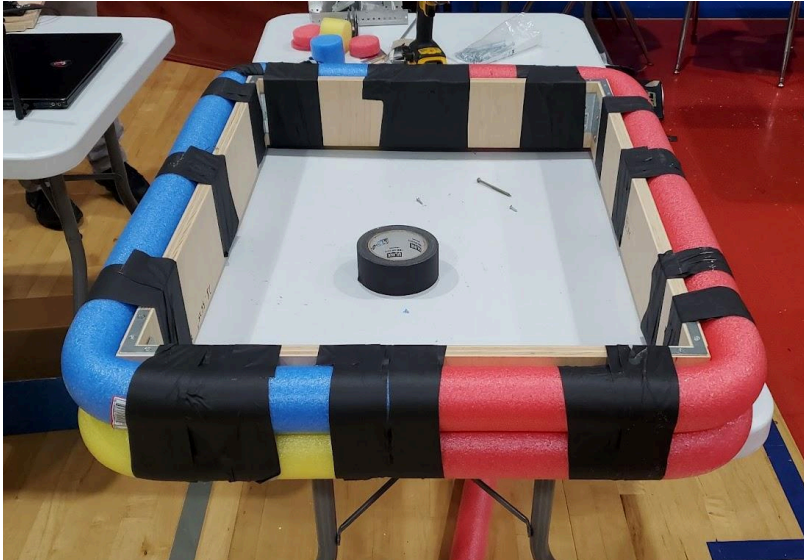
3 loops of tape were used to secure the noodle snugly to the frame while not compressing the noodles. The noodles are then snugly wrapped around the corners and secured to shorter sections of the frame.



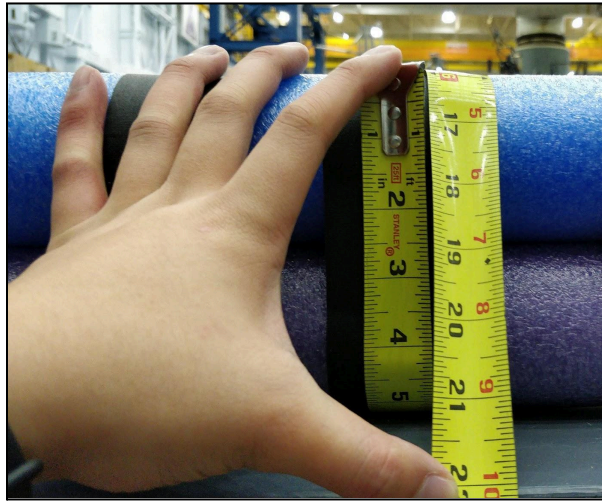
After securing one side, attach the other. In the previous step our first noodle bundle extended over the centerline on the shorter section of wood, this is desired. On each bundle cut one of the noodles such that the other bundle can fit in. The noodles should have a small gap between them, if they are deflecting each other (shown in the rightmost image) then they should be cut down to remove any visible bending. If the noodles do not overlap an additional pool noodle can be cut up to fill larger gaps.



Once both sides are fully attached with tape, make sure to tape the joining of the noodles in place. The bumpers are now ready for fabric.



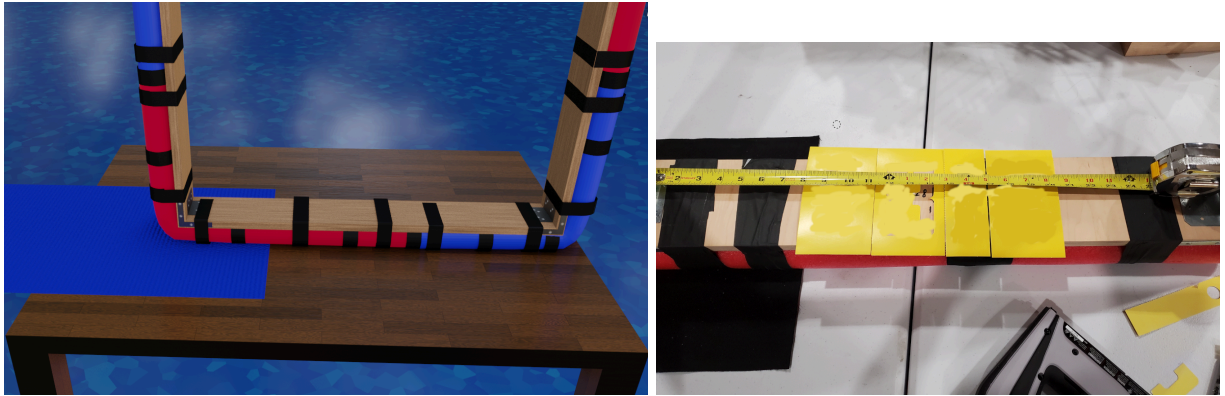
Measure out the width of the bumper fabric. To do this, we wrapped a tape measure around the pool noodles and bumper frame. In our case, the fabric needed to be around 16”.



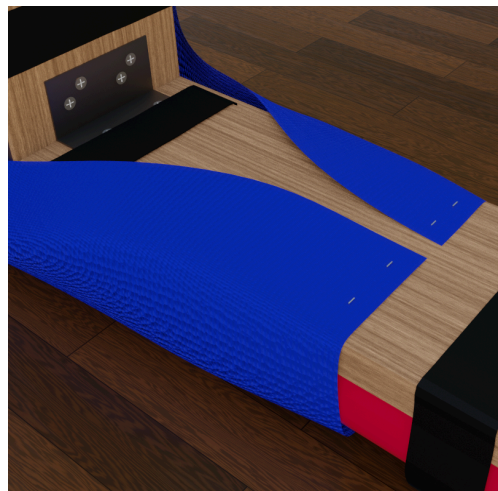
To cut the fabric, we laid the entire length on a group of tables and used scissors to cut along the marked line. Make sure to cut both the red and blue fabric to the same width.



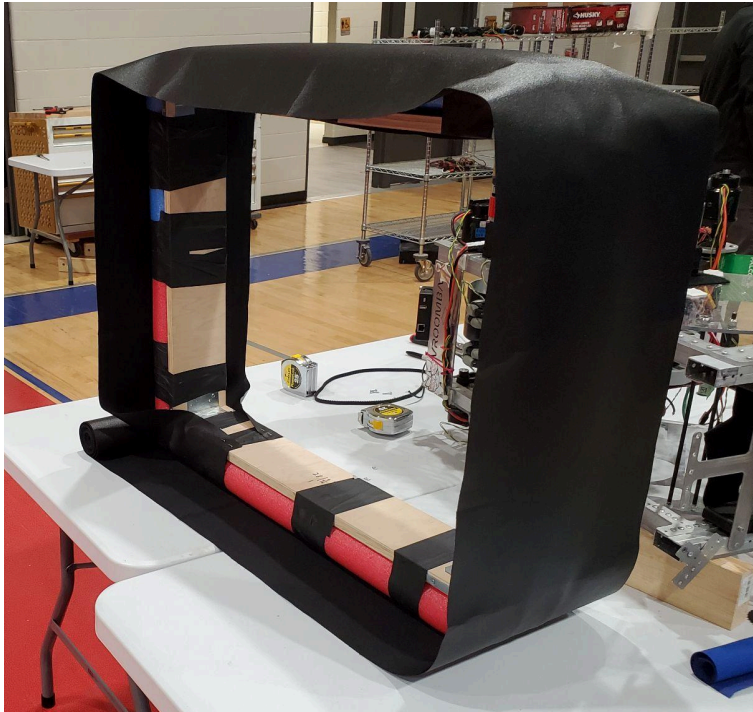
Next lay the fabric underneath a longer section of the bumper wood as shown in the picture below. Selection of this position is important for the coming steps, to find the ideal location use your stencils to layout the location of your numbers. The fabric should start about 2" from the end of the last stencil. Make sure to center the fabric widthwise such that there are equal lengths of fabric on both sides of the bumper.



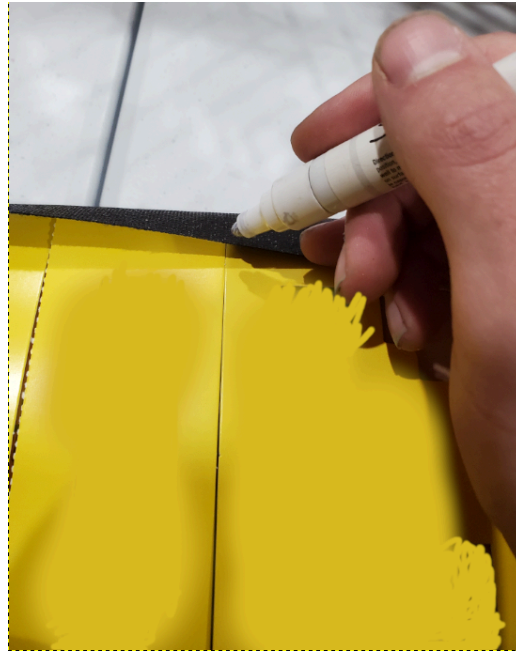
Once the desired location has been found the fabric can be wrapped around the bumper and stapled in place with two staples per side. It may be best to have one person pull the fabric towards the center, keeping a decent amount of tension on both sides while another person staples the bumpers in place. Alternatively one side could be fixed in place and the other side could be tensioned afterward. Overlap between the two sides is fine. Finally once the staples are in place on both sides mark the wood with a Sharpie where the staples went to assist with reinstallation of the fabric.



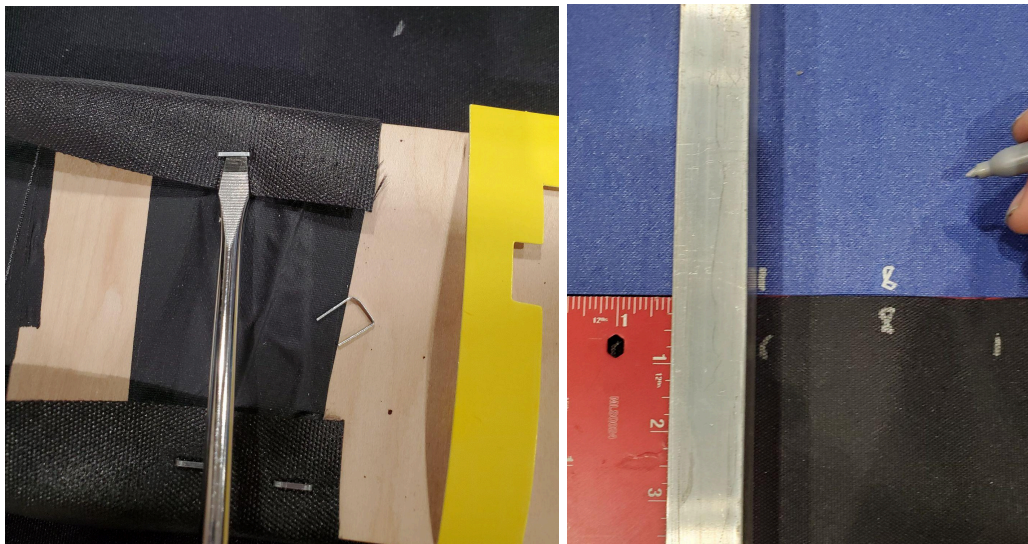
Next wrap the fabric around the entire wooden noodle assembly. There are two goals when doing this: make sure the fabric is tightly wrapped around each corner and keep the bumper frame centered within the fabric. The excess material can be cut off as shown below.



After the bumpers are secured, find the midsection of each bumper side, lay out the number stencils, and mark the stencil's locations on the outside of the bumpers. Write the number in the center of the section as well so you know where each number belongs. The corners can also be marked if desired.



Once the bumpers have been appropriately marked, use a flathead screwdriver to remove the staples. Then take the opposite alliance color fabric and lay it out on the ground next to the marked bumper. Align the marked bumper end to end with the opposite colored bumper and then begin to transfer the markings onto that bumper. Using a long piece of box tube or a long measuring device is a good way to make sure that the markings line up well. Finally cut the opposite colored fabric to the same size as the one that was stapled.

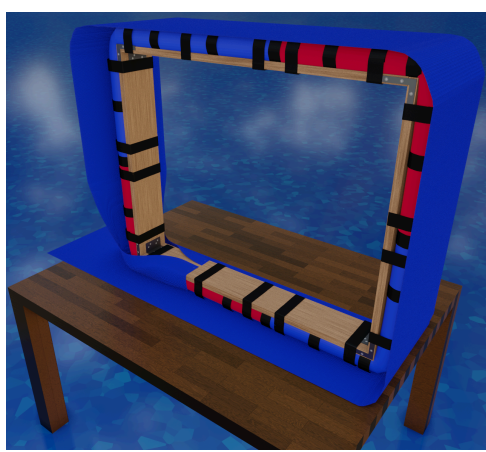
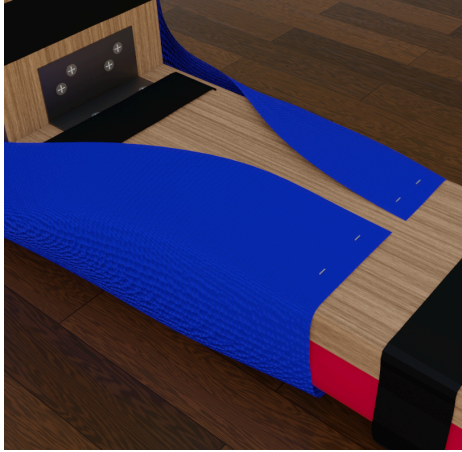


Once the bumpers have been properly marked it is time to add your team's numbers. We used a wooden template and white flex seal spray to add the team "number" to the bumpers. We elevated the wooden template off the fabric by 1/2" to reduce the amount of paint build up between the fabric and wood. However teams can also use [Stick on numbers](#), [Vinyl adhesive](#), or hand painting. We made sure the template was centered top to bottom and left to right before starting the spray. If you used our BOM to buy bumper materials you will have Flex Seal and the stencils. For the best look attempt to evenly elevate the stencils 1/2" above the fabric and spray from a higher distance, making sure to not to get Flex Seal on the rest of the fabric. Taping the stencils to the bumper material may also work. Make sure to let the Flex Seal dry before continuing.

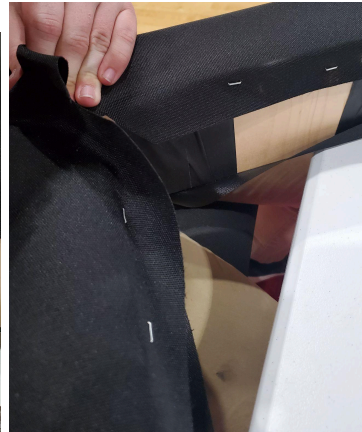


We added our "numbers" after completing the bumper, you can choose to do it later (after the fabric is stretched and stapled in place) too if you wish (these are "vanity" bumpers, they are not legal to compete with, your bumpers must contain your team's number on each of the four sides)

Once the bumpers have been painted we can move to reattach them. Repeat the steps that were taken to attach them the first time making sure to staple them in the correct location. Make sure that all numbers are centered on the bumpers.



First we will begin adding staples to the top of the bumper. Staple in the center of each side first, making sure the fabric is centered. It may be best to add a single staple on the bottom of each midpoint before moving on. When adding staples on the bottom make sure the fabric is pulled as tight as possible. Add staples until you reach the approximate spacing from the corner shown below. Staple all sides before moving onto the corners.



Here is a method we used for having nicer looking corners. Use one hand to pull the corner fabric parallel to one strip of wood while holding scissors in the other. Use the scissors to find the corner of the wood and then mark a 45 degree angle. Fold the material towards the other side and mark the same 45 degree angle. Finally make a straight line connecting the 45 degree lines. It may be best to leave an eighth of an inch from the corner to the start of your line.



Cut along the lines created. Once a corner is cut we will start adding staples. Pull the fabric tight to one side and add staples. After one side has staples fold the fabric over itself and attempt to get the corner to like it does in the bottom photo. Add staples to complete. Do this for all corners on the top.



After the top has been completed, flip the bumpers over and begin stapling on the new top starting from the center again. Make sure the fabric is pulled as tight as possible for the best looking bumpers. Using wide vice grips can be very useful for this task. You will have noticed that one of the sides has a good chunk of excess fabric, fold it over itself, leaving some space for the corner. Staple down the folded over excess fabric.



Once all sides have staples in them and everything looks correct, use a mallet on the staples to push them further into the wood so they do not stick out.



One of the most important considerations for the bumpers this year was the mounting height. Bumpers should not be dragging on the floor but should be low enough to prevent Notes from easily being run over. Running over Notes could lead to your robot being high centered on them, getting them stuck in the drivetrain or getting stuck underneath the robot. We found that 0.5" of ground clearance heavily mitigates this issue.

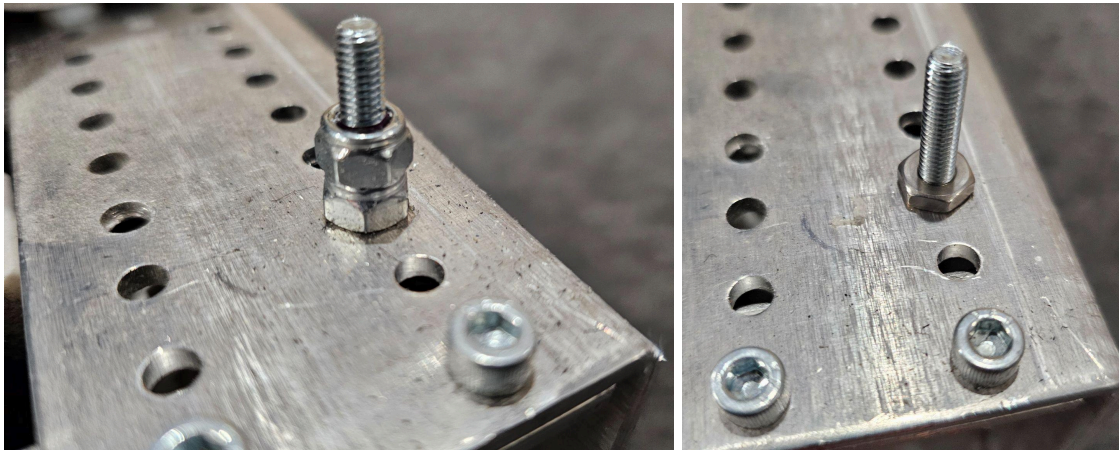


Note doesn't go under 😊



Note goes under ☹️

We only used the front/back brackets that come with the chassis, with two at the front corners and two more in the back corners. Note that 8 total front/back brackets will be used, 4 for each alliance color of bumpers. The brackets are secured to 1.5" 10-32 bolts that stick vertically out of the chassis. These bolts are inserted in the third hole in from the edge in the outer row of holes in the chassis front and end rails. The bumpers are set to the appropriate height by using nylock or regular nuts as spacers. Our bumpers were installed with two nuts on top of each bolt. We highly recommend using at least 1 nylock nut on the 1.5" 10-32 bolt. These nuts should be left in place on the bolts in the chassis, with only the top nuts on top of the brackets (shown below) coming off when the bumpers need to be changed.



Wood screws are used to secure the bumper to the bracket. Put the bumper frame over the robot and put it in place around the chassis. Position the bumper bracket over the bolt and add another nut to hold it in place. In order to install wood screws, you will need to drill a pilot hole for your wood screws through the fabric, corner brace, and into the wood frame so that the wood screws will be able to bite directly into the wood. Ideally, you will be able to get four wood screws into each corner.



Nylock nuts or the provided wingnuts should be used to ensure the bumper cannot come off during the match. Once one set of bumpers is undone, remove the four nuts holding the brackets down, lift the bumper set up, put the other color of bumpers in its place, and position four more brackets in place and tighten down the nuts again to hold them in place. Drill out pilot holes and then wood screw these four brackets in place to the other bumper set.

Severely compromised bumpers can result in your robot being disabled during a match (G411).

Everybot Finishing Touches

After the major mechanisms have been attached, ballast weights are required to ensure the robot is able to get ONSTAGE. Without ballast the robot will not be properly balanced during the climb.

Ballast Weight

Approximately 35 pounds of additional weight will be mounted to the back of the chassis to help counterbalance the robot for the climber to work properly and get the robot fully off the ground.

Required Tools

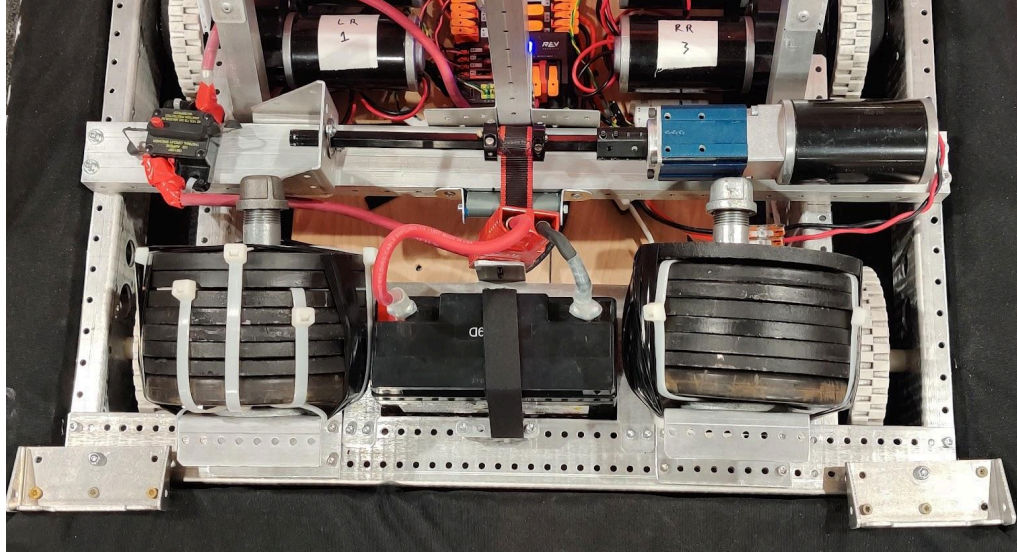
- 5/32" allen wrench or t-handle
- 3/8" socket or ratchet

Ballast Materials

- Qty(2) x 3/4" Pipe Flanges
- Qty(2) x 3/4" diameter by 6" Pipe
- Qty(2) x 3/4" Pipe Caps
- Qty(14-16) x 2.5lb Round Weights
- Qty(8) x 10-32 7/8" Bolts
- Qty(8) x 10-32 1.5" Bolts
- Qty(8) x 10-32 Nylock Nuts
- #10 washers
- 175lb weight-rated Zip Ties
- Qty(2) x Chassis End Plate cutoffs

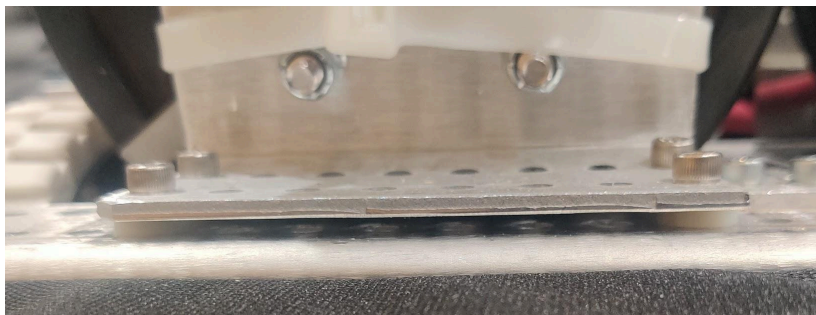
Ballast Attachment

The two Chassis End Plate cutoffs will be bolted to the rear of the robot in between the wheels and the battery bracket. Pipe will be added with round weights attached to counterbalance the weight of the mechanisms on the front of the robot. The weights will sit between the battery bracket and the Chassis Inner Side Rails.

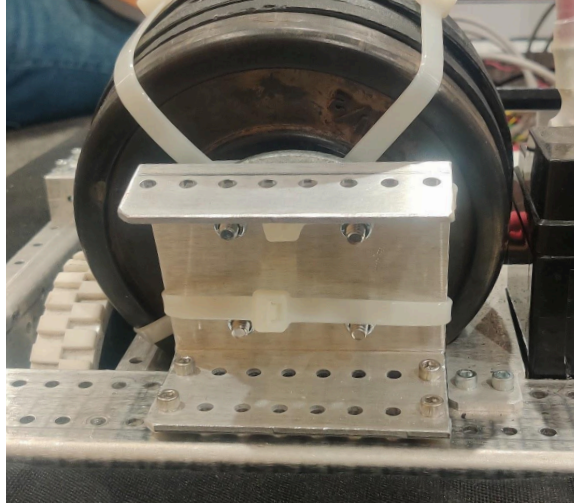


Clamp a 3/4" pipe flange to the Chassis End Plate cutoff pieces so that it can be mounted as high as reasonably possible towards the side with the shorter flange. Match drill out the holes in the pipe flange and attach them using 7/8" or 1.5" long 10-32 nuts and bolts.

Position the chassis cutoffs so they line up with the holes in the Chassis End Plate as close to the battery bracket bolts as possible. Use four 10-32 bolts (whatever you have left of 1.5" or 7/8") on each plate, two in each row of holes, with #10 washers between the cutoffs and chassis to shim the cutoffs up slightly (we used nylon spacers, but #10 washers are already required elsewhere).



Screw a 3/4" diameter 6" long pipe and 3/4" pipe cap into the pipe flange. Bend the chassis cutoffs back and up by pulling on the pipes so they are angled upwards like the launcher. Add 7 weights to each assembly and securely attach them using ~175lb weight-rated zip ties by wrapping four around each stack at even intervals to form a solid cylinder of weights. Add two more zip ties around the chassis cutoffs and through the loops of the zip ties around the weights. Wrap the entire stack and bracket in electrical tape several times to help hold it in place.

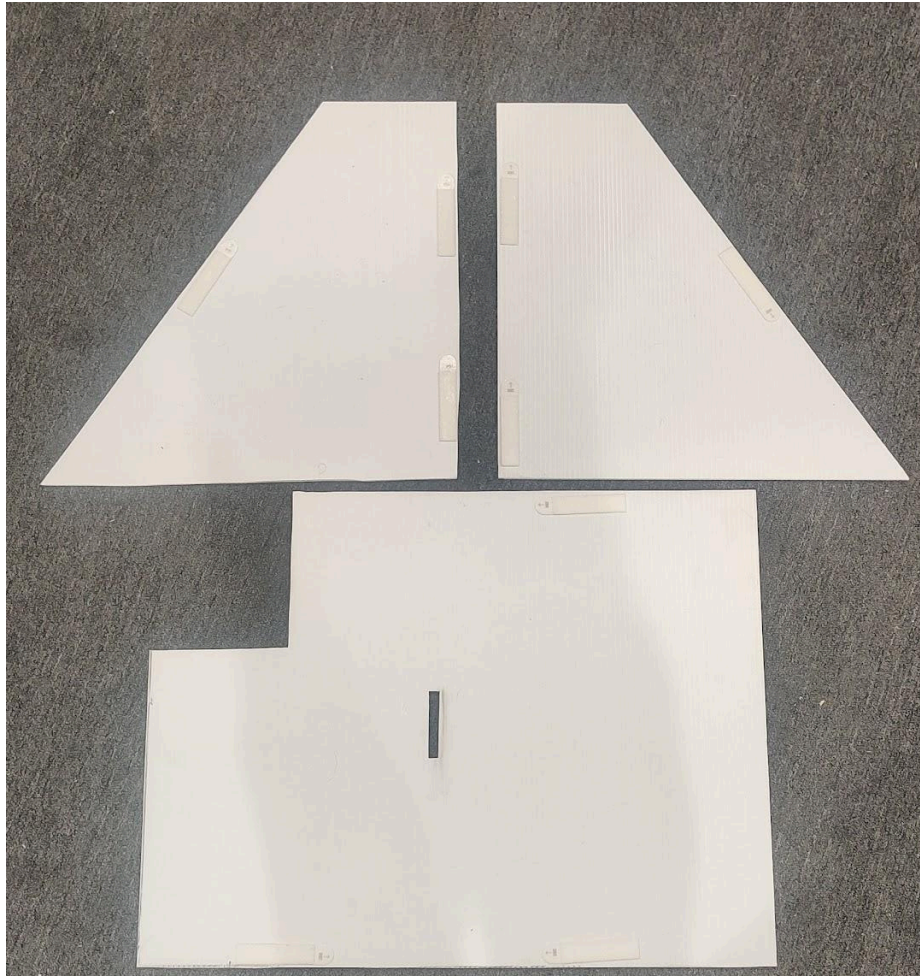


Robot Inspectors as your event may request that your weights be mounted more securely. Hose clamps or a similar strap will also function to securely attach the weights, as well as other tape like gaffer's tape. Ask your inspector if they have additional suggestions to help you pass inspection.

Depending on the exact manufacturing of your Everybot and any additions or changes you may have made, you may need to add additional weight to each side of the robot to balance the robot enough for the climber to function properly. Ideally, your team has some way to test the climber before your official events, either by building part of the Stage field element (plans from FIRST to construct one out of wood can be found [\[here\]\(https://www.firstinspires.org/robotics/frc/playing-field\)](https://www.firstinspires.org/robotics/frc/playing-field)) or otherwise hanging the chain or a chain substitute from the appropriate height.

Side Panels

Three corrugated plastic side panels were added to the sides of the KitBot launching mechanism to prevent Notes from getting stuck under the launching mechanism. These side panels could also be made from polycarb or just about any other similar flat, lightweight material (heavier materials will add even more weight in front of the climber and require more rear ballast).



The easiest way to cut the panels to exactly the right size is to simply hold your sheet of material up to the sides and front of your robot and mark out the boundaries of the panel you want. You will need to account for the size and shape of whatever roller claw gearbox and motor your team is using as well as a slot or hole so the robot signal light is visible if your material is completely opaque. These panels can be decorated with your team's name, number, logo, sponsors, artwork, or just about anything else you wish.



We attached our sheets using Velcro-style Command Strips but actual Velcro, dual lock (included in the KOP), or any other similar removable fastener will work just as well while still allowing the panels to be easily removed to access and service the electronics and other internal components.

Software Setup and Configuration

To set up your robot to properly run code, you will need to install several pieces of software ideally on a laptop that can be brought to competition. The laptop included in the Rookie Kit of Parts is sufficient for programming and driving the robot, but as your team expands you may want to invest in separate programming and driver station laptops so that your programming team can work on code while the drive team is driving the robot.

Required Materials

- Wired control system, ideally on robot drive base
- USB A to B cable ("printer" cable)
- Ethernet cable
- Robot battery
- Laptop(s)

You will need to have administrator access or permissions to install and change software on this laptop. A school-district managed laptop may be too restricted to properly use. The laptop in the Rookie Kit should be sufficient for programming and operating the robot.

Configuring Spark MAX Motor Controllers

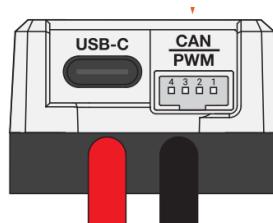
To configure the Spark MAX motor controllers, please download the [REV Hardware Client](https://docs.revrobotics.com/sparkmax/rev-hardware-client/getting-started-with-the-rev-hardware-client). This webpage has all the information needed to use the Spark MAX but we will go over the relevant information below.

Latest REV Hardware Client - Version 1.5.3

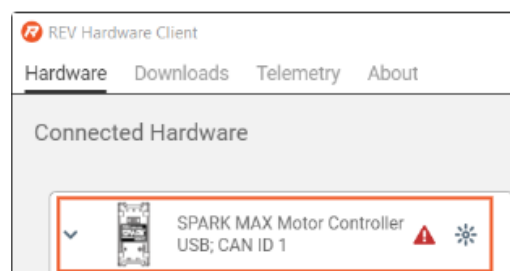
Download Latest REV Hardware Client

Run the installer and click through the install process. Run the program and check the “About” tab to see if there are any updates available.

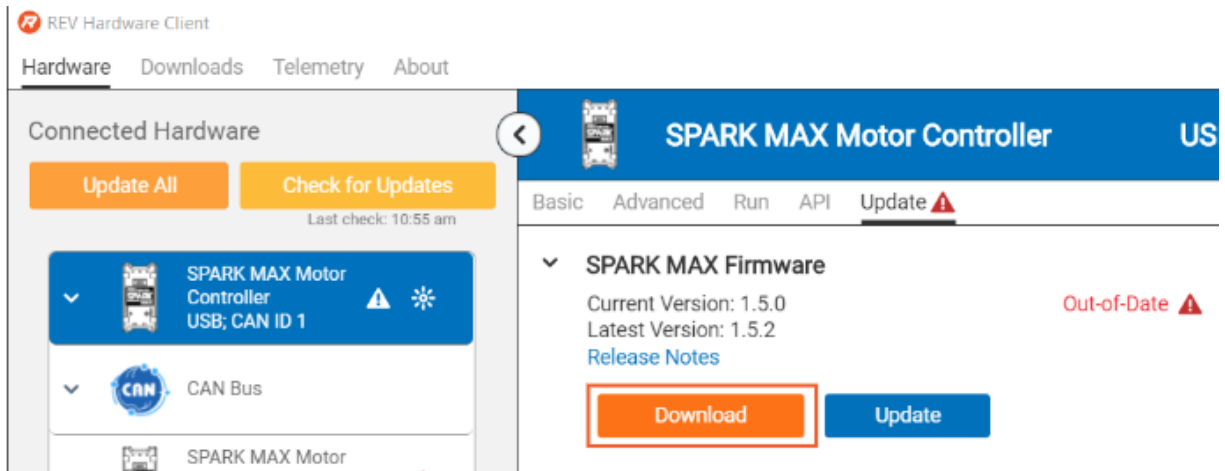
The Spark Max includes a USB C port which is the easiest way to interface with individual Spark Maxes. Spark Maxes can be connected to when unpowered or completely disconnected from the robot or battery when connected over USB. The USB port is located next to the PWM/CAN connection on the power input side of the controller.



With the Hardware Client open, plug in one of the Spark Maxes. It should appear over to the left side of the window.



If you see a red triangle, the Spark Max firmware is out of date. Click into the controller and download and update the firmware in the “Update” tab.



Click back to the “Basic” tab. The two most important settings here are the CAN ID and the Motor Type. The CAN ID is how each controller in the chain knows to respond to commands sent by the code and must be unique for each controller on the bus.

SPARK MAX Motor Controller USB; CAN ID 1

Basic Advanced Run API Update ⚠

1 2 1

3 Load Configuration Save Configuration ↺

4

Motor Type: REV NEO Brushless

Idle Mode: ☒ Brake

Smart Current Limit: 80

Sensor Type: Hall Effect

Encoder Counts Per Rev: 4096

PWM Input Deadband: 0.00 0.05

Limit Switch

Hard Forward Limit: ☒ Enabled

Forward Limit Polarity: ☐ Normally Closed

Hard Reverse Limit: ☒ Enabled

Reverse Limit Polarity: ☐ Normally Closed

Soft Limits

Forward Limit: ☐ Disabled

Forward Limit Value: 0

Reverse Limit: ☐ Disabled

Reverse Limit Value: 0

Ramp Rate

☐ Disabled

Rate (seconds to full speed): 0

Burn Flash Restore Factory Defaults

[Report an Issue](#)

The CAN IDs expected by the provided Everybot starter code are as follows:

- 1 - Left rear drive motor
- 2 - Left front drive motor
- 3 - Right rear drive motor
- 4 - Right front drive motor
- 5 - Feed motor
- 6 - Launch moto
- 7 - Climber motor
- 8 - Roller claw motor

The motor type should be set to “REV NEO Brushless” if using a NEO motor or set to brushed if using any other type of motor (CIM, 775pro, etc). Leave the sensor type to none unless you have specifically added a sensor compatible with the Spark Max to your robot and plugged it into the

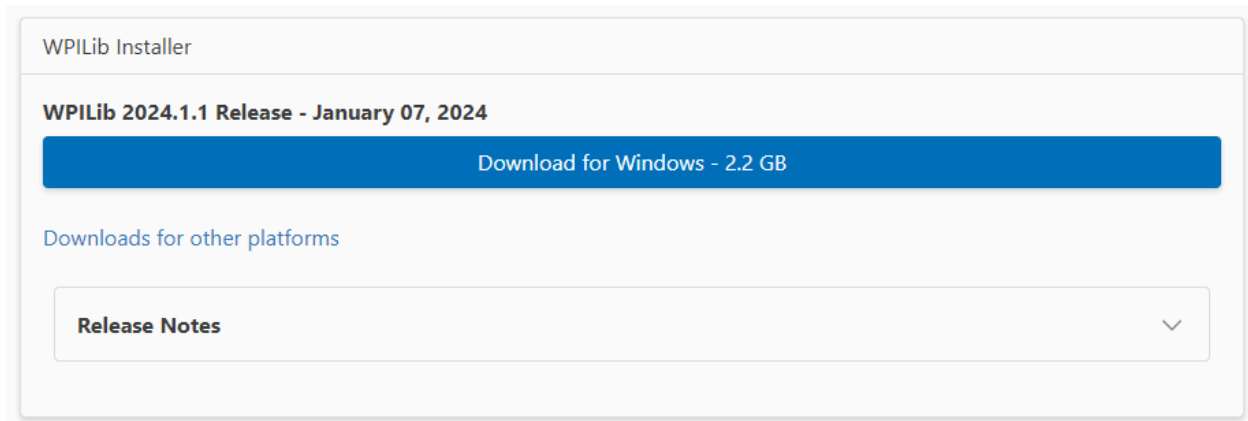
current Spark Max (if the motor type is set to NEO, the sensor type should automatically change to read the NEO's hall effect sensor). When you have set the CAN ID and motor type correctly, click "Burn Flash" at the bottom of the window. Do not worry about the "Save Configuration" button, this saves a copy of the current settings to the local computer, not to the motor controller itself.

Installing WPILib VSCode

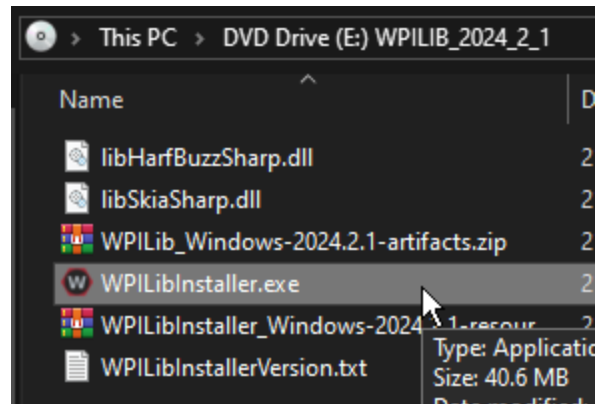
In order to begin programming your robot, you will need to install the WPI Library, which is a special version of Visual Studio Code with FRC-specific additions like the built-in ability to deploy code to the robot.

The official instructions for installing WPILib can be found [here](https://docs.wpilib.org/en/stable/docs/zero-to-robot/step-2/wpilib-setup.html). This section is intended as additional information.

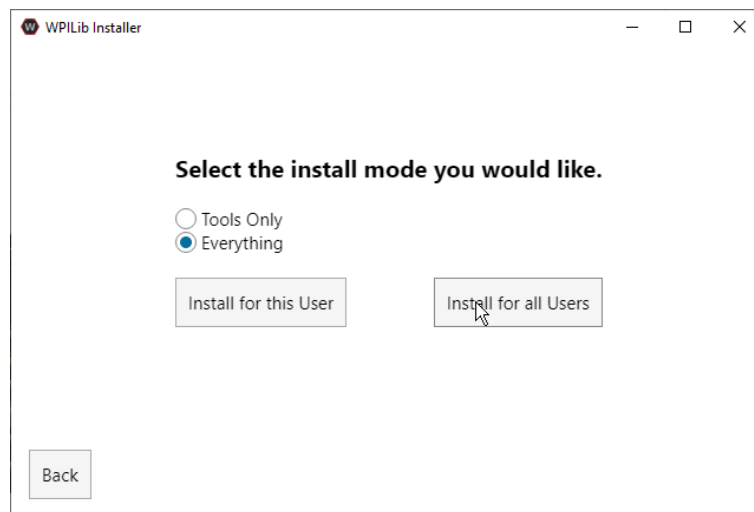
Download the WPILib installer from the link above. If you are using a non-Windows system, check the “Downloads for other platforms” link.



When the download is complete, launch File Explorer and find the downloaded file. It should be at the top of the “Downloads” folder by default. To properly run the installer, right click the file and select the “Mount” option with the icon of a disc. After the file is mounted, click WPILibInstaller.exe



Click “Start” and then install everything for all users.



On the next screen, select Download for this computer only and then select Next when the download is complete. Wait for the installation to finish and click Finish to close the installer.

WPILib Installer

For licensing reasons, this installer must download VS Code separately. Each year gets its own install separate from the system one.

We strongly recommend using WPILib's VS Code instead of the system one or a separate IDE.

Done Downloading. Press Next to continue

Download for this computer only (fastest)	Skip and don't use VS Code (NOT RECOMMENDED)
Download VS Code archives to share with other computers/OSes for offline install	Select existing VS Code archive for offline install on this computer

Back

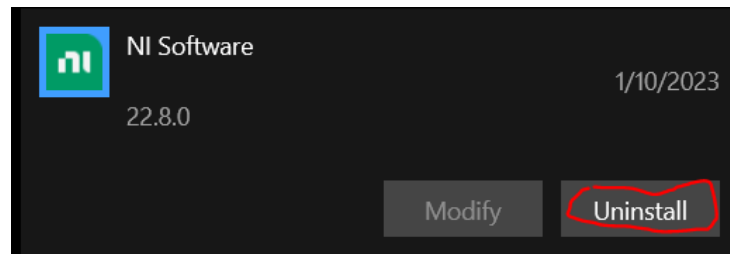
Next

Installing FRC Game Tools

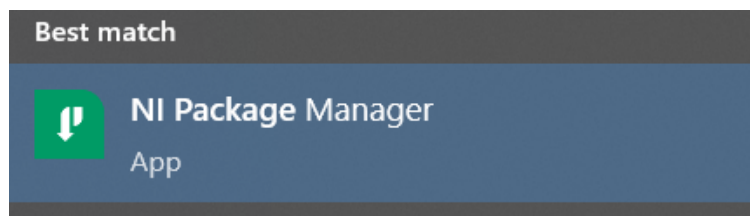
The official instructions for installing FRC Game Tools can be found [here](https://docs.wpilib.org/en/stable/docs/zero-to-robot/step-2/frc-game-tools.html). This section is intended as additional information.

The following three steps are for teams who have installed FRC Game Tools in previous seasons. Sometimes, having old versions of Game Tools installed will mess with new installations.

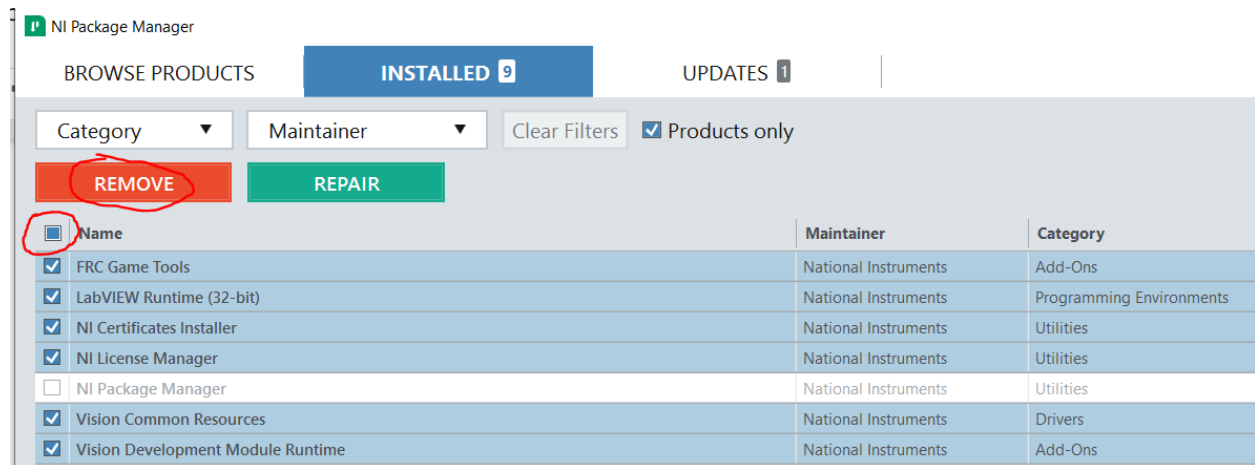
In Windows go to “Add or Remove Programs” and uninstall “NI Software”



Launch “NI Package Manager”



Click the circled radio box and then click remove to uninstall any older Game Tools components



Obtaining FRC Game Tools

Navigate

[here](<https://www.ni.com/en/support/downloads/drivers/download.frc-game-tools.html#500107>), make sure 2024 is selected, and click "download offline"



FRC Game Tools

FRC Game Tools provides components that help FIRST Robotics Competition (FRC) participants manage and communicate with robots.

[+ Read More](#)

Note: Install programming environments such as NI LabVIEW or Microsoft Visual Studio® before installing this product.

DOWNLOADS

Supported OS	Windows
Version	2024
Included Editions	Full
Application Bitness	32-bit and 64-bit
Language	English

FRC Game Tools 2024

Release Date
Jan/08/2024

Included Versions
2024

> Supported OS

> Language

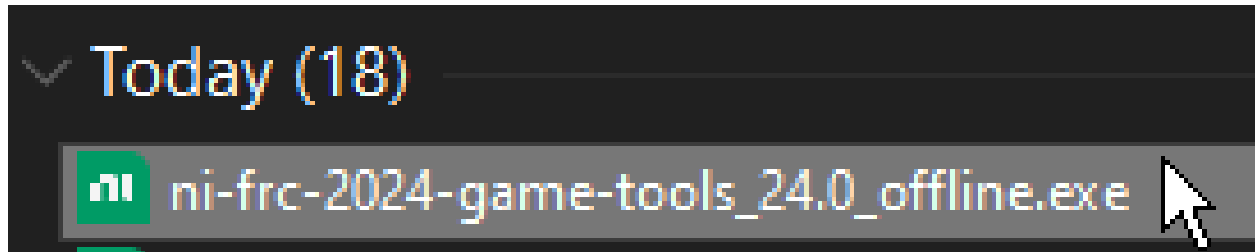
> Checksum

DOWNLOAD

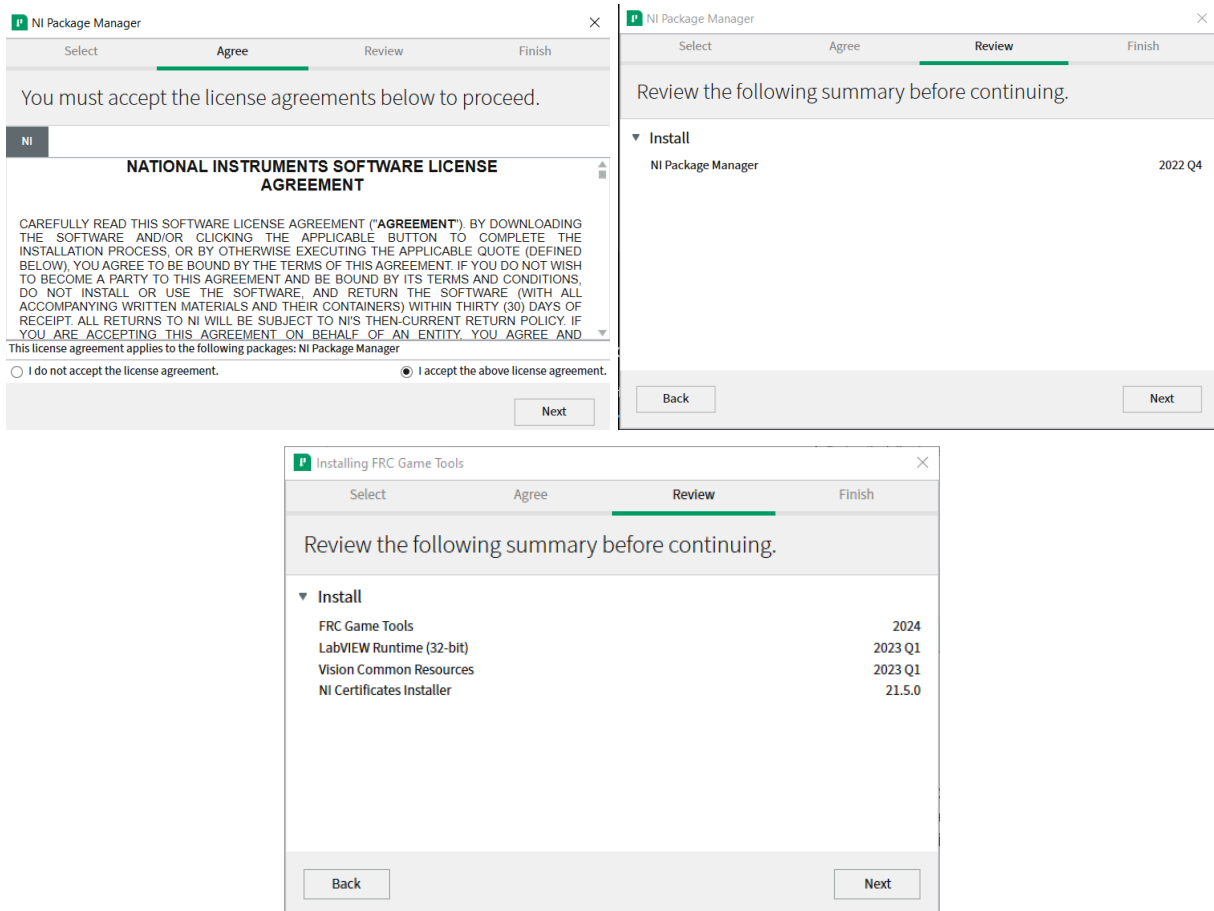
INSTALL OFFLINE

File Size
5.31 MB

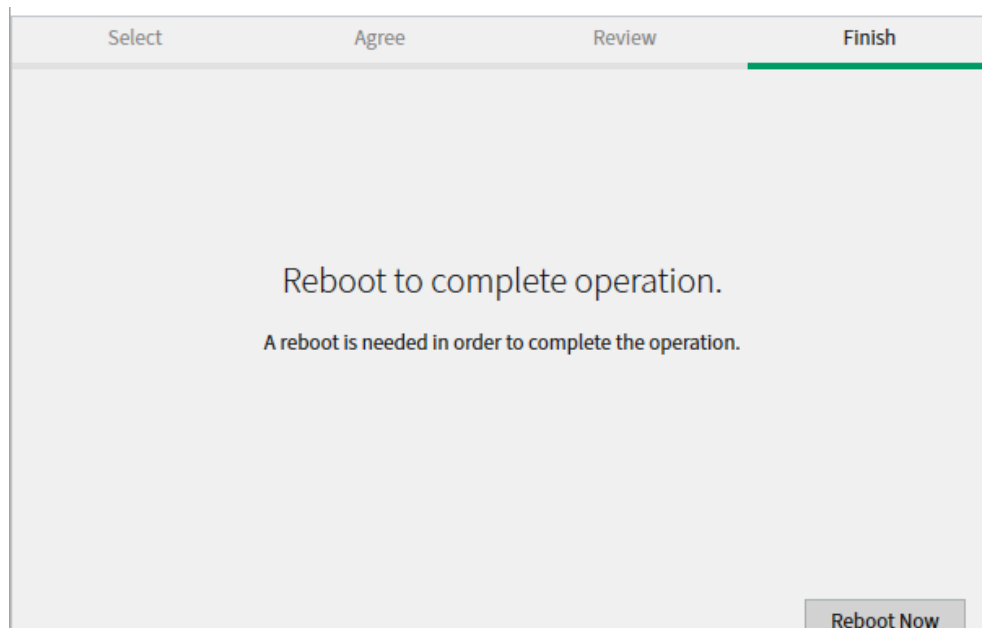
After the download is complete, launch the program



Continue hitting next and agreeing to the license terms when prompted



Reboot to finish the installation



Imaging RoboRIO 2.0

The official instructions for imaging the roboRIO 2.0 can be found [here](<https://docs.wpilib.org/en/stable/docs/zero-to-robot/step-3/roborio2-imaging.html>). This section is intended as additional information.

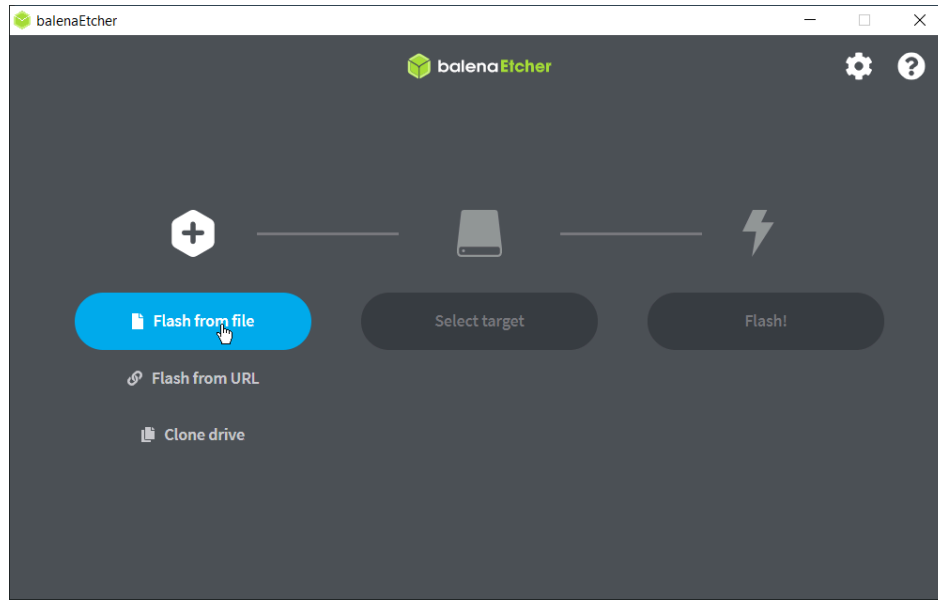
The National Instruments roboRIO 2.0 included with the rookie Kit of Parts has to be “imaged” with a known set of files before it can be used to run your robot. You must have completed the TODO: FRC Game Tools installation and have your roboRIO connected to power from the Power Distribution Hub. For veteran teams with the original roboRIO, see the [WPILib documentation](<https://docs.wpilib.org/en/stable/docs/zero-to-robot/step-3/imaging-your-robo-rio.html>) for instructions on imaging the original roboRIO.

To image the roboRIO 2.0, the included 4 GB microSD card has to be inserted into a SD card reader in a computer. The Lenovo laptop included in the rookie Kit of Parts includes a built-in SD card slot, but an adapter is required to fit a microSD card.

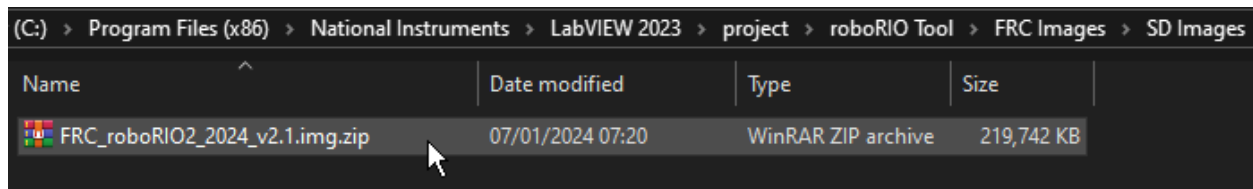
Take the microSD card and insert it into the computer you previously installed FRC Game Tools on.

Download and install [Balena Etcher](<https://etcher.balena.io/>).

After installation is complete, launch Balena Etcher and select “Flash from File.”

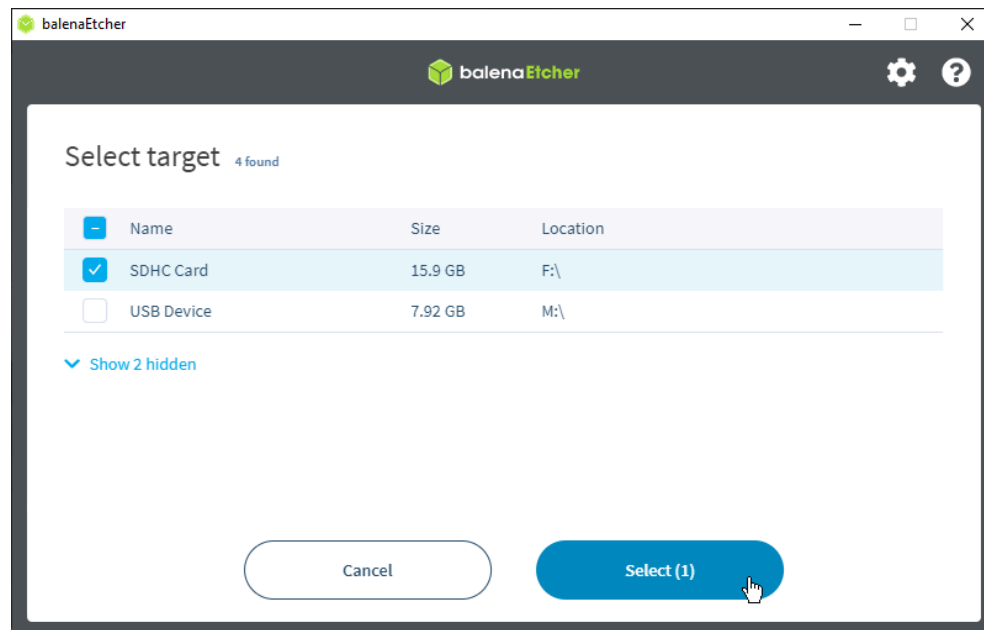


Locate the FRC_roboRIO2_2024_v2.1.img.zip file. If FRC Game Tools is correctly installed, it should be located in C:\Program Files (x86)\National Instruments\LabVIEW 2023\project\roboRIO Tool\FRC Images\SD Images



Balena Etcher may have automatically selected the microSD card as the target drive. If it did not, click “Select target” and pick the microSD card from the list of drives.

If you have a USB flash drive or other storage device plugged into the same computer, change the target to the microSD card. If the microSD card does not appear in the list of devices, click “Show [x] hidden” and see if it appears there, try removing and reinserting it, or try a different SD card reader.

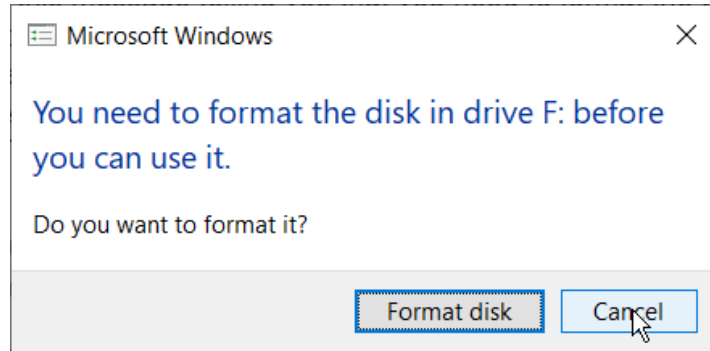


Click “Flash!” to copy the roboRIO 2.0 image to the microSD card.

Imaging a device will erase whatever data is currently on it and replace it with the roboRIO 2.0 image files, so make sure the target device is your microSD card or you may accidentally erase important data on a different drive.

When Balena Etcher has finished writing the image to the microSD card, remove it from the computer and insert it into the microSD card slot on the roboRIO 2.0.

After Balena Etcher is done, Windows may tell you that a new device needs to be formatted before it can be used. Click cancel on this window. The microSD card is now formatted in a way that the roboRIO 2.0 can understand but Windows can not.



Connect the roboRIO 2.0 to the computer using a USB cable plugged into the computer's USB port and the roboRIO 2.0's USB B port (the square-ish "printer" style port). Turn on power to the robot so the roboRIO 2.0 is on and booting up.

Launch the roboRIO imaging tool included with FRC Game Tools. After a little while, the imaging tool should identify the roboRIO as a valid target. If it does not, try a different USB port or cable.

Select the roboRIO in the target list. Fill out the "Team Number" box with your team's number and click "Apply." You should now be able to connect to your roboRIO correctly either wired directly to a computer or wirelessly through a correctly configured radio to upload code and drive your robot.

Imaging Radio

The wireless radio must be properly configured to communicate with the roboRIO and the driver station laptop. When you go to competitions, field staff will reprogram the radio again so that only the field hardware can communicate with it, and the robot will have to be connected directly with a USB or Ethernet cable to connect to the robot at competitions, and the radio will have to be reprogrammed after competition if you want to communicate with it wirelessly again.

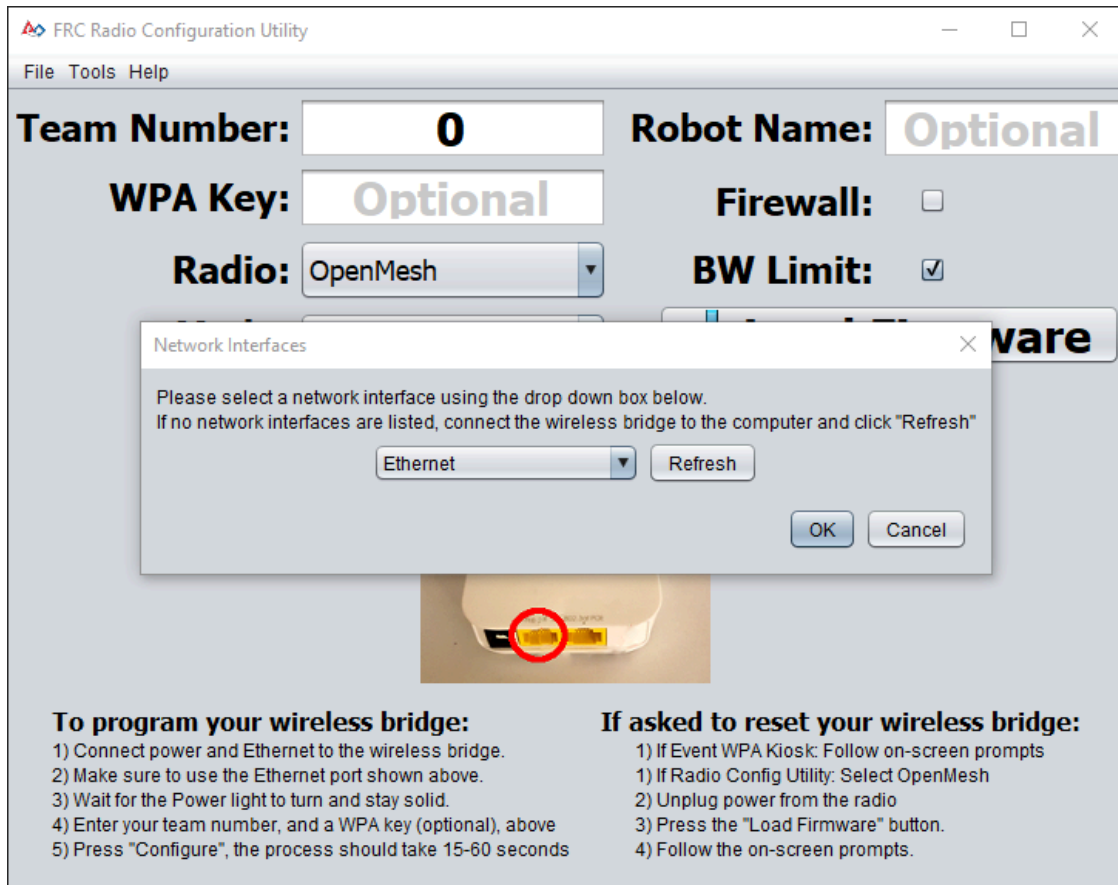
The Rookie Kit of Parts includes a USB dongle with additional USB ports and an Ethernet port that can be used with the laptop also included in the rookie kit.

The official instructions for imaging the robot radio can be found [here](<https://docs.wpilib.org/en/stable/docs/zero-to-robot/step-3/radio-programming.html>). This section is intended as additional information.

Download the FRC Radio Configuration utility at the link above. Click through the install process.

Connect the radio to power and the laptop. If your radio is wired using Power Over Ethernet in the left jack, turn on the robot so the radio receives power and plug an Ethernet cable between the right port on the radio and the laptop's Ethernet port (or the port on a USB dongle). Wait until the power LED has been on for 10 seconds before trying to configure the radio.

Open the Radio Configuration Utility. Select the interface for the Ethernet port on your laptop (probably called "Local Area Connection" or "Ethernet")



Other interfaces may mess with the utility's ability to image the radio. If there are connection problems, try disabling the wireless or other network interfaces in Device Manager and try again. Additional information about disabling other network adaptors can be found [\[here\]\(https://docs.wpilib.org/en/stable/docs/networking/networking-introduction/roborio-network-troubleshooting.html#disabling-network-adapters\)](https://docs.wpilib.org/en/stable/docs/networking/networking-introduction/roborio-network-troubleshooting.html#disabling-network-adapters)

The first time you set up a fresh radio, you will first need to flash it with a custom firmware. Make sure "OpenMesh" is selected in the "Radio" dropdown and select "Load Firmware".

FRC Radio Configuration Utility

File Tools Help

Team Number: **Robot Name:**

WPA Key: **Firewall:** ☐

Radio: **BW Limit:** ☒

Mode: **Load Firmware**

Configure



To program your wireless bridge:

- 1) Connect power and Ethernet to the wireless bridge.
- 2) Make sure to use the Ethernet port shown above.
- 3) Wait for the Power light to turn and stay solid.
- 4) Enter your team number, and a WPA key (optional), above
- 5) Press "Configure", the process should take 15-60 seconds

If asked to reset your wireless bridge:

- 1) If Event WPA Kiosk: Follow on-screen prompts
- 1) If Radio Config Utility: Select OpenMesh
- 2) Unplug power from the radio
- 3) Press the "Load Firmware" button.
- 4) Follow the on-screen prompts.

After the radio has the custom firmware, you should not need to reload the firmware unless it becomes corrupted or a new version is released (the last time there was new firmware was in 2019).

Now you will need to set the team number. Type the team number into the team number box and click "configure". The rest of the default settings are probably what your team will want, but there is more information on the page linked above if you are interested or want to change any of the settings.

When the radio is configured and turned on, it should broadcast a wireless network with the name set to your team number. Connecting to this network will allow your laptop to wirelessly connect to the robot to deploy code and drive the robot. Note that your laptop will be disconnected from the regular internet when connected to the robot, so you will need to disconnect from it and reconnect to your normal wifi network if you need to download or look something up in the middle of testing the robot. At competition, the driver station consoles on

the field will have an ethernet cable that you plug into your laptop, and the field electronics will handle connecting to your robot wirelessly.

Remember - you will not be able to connect wirelessly to your robot in the pits or on the practice field at competition, so you will want to bring a USB B and/or Ethernet cable to tether to the robot to update code and test systems. A long Ethernet cable is also useful if you want to test autonomous or practice driving if your event has a practice field, as the robot will need to remain tethered while moving.

If you run into problems connecting to the radio, check that other network devices have been turned off and that nothing else is plugged into the radio or laptop. You may find it necessary to remove the radio from the robot and plug it into the wall using a 12 volt center positive power supply through the barrel jack with the ethernet cable plugged into the left port closer to the barrel jack. Check the troubleshooting steps at the link above or try the configuration utility on a different computer if problems persist.

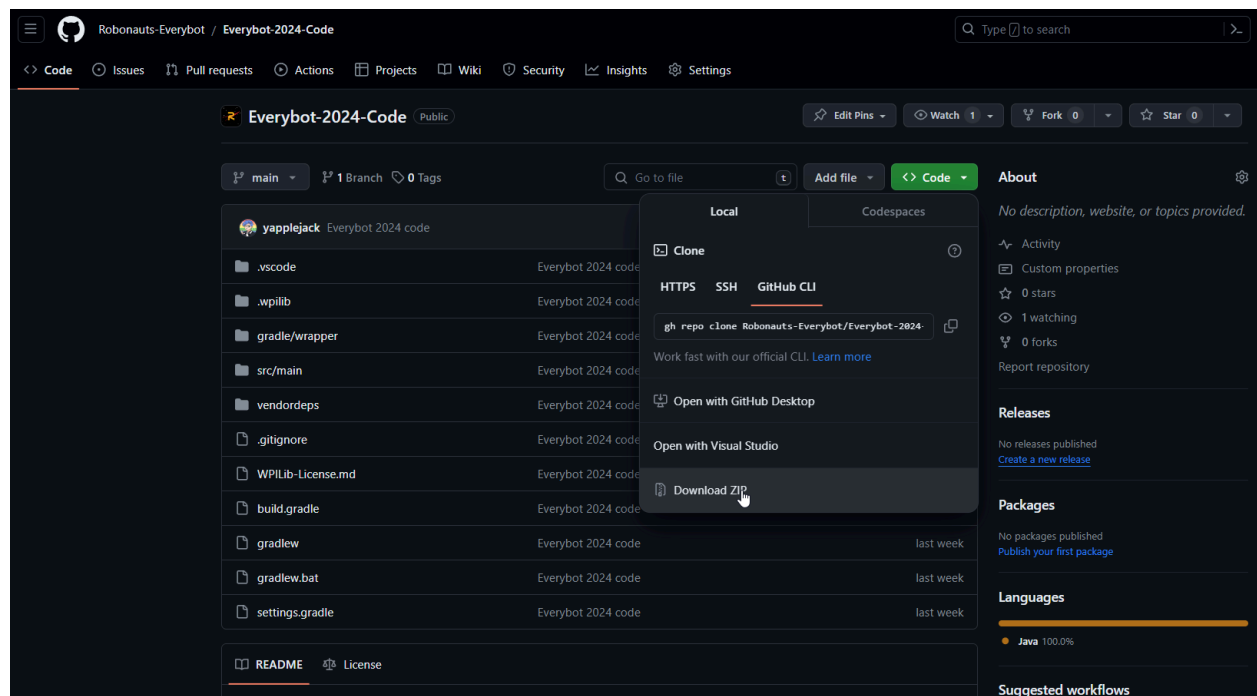
Deploying Starter Code

More documentation on connecting to the robot and deploying code can be found [here](https://docs.wpilib.org/en/stable/docs/zero-to-robot/step-4/running-test-program.html). This page contains Everybot-specific information.

Before enabling the robot with code for the first time, put it up on 2x4s or other “blocks” so that the wheels and drive belts are not touching anything and it will not move or run anybody or anything over. When you are confident the drive system is working properly, you can try running it on the floor.

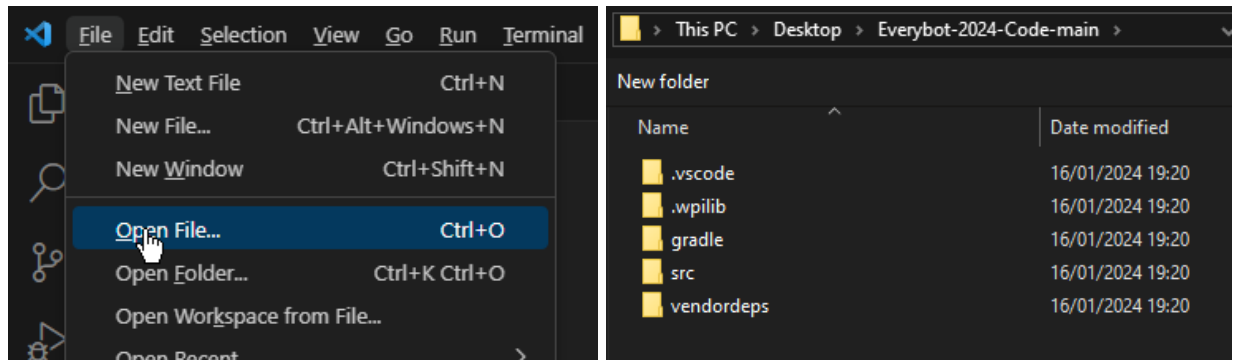
Ensure you have followed the previous steps and have the necessary software installed and hardware configured.

Download a ZIP file of the 2024 Everybot code
[here](https://github.com/Robonauts-Everybot/Everybot-2024-Code)

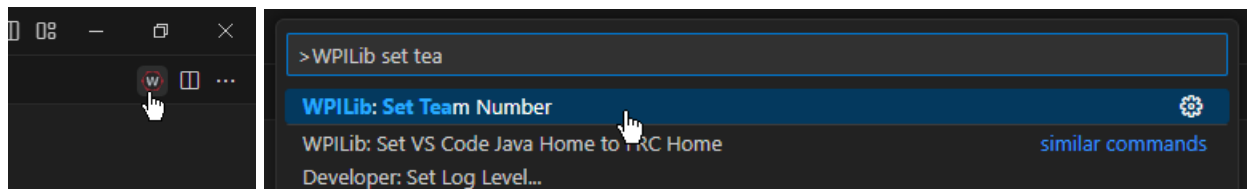


Unzip the file and move it to a location you will remember like the desktop. Open up WPILib VS Code

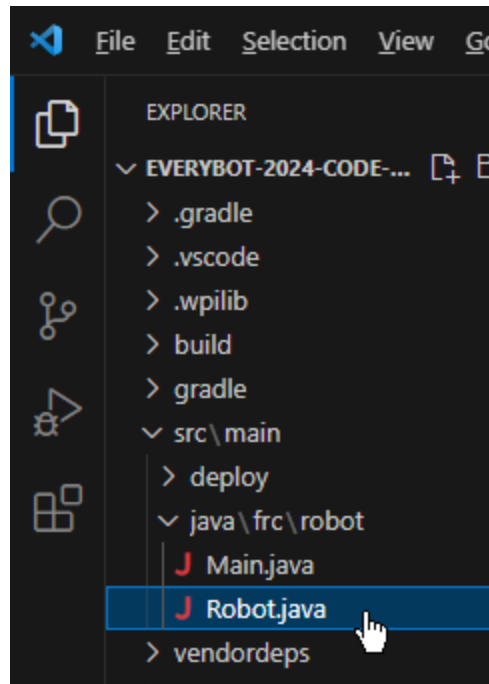
In the “File” menu, click “Open Folder...” and select the folder you extracted. This folder should contain the folders .vscode, .wpilib, gradle, src, and vendordeps. You may need to indicate that you trust the authors of these files before you can edit and use them



Click on the “W” in a hexagon in the upper right corner of the screen and search for “set team number”. Set the number to your team’s number (the same number used when you set up the roboRIO and radio)

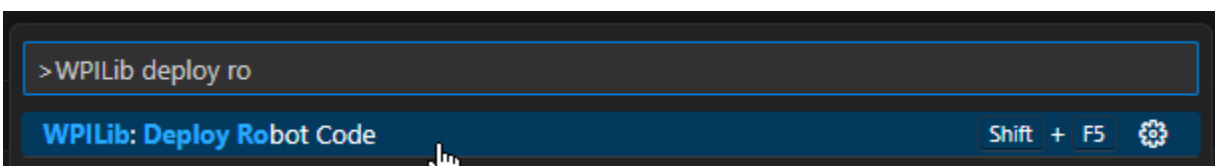


The actual code for the robot is in the file Robot.java. This file can be found by clicking into the src/main/java/frc/robot folder path in the file manager to the left of the main window. Check that this file does contain the robot code.



Ensure the robot is wired and the Spark Max CAN IDs have been assigned. Power on the robot and wait for it to boot up, joining the Wifi network with your team's number when it appears. Alternately, connect directly to the robot with a USB printer cable or Ethernet cable (this is required at competition where the radios are reprogrammed to only communicate with the field).

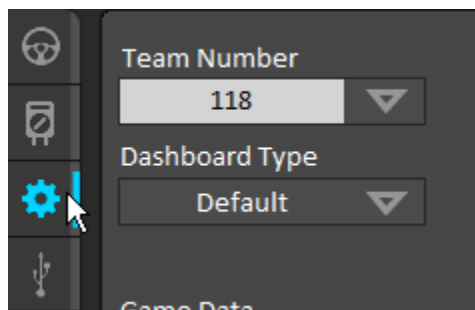
Deploy the robot code. Click the “W” again and search for “deploy robot code”. This will take longer the first time you do it, and any errors that WPILib encounters will appear in the terminal at the bottom of the screen.



If you encounter an error about not being able to communicate with the robot or roboRIO, check that all of the control system is receiving power and change connection methods (switch to a USB or Ethernet cable). If there is an error about code compiling, check that the code was properly downloaded and extracted.

If you are using one laptop to program and drive the robot, open the FRC Driver Station software installed as part of FRC Game Tools previously. If you have a different driver laptop, disconnect the programming laptop and connect the driving laptop to the robot's wireless network instead and open the FRC Driver Station on that computer.

If this is your first time opening the driver station, you will need to set your team's number. Click the settings gear in the lower left corner and set the team number.



The driver station will likely say “No Robot Communication” when it first opens. If the robot is connected properly, this should change to “Tele-op Disabled” after a short time, and the communication and robot code indicators should change from red to green. This may take a minute or two, but if you have been waiting for five or so minutes there is probably a connection problem. Try connecting directly to the robot with a USB or Ethernet cable.

Connect whatever USB controllers your team wishes to use to control the robot to the driver station laptop (some are provided in the Rookie Kit of Parts, but Xbox or other **wired** controllers can also be used). Click on the USB symbol in the lower left hand corner and you should see a list of connected USB controllers. Pressing a button on a controller will show which number it has been assigned.

The default Everybot code desires two controllers. By default the controls are set up for the two Logitech controllers included in the Rookie Kit of Parts. Xbox and PlayStation style controllers use different axis and button mappings and may cause the robot to move unexpectedly if used without modifying the provided code.

The driver controller uses axis 1 (up and down on the left stick) to move forwards/backwards and axis 4 (left and right on the right stick) to turn left/right.

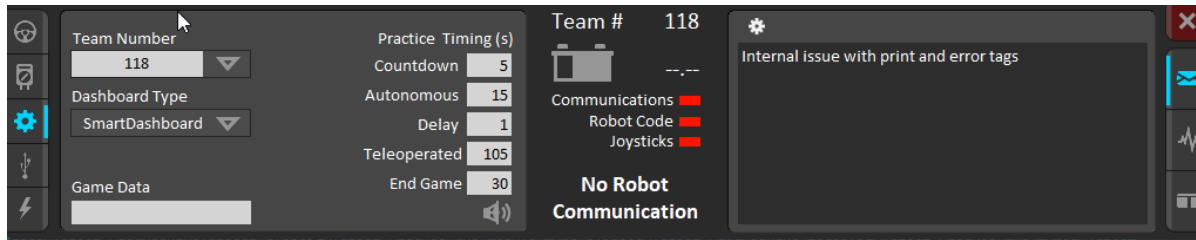
The other controller, for the “operator”, controls the mechanisms. The Logitech controller buttons are indexed from 1, not zero, with raw button 1 (A on the Logitech) used to spin up the launcher wheel and button 6, the right bumper (button above the right trigger) to feed the Note into the spinning launcher wheel. Button 5, the left bumper, is used to intake Notes into the launcher. Button 2, the B button on the Logitech controller, is used to spit a Note in the launcher out onto the floor. Buttons 3 and 4 (X and Y on the Logitech) are used to power the roller claw in and out, with the buttons powering it in opposite directions. POV down and up (also called 0 & 180, the “POV” control is more commonly referred to as the D-Pad or directional pad. It can be pushed any cardinal or intermediate direction) will move the climber up and down.

Click back to the steering wheel tab in the left hand side of the driver station window. This main tab has controls for “enabling” the robot. Enabling is the process for starting the main sections of your robot code that allow it to actually respond to controls and do things. There are also options to test specifically the autonomous modes as well as run a complete “practice” match with a timed autonomous mode that then transitions to teleoperated before disabling the robot at the end of the match period. Make sure nobody is touching the controls and that everyone is clear of the robot. It is good practice to say “Enabling!” before enabling the robot so that people around know that the robot is going to begin moving soon and to stay out of the way.

The orange Robot Signal Light should begin blinking. The number 0 controller should have control over the drivetrain. Carefully push the stick forward and see if the robot’s wheels run forwards.

Check that the launcher and other mechanisms are working properly. If motors are spinning in the wrong direction, look at the code in WPILib and change the “inverted” settings for the relevant motors (see the comments in the code for more information). If motors are not moving at all, make sure they have the correct CAN IDs and check if the motors are plugged in properly. The lights on the motor controllers will go from blinking to solid when getting a “0” signal and then blink red when told to reverse and green when told to go forward. If the lights do not change color, there is probably a problem with the communication wiring. If the lights do change colors but the mechanisms are not running, there may be a problem with the wiring going to the motor or a mechanical issue with the gearbox or mechanism. If the motor controllers have no lights at all, they probably are not receiving any power. Check that there are breakers inserted into the relevant slots in the PDP/PDH.

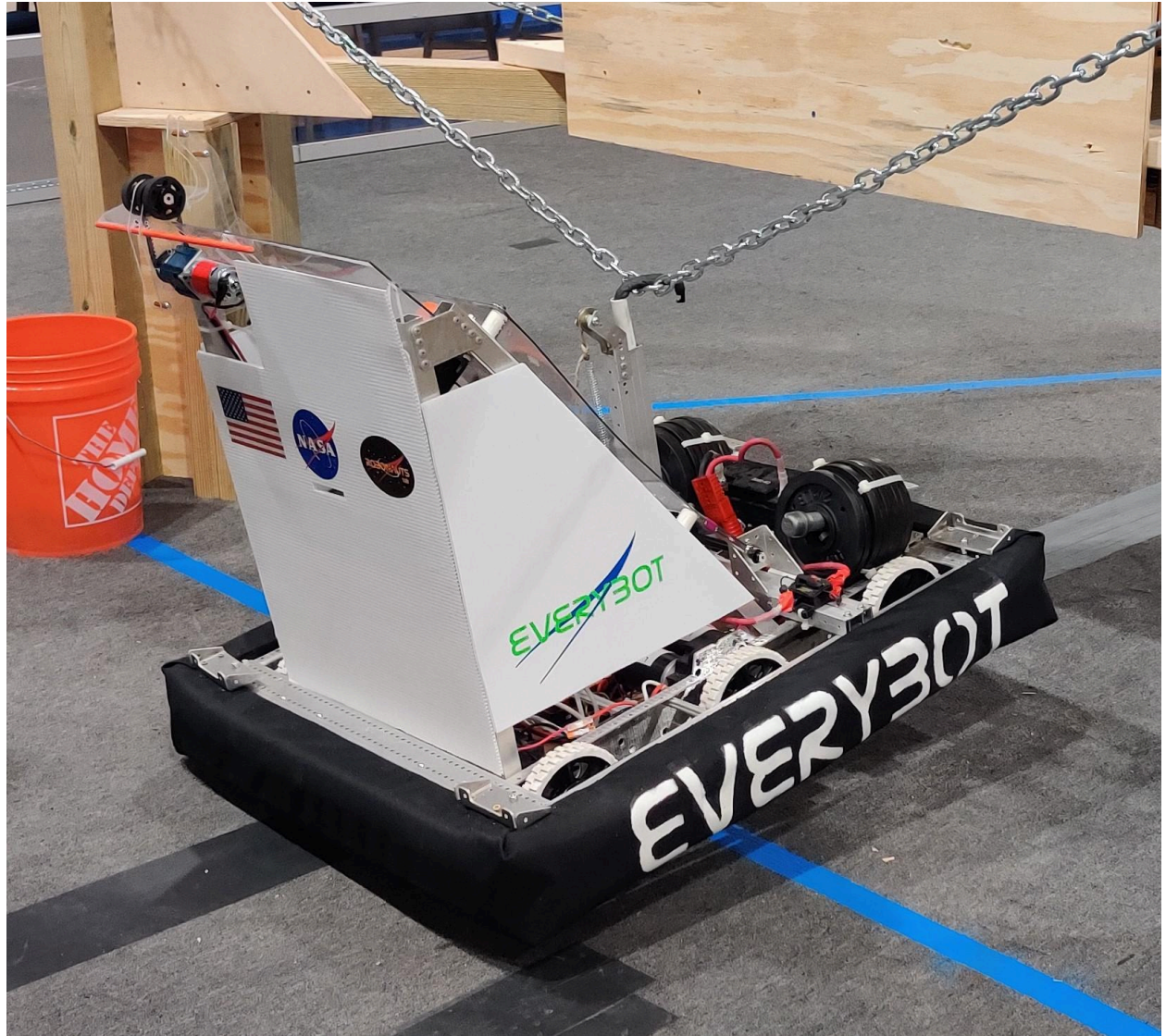
After testing out teleoperated (normal human-controlled) mode, try out the pre-programmed autonomous mode. Select the autonomous mode in the driver station. This can be done via the smartdashboard, select the radio button that corresponds to the desired auto.

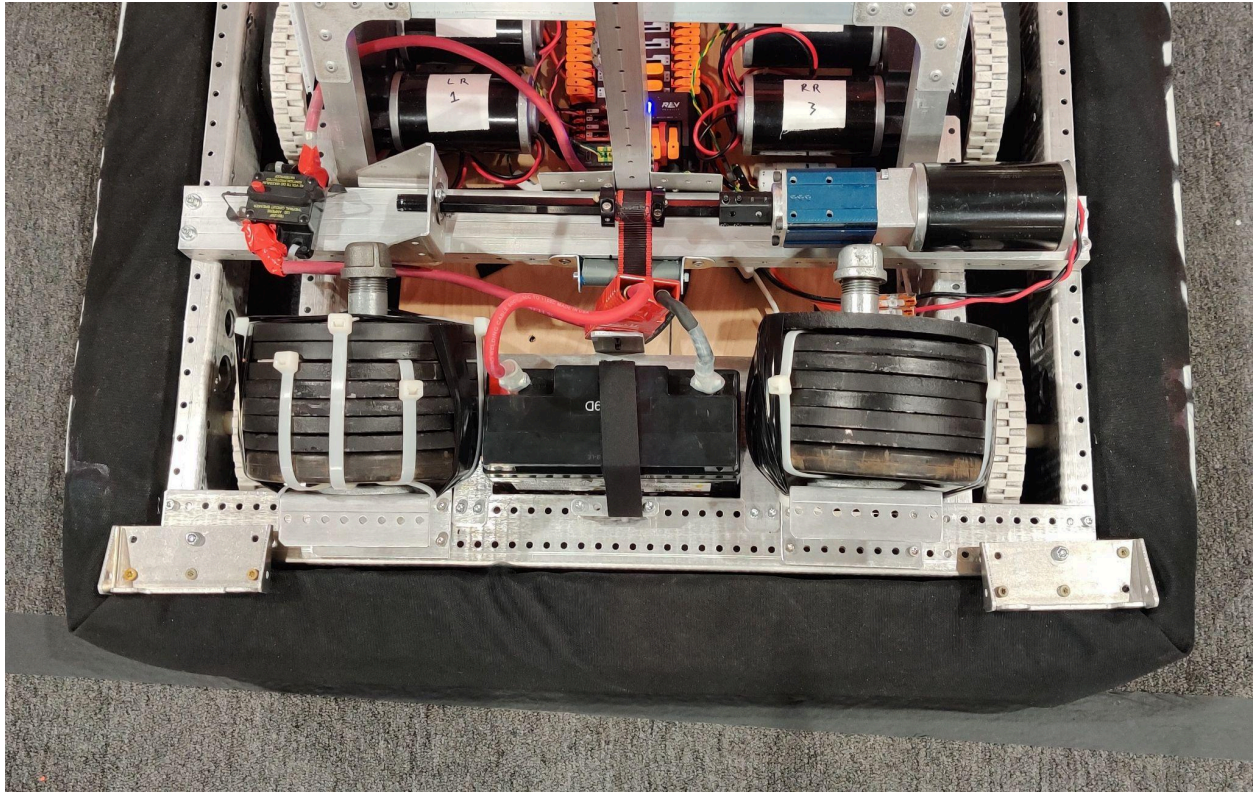


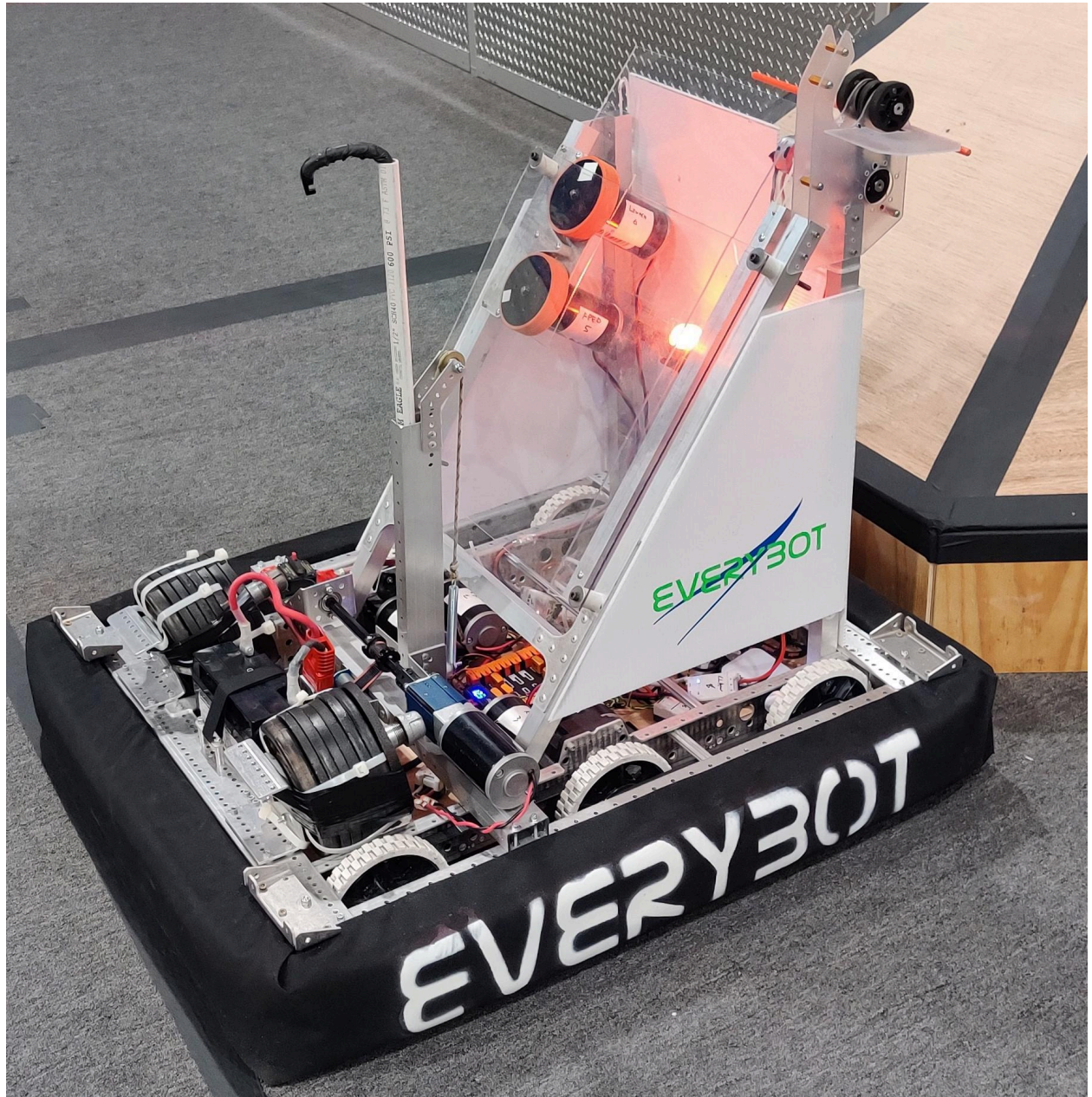
Enable the robot in autonomous mode to see if it functions correctly (try it up on blocks first). The score auton will only run the launcher, the back up auton will back the robot up, and the launch and back up auton will do both. The do nothing auton does nothing. Try out adjusting some of the auton time settings in the code (you will have to redeploy code every time you make a change) and see how they affect how long and far the auton runs. You may need to adjust autons before matches based on what you and your alliance partners want to get done in auton for a particular match.

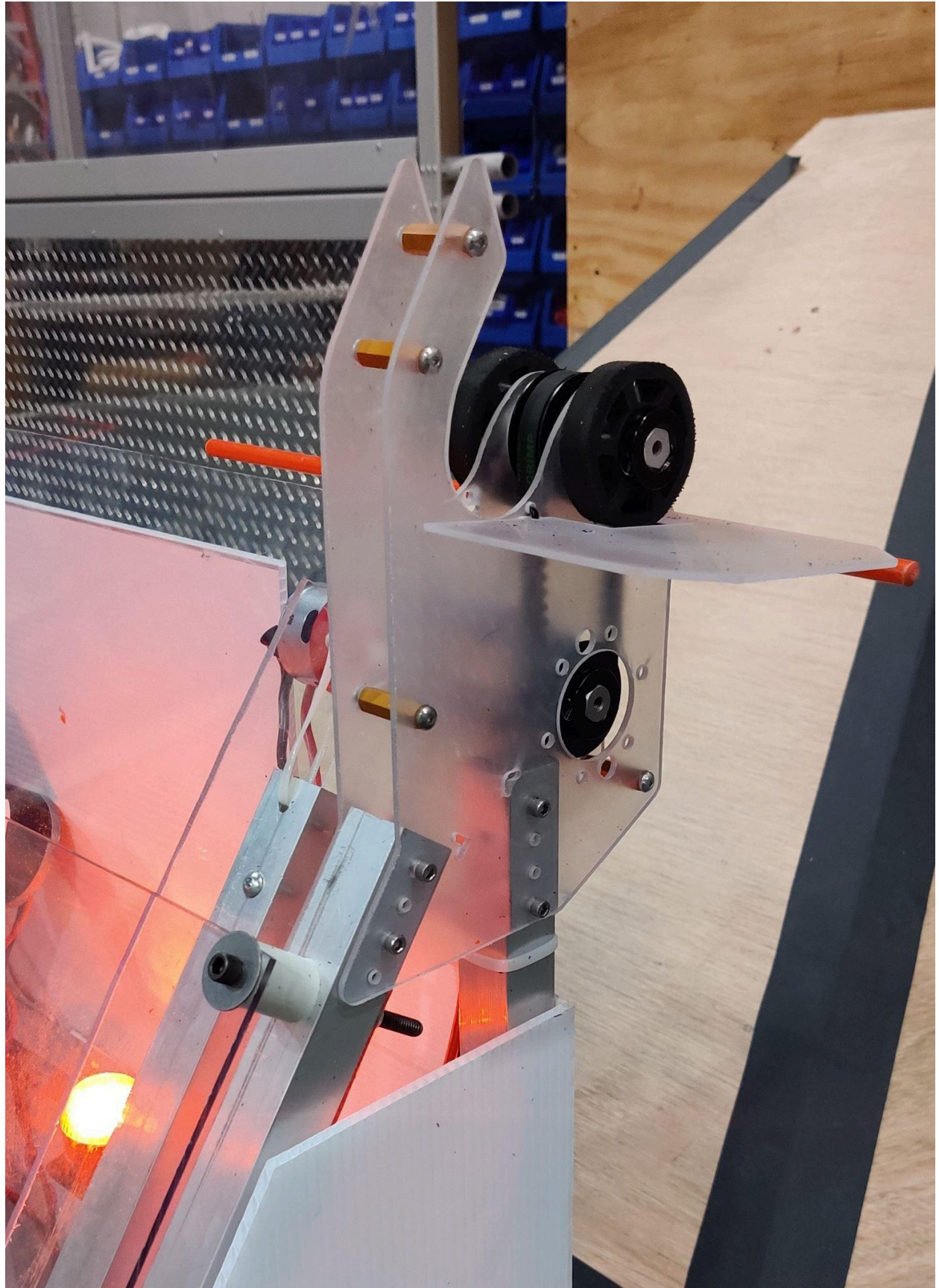
If you look carefully at the code and the comments included, you should be able to see how the autonomous routines are written and how your team can modify the existing ones or add new ones. More complex autonomous routines may benefit from encoders, gyroscopes, or other navigational sensors.

Completed Everybot Photos

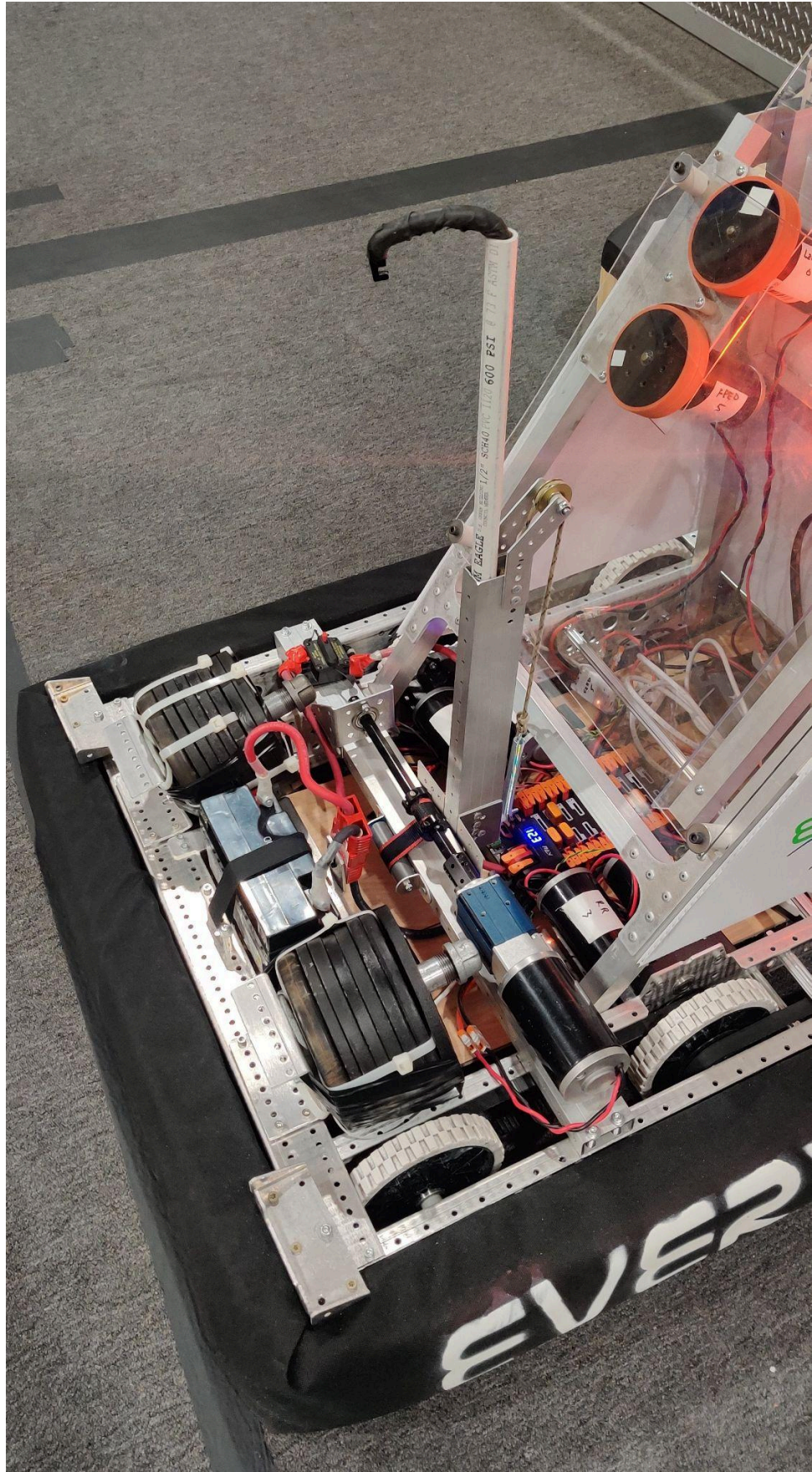


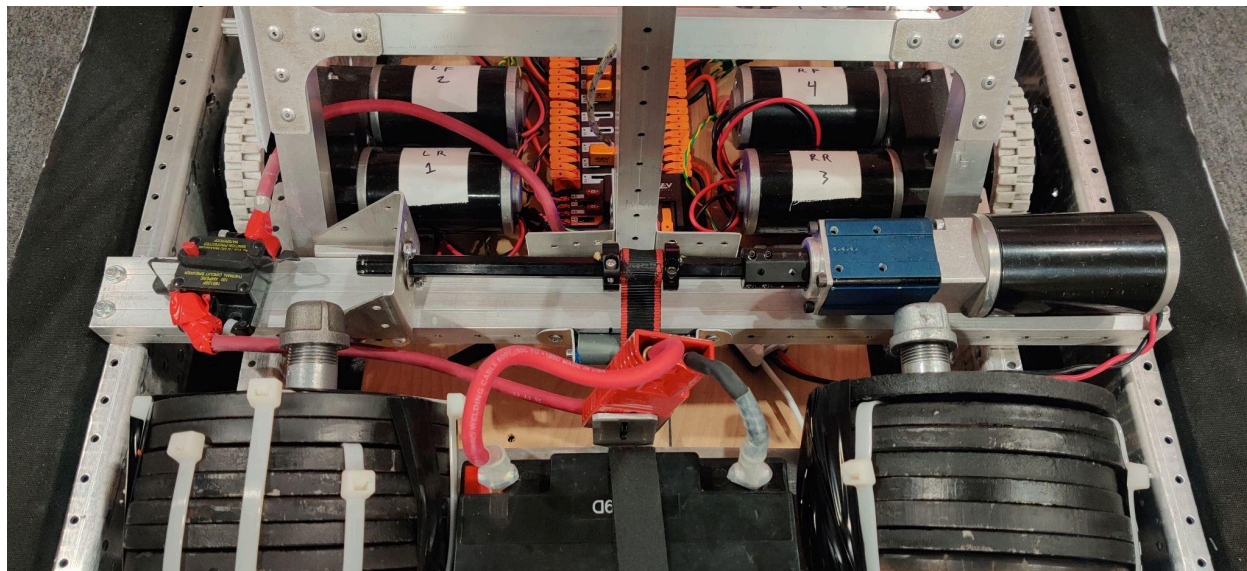


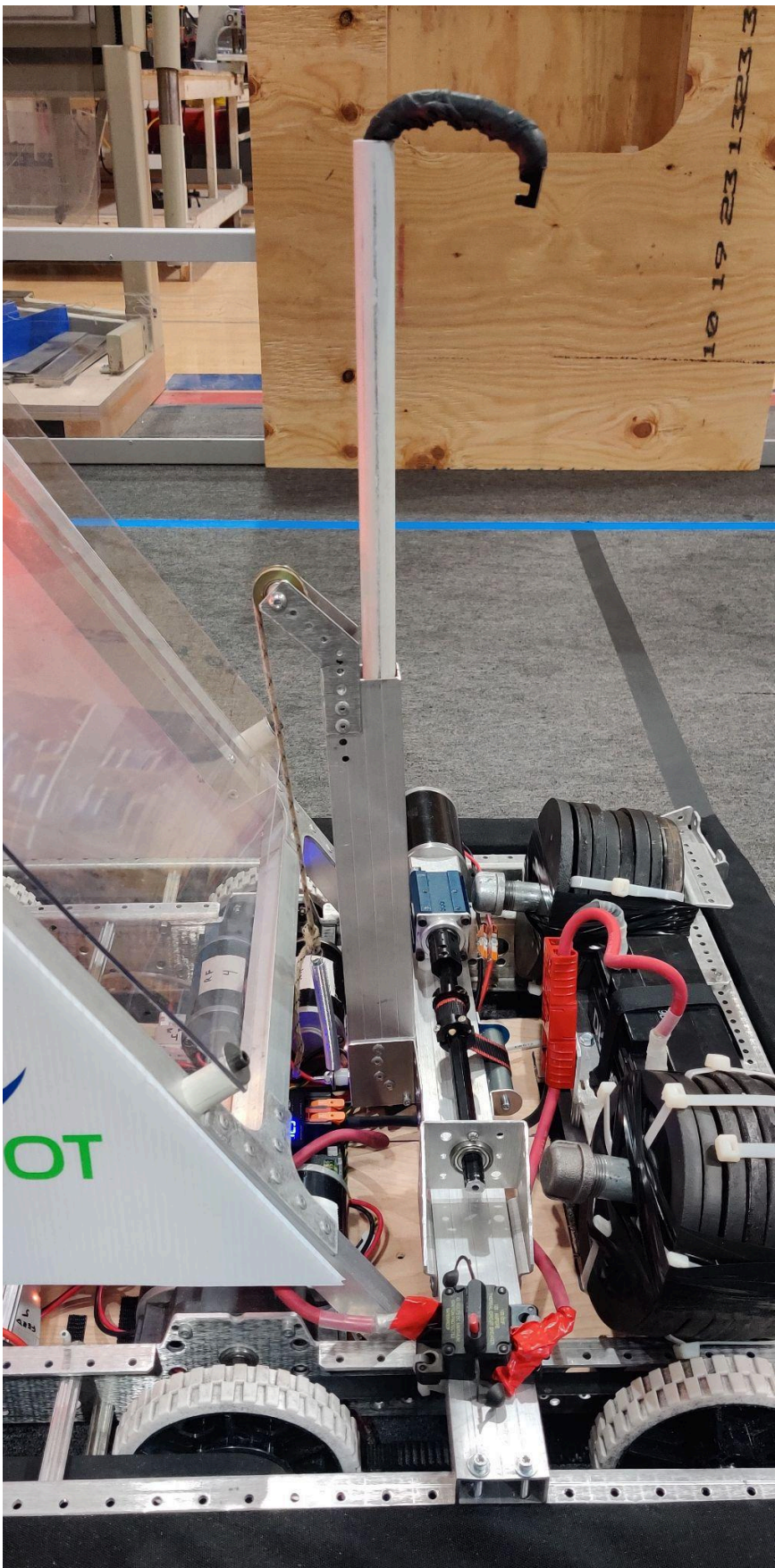


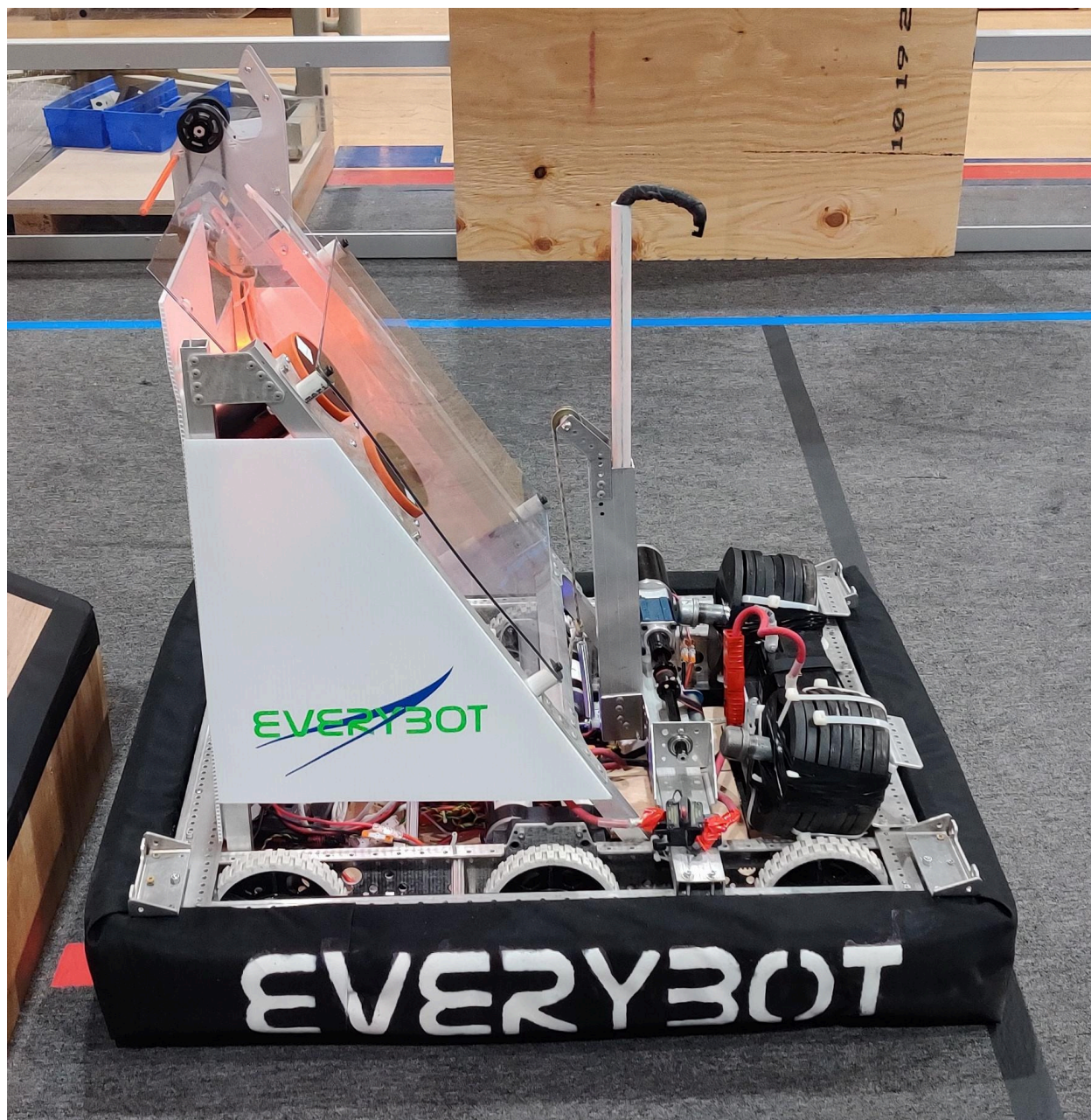












Everybot Troubleshooting

Everybot does not climb high enough

If the Everybot climber does not lift the robot far enough off the ground, check that the PVC slider can easily make its way up and down the climber box tube and that the motor and gearbox are running and engaging correctly. If the back of the robot makes it off the ground but the front hangs down and remains touching the ground, add more weight to the rear ballast.

Everybot does stay climbed

If the Everybot droops down on the chain and touches the floor within the period of time it would normally be hung up during endgame, a 1/2" ratcheting wrench can be added to the shaft to hold the robot up. A ratchet with a reversible pawl so that it can be flipped around to the other direction so it can more easily be reset is preferred, otherwise the ratchet would need to be removed after every climb. Be careful to not drive the climber too far as it will bind up the ratchet. Some kind of catchment like bolts in the bearing support on the climber may be helpful in keeping the ratchet in place.

Everybot can not intake Notes into the launcher

If Notes are falling shallow off the intake chute for the launcher the height of the front of the launcher may need to be lowered down slightly. The bend in the end of the lower launcher plate can be increased up to the point that it causes the Note to drag on the top of the launcher chute, as too much of a bend will push the bottom plate upwards too far and cause shots to fall short. The [FIRST KitBot Guide](<https://firstfrc.blob.core.windows.net/frc2024/KitBot/KitBot%20Build%20Instructions.pdf>) includes a section at the bottom with troubleshooting steps that suggests adjusting the front mounting point where the upright supports meet the chassis.

Everybot can not make shots into the Speaker

Make sure the launcher wheel is spun up to full speed before firing. Check that the Notes are not scraping against the launcher top panel and adjust the bend in the end of the bottom panel so there is less of a hump midway through the launcher chute. If you have a slow motion camera on a team member's cell phone, record a Note firing out of the launcher from above and see if it is brushing up against or bouncing off the roller claw or another portion of the robot. If the Notes are close to making it in, a slight adjustment of where the launcher mounts to the front of the chassis may also help. In our experience, both the KitBot and the Everybot shoot to the left rather than directly straight ahead.

Can we use other motors/gearboxes/brackets/etcetera

In general, yes! Ideally, the climbing gearbox is somewhere between approximately 50:1 to 75:1, but other configurations may work, they will just need to be tested first. A variety of different manufacturer's gearboxes can be used to run the climber. Any of the larger FRC-legal motors (CIM, NEO, Falcon, MiniCIM, etc) can drive the climber as well as 775-class motors as long as you are careful to not stall the motor and burn it out. The Everybot roller claw plates can accept mounting for a 775Sport, Max Planetary (and any motor with a 2 inch bolt circle), or VersaPlanetary.

If you are having additional problems with the Everybot or KitBot, please get in touch with the Everybot team in the [Everybot Discord server](<https://discord.gg/b3GbxFzkt>). This page will be updated with additional information as the season progresses.