

AutoRally Chassis Instructions



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1 Getting Started

This is a step-by-step guide to construct a complete AutoRally chassis. Starting from a 1/5 scale HPI Baja 5SC chassis, you will replace the gasoline engine with an electric conversion, upgrade many of the stock parts, and install sensors and a few custom fabricated components. The result is an off-road autonomous research' chassis capable of high-speed aggressive maneuvers.

The chassis is controlled with a standard RC transmitter or by a computer connected to the electronics box. Seamless remote switching between autonomous and manual control is done with a switch on the transmitter. The last channel on the transmitter, controlled by another button, is a remote run-stop. It controls a live-man relay on the chassis that sits between the throttle signal and electronic speed controller (ESC).

Many of the steps refer to instruction booklets included with 3rd party components, the maintenance manual for the 5SC, or other documents located in [manuals/](#). To avoid extra work, make sure to follow only the portion of external instructions specified in this document.

These instructions assume some experience with, or willingness to learn: understanding manufacturer-provided documentation, soldering, 3D printing, laser cutting, servo motors, various crimps and housings, reading basic circuit diagrams, and Arduino programming.

The quality of solder joints, crimp housing connections, heat shrink coverage, and wire routing are especially important for the reliability of the chassis. The most common problems (and often most frustrating to debug) are loose wire housings, bad crimp connections, and failing solder joints.

Wire routing is the final step in the chassis build. **Make sure to leave sufficient length when cutting wires to allow proper routing on the chassis with slack for moving parts such as steering and suspension.**

While this chassis is the basis for an accessible research platform, it can cause serious injury and damage if operated in an unsafe manner. Only operate in an access-controlled space where the operator can maintain line-of-sight visibility to the chassis at all times.

This document is best viewed in color.

1.1 Total Time

Total estimated time to construct a complete chassis for one person is 41.75 hours, not including the time to print 3D printed and laser cut components, which will vary significantly based on the printer used. Each step includes an estimated completion time, but the actual time may be longer if you have to learn new skills.

1.2 Parts List

A complete parts list for the AutoRally platform (chassis and compute box) can be found in the [AutoRally Parts List](#).

1.3 Tools

Tools required for the assembly of the chassis: tool kit included with the HPI Baja 5SC, hex key set, Phillips screwdriver set, utility knife, wire cutters, wire strippers, needle nose pliers, crimp tool suitable for all crimps, soldering iron, 3rd hand, heat gun, hot glue gun, hand saw.

1.4 3D Printed Parts

Models for all components that require 3D printing are located in [models/](#). These parts include the electronics box assembly, brake disc aligners, rear wheel rotation sensor mounts, rear wheel rotation sensor magnet mounts, brake master cylinder mount. It is advised to use a 3D printer with support material. Print time for a complete set of chassis components is 26 hours and 35 minutes, which will vary greatly based on the printer used, and is not included in the build time estimate. Material usage for a complete set of chassis parts is about 250 cm³, not including support material. 3D printed parts were made on a Dimension SST 768.

1.5 Laser Cutting

The GPS box lid and chassis battery fooam (available in [models/](#)) are laser cut out of acrylic and craft foam, respectively.

1.6 Software

A few software tools should be installed to complete the chassis configuration:

- [Castle Serial Link](#)
- [Arduino IDE](#)

1.7 Resources Included with Instructions

- [AutoRally Parts List](#)
- Component models for 3D printing in [models/](#)
- Product manuals and datasheets in [manuals/](#)
- Video tutorials saved for offline viewing in [videos/](#)

1.8 Useful Links

Note: all videos can also be found in the [videos/](#) for offline viewing.

- [Castle Creations Electric Conversion Video Tutorials](#)
- [How to Solder Bullet Connectors](#)
- [Mecatech Brake Bleed Tutorial](#)
- [Molex Crimping Guide](#)
- [Crimping Tutorial](#)
- [Crimp Pins Pictures](#)
- [Adafruit Soldering Tutorial](#)

2 3D Printing

Time 30 hours 27 minutes (print time)

Parts

- Models for all chassis components are .stl files located in [models/](#)

Instructions

- a. Print all custom chassis components:
 - i. Electronics box
 - ii. Electronics box lid
 - iii. GPS box
 - iv. Left and right front brake disc aligners – **only print if front brakes are used**
 - v. 2 front wheel rotation sensor mounts – **only print if front brakes are not used**
 - vi. 2 rear wheel rotation sensor mounts
 - vii. 2 rear wheel rotation sensor magnet mounts
 - viii. Brake servo mount

3 Fabrication

Time 0 hours 30 minutes

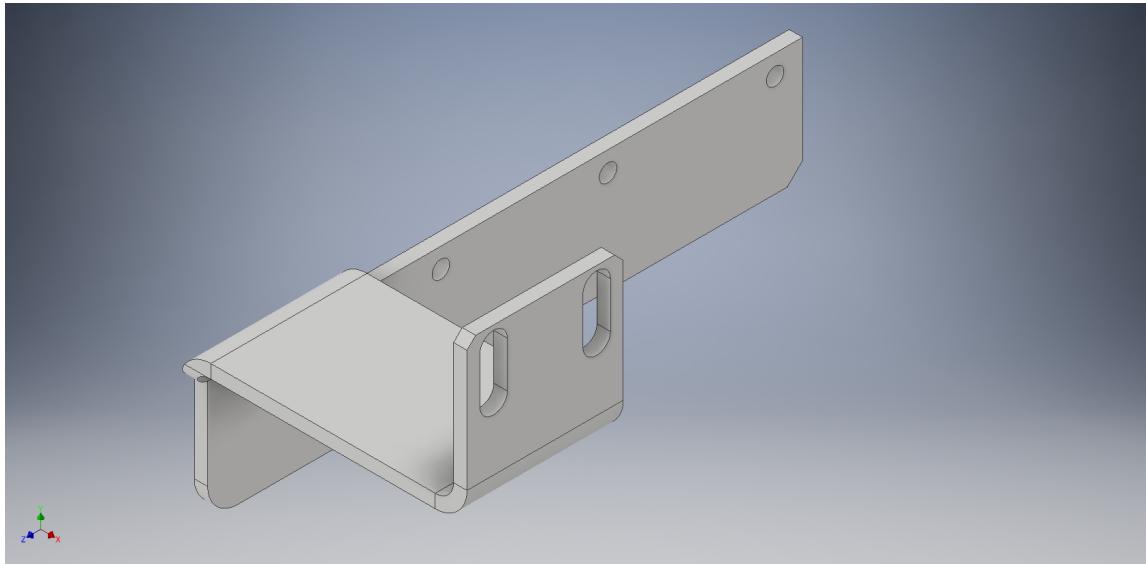
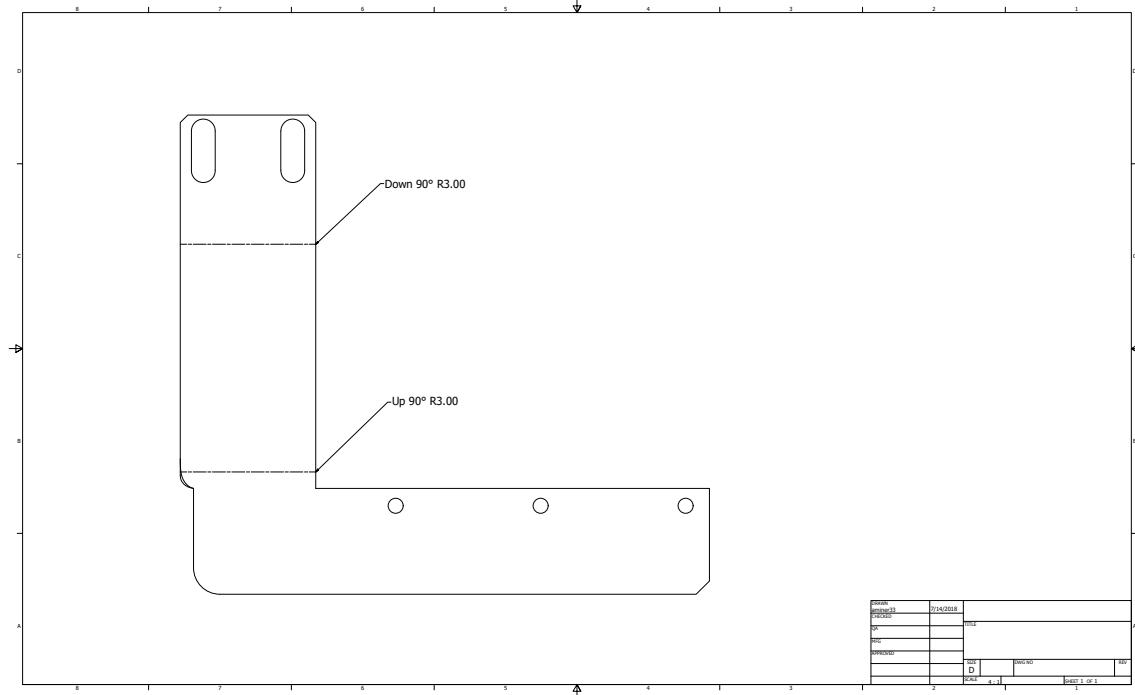
Parts

- 24 inch × 36 inch, 0.09 inch-thick 3003 aluminum sheet

Instructions

- a. Using a waterjet cutter, cut the Master Cylindar Plate.dxf file located in [models/](#) with a waterjet.
Make sure to position the cut tightly against an edge fo the sheet as the rest of the sheet will be needed for the compute box build.
- b. Bend the Master Cylindar Plate per the following diagram.

4 LASER CUTTING



4 Laser Cutting

Time 0 hours 30 minutes

Parts

- Models for all chassis components are .stl files located in [models/](#)
 - 12" x 24" x 5/64" acrylic sheet
 - Copper foil sheet 11.5" x 12"

- 6mm thick Craft Foam

Notes

- If available, use a laser cutter to cut out the parts. Otherwise, print the provided PDFs onto paper and use as stencils to cut the part manually.

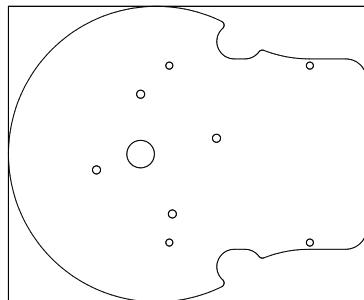
Instructions

a. GPS box lid

- i. Using the provided [GPS Box Lid.pdf](#) file, cut out the electronics box lid.



- ii. Roughly cut the copper sheet to the shape of the GPS box lid. Apply the adhesive side of the copper sheet to the top surface. Refer to either image below as reference for the top surface, which is the surface the antenna will be mounted against.

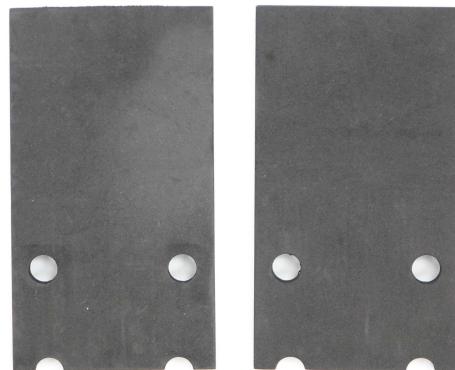


- iii. Trim the excess copper around the edges and through the holes of the GPS box lid.



b. Battery foam

- i. Using the provided Chassis Battery Foam.pdf file, cut out 2 copies of the battery foam.



- ii. Hot glue the 2 battery foam cutouts together.



5 Capacitor Precharge Circuit

Time 4 hours 0 minutes

Parts

- Castle Creations Mamba XL-X ESC
- 1 chassis battery (6500 or 9000 mAh)
- 1 pair 4mm banana plugs (male and female)
- 2 pieces red shrink wrap for 4mm banana plugs

5 CAPACITOR PRECHARGE CIRCUIT

- 1 resistor, 2 ohm, 3W
- 2 6.5mm male CC Bullet
- 1 piece red shrink wrap for 6.5mm bullet
- 1 piece black shrink wrap for 6.5mm bullet
- red wire, 16awg
- assorted shrink wrap

Caution: When working with batteries, always keep one exposed contact covered to avoid short circuits. Instructions

a. Watch [How to Solder Bullet Connectors](#)

b. Solder 6.5 mm male bullets to ESC leads. The leads may already be tinned by the manufacturer and might be too large for the bullet connectors. Before attempting to solder into the socket, you may want to shave off some of the solder until the leads will fit into the socket without being heated.



c. Apply heat shrink for 6.5mm bullets to ESC leads.



d. Cut 2, 2.5-inch pieces of the red 16awg wire. Solder one male/female 4mm connector to each wire piece, and heat shrink the connectors



e. Cut the 2 ohm resistor leads down like shown. Bend one lead down like shown.

5 CAPACITOR PRECHARGE CIRCUIT



- f. Solder the unbent lead of the resistor to female 4mm connector wire and heat shrink the connection.



- g. Remove the heat shrink from the red battery bullet connector. Cut away a small portion of insulation on one side of the red battery lead close to the bullet connectors and on one side of the red ESC power wire. It may help to tin the exposed wire to help with the upcoming soldering.



- h. Solder the male 4mm connector wire to the exposed wire of the red ESC power wire. Heat shrink the exposed section of wire.

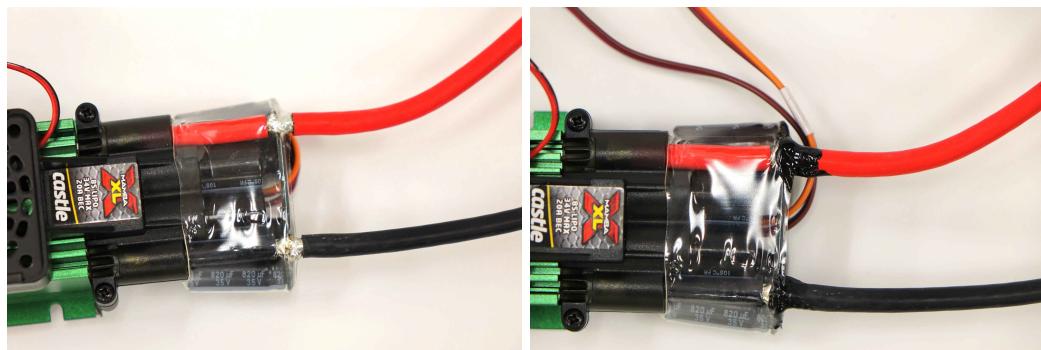


- i. Solder the bent end of the resistor to the exposed wire on the battery. Heat shrink over the connector and resistor.

5 CAPACITOR PRECHARGE CIRCUIT



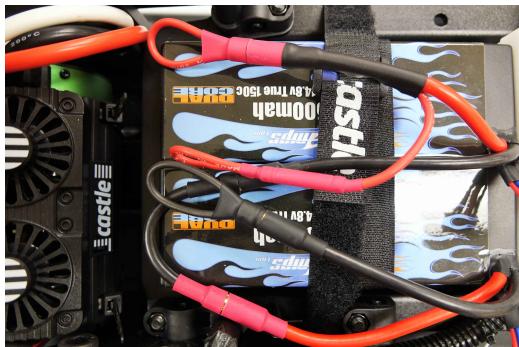
- j. Use liquid electrical tape to cover the exposed connections on the ESC as seen in the images below.



- k. Loop a length of red 16 awg wire and solder both ends into the solder cup of a male banana connector. Heat shrink the solder joints to ensure that they are not exposed.
- l. Repeat the process in the previous step to create two red loops with 6.5 mm male connectors and two black loops with 6.5 mm male connectors. Heat shrink the solder connection to ensure that no part of the connection is exposed. **Bring the heat shrink down to the edge of the connector body above the part that actually forms the connection.**



- m. Use the plugs created in the previous two steps to plug the battery connectors when the vehicle is not in use. This will prevent inadvertent battery connections or short circuits.



6 Electric Conversion

Time 8 hours 0 minutes

Parts

- Castle Creations ESC
- Castle Creations 2028 motor
- Castle Creations motor fan
- Castle Creations Baja (CCB) conversion hardware or Rovan Baja (RB) conversion hardware
- If using RB kit:
 - 2 M5×16mm button head screws
 - 2 M3×10mm socket head screws
 - 1" wide Heavy Duty Mounting Tape
 - Battery foam from “Laser Cutting” section

Notes

- If your conversion kit does not include instructions, refer to the Chassis-electric-conversion-instructions-CC_Baja.pdf file in the [manuals/](#) folder. The item numbers in this section correspond to those in the instructions' parts list.
- A link to videos is provided in “Useful Links” or they can be found in the Baja_Electric_Conversion_Videos in the [videos/](#) folder. Modifications to video instructions are listed below.
- Remember to **always** use thread low-temperature lock (Z186 red threadlock or blue Loctite 243 instead of the greenish-blue colored thread lock Z159) for metal-on-metal connections.
- Video #7 can be skipped since that covers what should be done in the “Capacitor Precharge Circuit” section.

Instructions

- a. Remove the wheels, rear skid plate, engine plate, side covers, both side rail guards, and the roll cage as shown in video #2.



- i. Removal of rear skid plate: Remove the single body clip at the back holding the skid plate to the frame. Then pull the skid plate out.



- ii. Removal of side guard rails: For each guard rail, remove the 2 screws on the top (front side), 2 at the bottom (rear side) and 1 body clip each (rear side). Use provided tools with the conversion kit.



- b. Disassemble the transmission as shown in video #2. **Remove the C-clip first (you can use pliers for this). Use the extra spur gear provided to remove the pinion gear (refer to the images).**



- c. Remove the rear brake and clutch, both engine mount braces, the air filter sleeve set, and all engine screws on the base plate (on the bottom of the chassis) as shown in video #2.

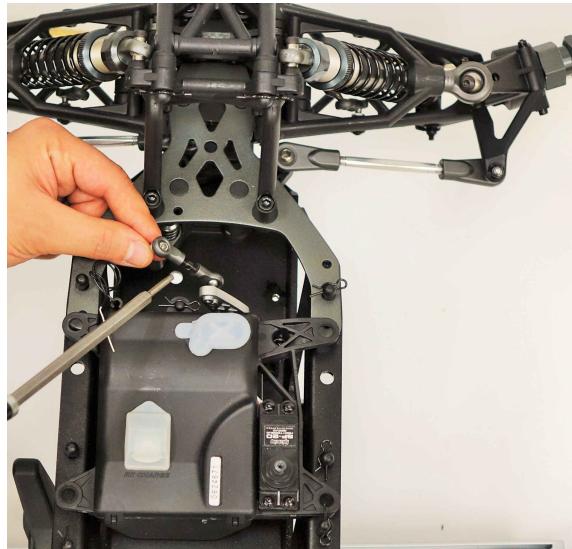


- d. Disconnect the throttle linkage, and remove the engine as shown in video #2.





- e. Disconnect the fuel lines and remove the gas tank as shown in video #2. **Reserve the plastic supports that connect the tank to the aluminum chassis for the Electronics Box installation.**
- f. Disconnect the steering servo and remove the battery box as shown in video #2.



- g. Remove the rear upper plate as shown in video #2.



- h. At about the two minute mark in video #3, you will be using a diff spacer (item #18), a spacer with a flat on one side. The CCB kit includes this spacer, but the RB kit only includes round spacers. In that case, grind a flat on one of the included spacers.



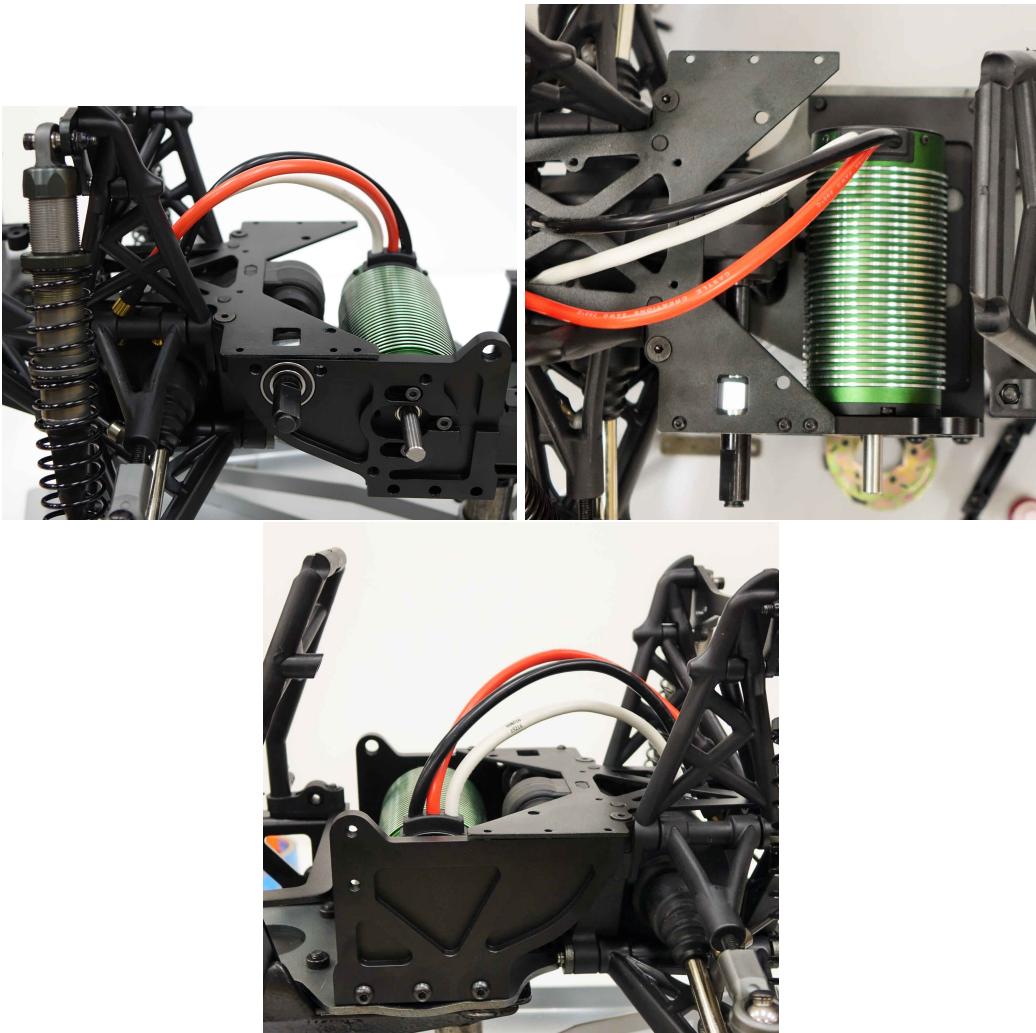
- i. Remove the disc brake hub to allow the bearing to be flush with the motor mount plate.



- j. Install the motor with the wires facing up. The video will say to install the wires with the motor wires facing to the side, but disregard that instruction. Additionally, disregard how the wires are routed in the videos. Wire routing instructions are included in a later section. **Remember to always use thread lock (use Z186 red threadlock or use blue Loctite 243 instead of the greenish-blue colored thread lock Z159) for metal-on-metal connections.**

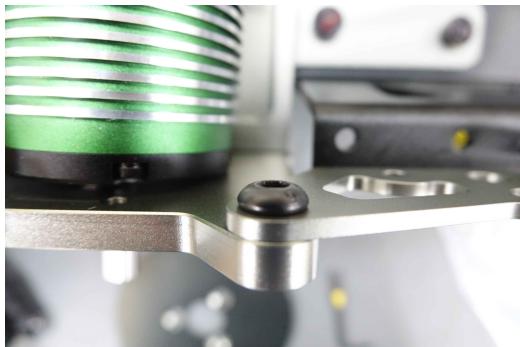
Note: If you are using the RB kit, install the M5×16mm screws in place of the two missing M5×15mm screws to mount the box frame plate (item #12).





- k. The motor mount plate in the CCB kit has three slots for mounting, while the RB kit has only two slots. Both kits use M4×8mm screws for mounting. **Follow the details of the next two steps exactly as written.** Keep the M4×8mm screws very loose to align the motor mount plate. Also, only tighten the screws for the motor mount plate (item #3) and box frame plate (item #12) at the same time.
- l. In video #4, the roll cage is installed. Prior to installing the roll cage, mount the passenger frame plate (item #9) to the motor mount plate (item #3) using the corresponding screw (M8×10mm socket head cap screw¹ (item #25) for the CCB kit or the M6×10mm button head screw for the RB kit). Note that the screw head should be inside the car as shown below.

¹The parts list in the conversion kit instructions says that the screw is M8×20mm. This is incorrect.



Then, loosely install the two M5×15mm flat head screws (item #22) into the passenger frame plate. Finally, tighten all the screws on the passenger frame plate first, and then tighten the screws for the roll cage.



- m. Install the driver frame plate (item #11) to the box frame plate (item #12) and the roll cage using three M5×15mm flat head screws.
- n. Follow electric conversion video #5 to set up the mesh. Do **not** apply green Loctite to the motor shaft. Only apply low-temperature Loctite to the pinion gear's set screw.

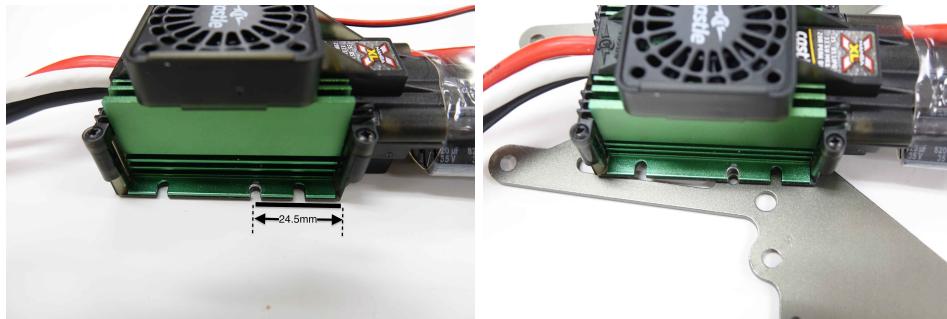


For the RB kit, install the pinion gear with the set screw facing inward toward the motor, as shown below.

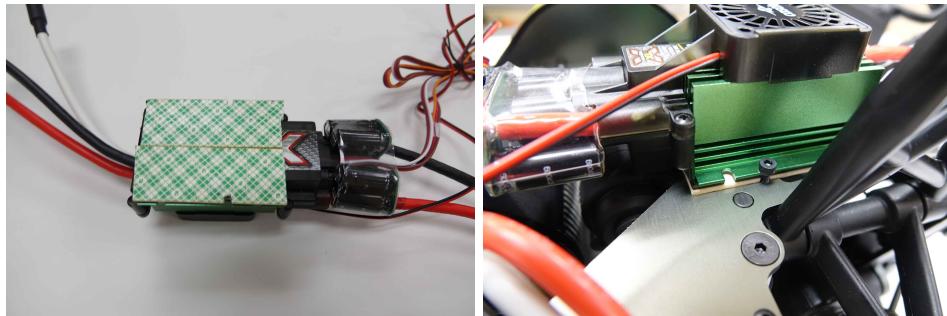


- o. Do not reinstall the side rail guards, wheels, or the battery box with servo.

- p. This step only applies if you are using the RB kit. In video #6, the ESC is installed. The diff plate (item #8) in the RB kit has two screw holes that are not aligned with the slots on the ESC. In that case, create a 3mm wide slot on each side of the ESC, each centered 24.5 mm from the capacitor side of the ESC, as shown below.



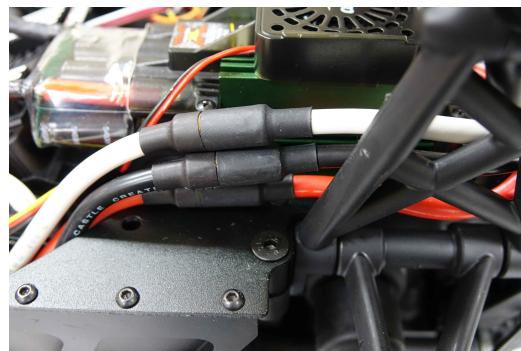
Cover the bottom of the ESC with heavy duty tape, and cut slots into the tape for each center slot on the ESC, as shown below. Mount the ESC to the diff plate using two M3×10mm screws.



- q. Install the battery foam. If you are using the CCB kit, use the included foam. If you are using the RB kit, use the battery foam you cut.



- r. **Do not follow steps in video #8.** However, it is still useful to watch.
 s. In video #9, only perform the steps required to connect the motor and the ESC. Remember to connect white to white and black to black. Do not follow the steps in the remainder of video #9. Refer to the photo.



7 Steering Linkage and Side Rail Guards

Time 1 hours 0 minutes

Parts

- Turtle Racing Billet Servo Saver
- Integy Side Rail Guards (if available)
- Low-temperature threadlock

Instructions

- a. Complete through step 13 of the [Steering Linkage Instruction Booklet](#), also located in [manuals/](#)





- b. Mount the side rail guards, and add a drop of threadlock on each of the four mounting screws. If available, use the Integy side rail guards instead of the stock plastic side rail guards.



8 Battery Box Eliminator and Steering Servo

Time 1 hours 0 minutes

Parts

- Team Fast Eddy Battery Box Eliminator Kit
- Savox steering servo
- 2 small body pins
- M3 lock nut (part no. Z663 in the Baja kit)
- Alloy Horn for Multiplex RHINO Digi 4 Servo

Instructions

- a. Secure steering servo to battery box eliminator with 4 included screws ensuring correct orientation.
 - i. To secure the steering servo into the battery box eliminator, remove the 4 screws on the base of the servo and take-off the base. Then slide the servo into the eliminator bottom first. Put the base back onto the servo and secure it with the 4 screws (Refer to images for proper orientation of the servo with respect to the battery box eliminator). Finally, secure the servo to the battery box eliminator using the 4 provided screws. Use thread lock as they are metal-to-metal connections (Disregard the nuts, spacers, etc. provided with the servo for now). **Ensure that the gasket is aligned and the servo base plate is seated correctly.**

- ii. Position the servo horn such that the arm is vertical when the servo is centered. To find the vertical position, first move the horn to either extreme. The rightmost photo below shows the position of the servo horn when the servo is centered.
- iii. After the horn is in place, screw on the provided set screw and lock washer.



- b. Complete steps 14-15 in the Billet Steering Linkage instructions to attach steering servo to servo saver
 - i. Next, install the servo link arm. Use thread lock on the screw. Use the tie arm from original steering servo mechanism to connect the servo link arm to the servo saver assembly. To do this use a M3 lock nut (Baja part # Z663) from the spare parts provided with the Baja. This is crucial as any different sized lock nut would obstruct the motion of the servo link arm (180 degrees).
 - c. Install the battery box eliminator onto the chassis using two body clips, such that you are able to read "TEAM FAST EDDY" on the top of the eliminator when looking from the front of the chassis toward the back.



9 Shocks

Time 2 hours 0 minutes

Parts

- Front springs: 5.8"
- Back springs: 2" and 4"
- 2 59 ml bottles of Factory Team 60w silicone shock oil

Instructions

- a. Refer to the **shock maintenance** instructions in the Baja 5SC instruction manual. Remove the 2 cap head screws (94510 and 94520 at the top and bottom of the front shocks; 94510 and 94512 at the top and bottom of the rear shocks) that hold each of the shocks to the chassis.
- b. Referring to the **Shock Disassembly** instructions, disassemble each of the 4 shocks.



- c. Refer to the Shock Assembly section in the Instruction Manual to replace the HD Piston 16mm C-1 (16 holes) with HD Piston 16mm A-1 (2 holes). **This is required to be done before filling the shocks with oil.**
- d. Refer to **Filling with Shock Oil** instructions. Make sure to fill all the 4 shocks with 60w oil.
- e. Refer to **Shock Spring Installation** to replace the original springs with new stiffer springs.



- f. Reverse the steps above to reinstall the 4 shocks.



10 Axle Extenders

Time 2 hours 0 minutes

Parts

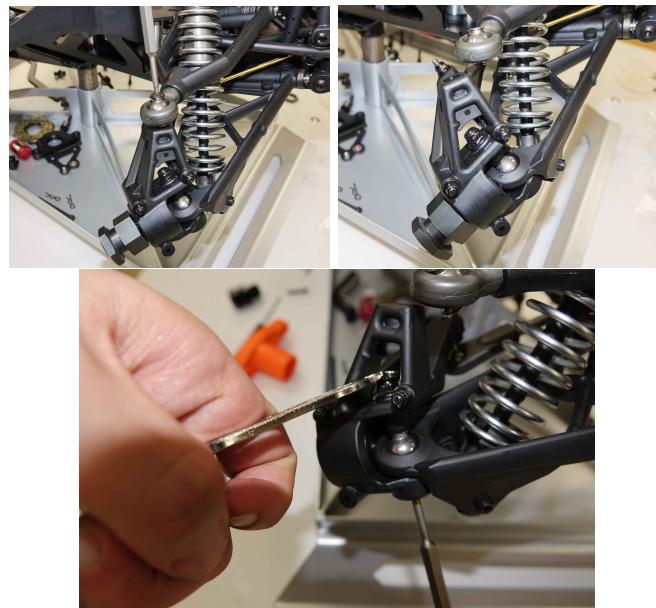
- Darksouls Baja axle extender set

Instructions

- a. Front axle extenders
 - i. Remove the screws from the inside of the front axle extenders.



- ii. Remove the top and bottom screws that hold the front axles boots to the rest of the axle assembly.



- iii. Remove the stock axle extenders and replace with the Darksouls front axle extenders.



- iv. Secure the front axle extender using C-clips.



- v. Replace the screws that connect the axle boots to the rest of the axle assembly.
- b. Rear axle extenders
 - i. Remove the screws from inside the rear axle extenders.



- ii. Push out the pins that hold the rear axle extenders to the drive shaft.



- iii. Remove the stock axle extenders and replace with the Darksouls rear axle extenders.



iv. Replace the pins.



v. Loosely screw in the nuts on the rear axle extenders so that they do not get misplaced.

11 Wheel Rotation Sensor Magnet Mounts

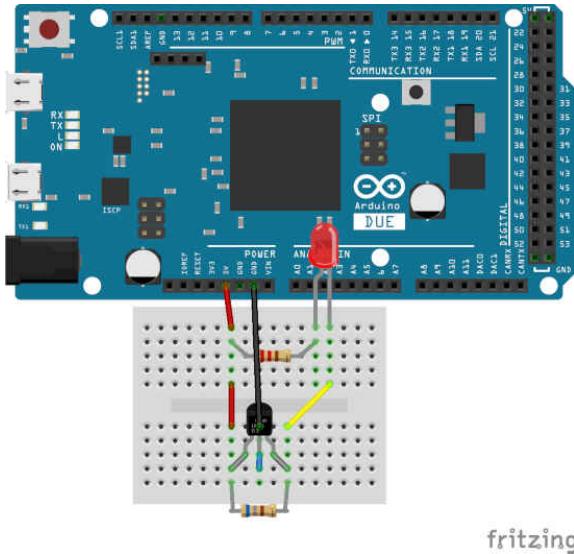
Time 1 hours 15 minutes

Parts

- 2 3D printed front wheel magnet mounts (if front brakes are not used)
- 2 3D printed rear wheel magnet mounts
- 4x12 wheel rotation sensor magnets
- Arduino Due (or alternative 5V source)
- Red LED
- 220Ω resistor
- 680Ω - 820Ω resistor
- Optek OH090U Hallogic Hall-effect sensor
- Epoxy

Instructions

- a. Assemble the magnet test circuit as shown in the figure below.



- b. Take one of the magnets and bring it near the front face of the Hall-effect sensor of the test circuit assembled in the previous step. **The front face has writing on it.** If the LED does not light up, flip the magnet over and try again.
- c. The side of the magnet facing the front face of the sensor when the LED lights up is the south pole of the magnet.
- d. Repeat the following steps for the 2 front wheel magnet mounts and 2 rear wheel magnet mounts. If you are installing front brakes, you will not need the front wheel magnet mounts.
- e. Place masking tape over the holes on the side opposite the large protrusion. Set a magnet in each hole so that the south pole of the magnet is touching the tape and thus facing opposite the large protrusion. An easy way of doing this is to take the column of magnets and press it into the hole. Then slide sideways so that one magnet stays in the hole and the rest of the column detaches. So long as you confirm the orientation of the first magnet is correct, repeating this process for the other magnets will work without the need for testing polarity so long as you use the same end of the column, since the magnets will align in the column according to the same polarity orientation.
- f. Epoxy the magnets to the magnet mounts. You only need to epoxy one side. The epoxy may take 24 hours to dry.



12 Front and Rear Rotation Sensors

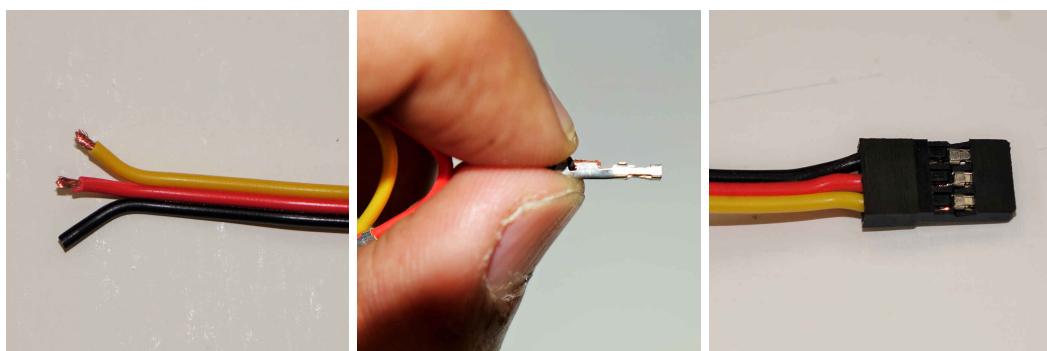
Time 1 hours 30 minutes

Parts

- 6 Optek Hallogic OH090U Hall Effect Sensors
- 6 Futaba J female connector assemblies
- 6 11" lengths of servo wire
- Heat shrink
- Zip ties

Instructions

- a. Follow this [Crimping Tutorial](#) and the [Molex Crimping Guide](#) to learn how to crimp these connectors. [Crimp Pins Pictures](#) shows some well-made crimps.
- b. Crimp one Futaba J connector to one side of each of the 11" lengths of servo wire.



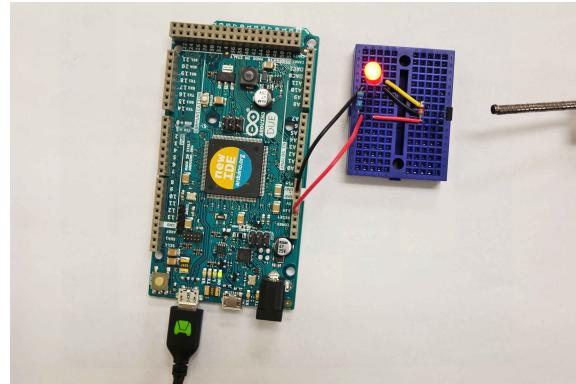
- c. Solder one sensor to the opposite end of each of the 6 lengths of servo wire. Note that the ground lead of the sensor is the middle lead, so ensure that the correct wire is soldered to each lead. See the [Rotation Sensor Datasheet](#) for more details. **Note that when the writing on the sensor face is facing you, the leftmost lead is VCC, the middle lead is ground, and the rightmost lead is the sensor output.** Note that a small piece of heat shrink should be slipped onto each lead prior to soldering.



- d. Heat the heatshrink on each lead and ensure that the lead and the solder joint are completely covered. No conductive part of the assembly should remain exposed.

12 FRONT AND REAR ROTATION SENSORS

- e. Test each of the completed rotation sensor assemblies using the test circuit and the wheel rotation magnet mounts created in previous steps.

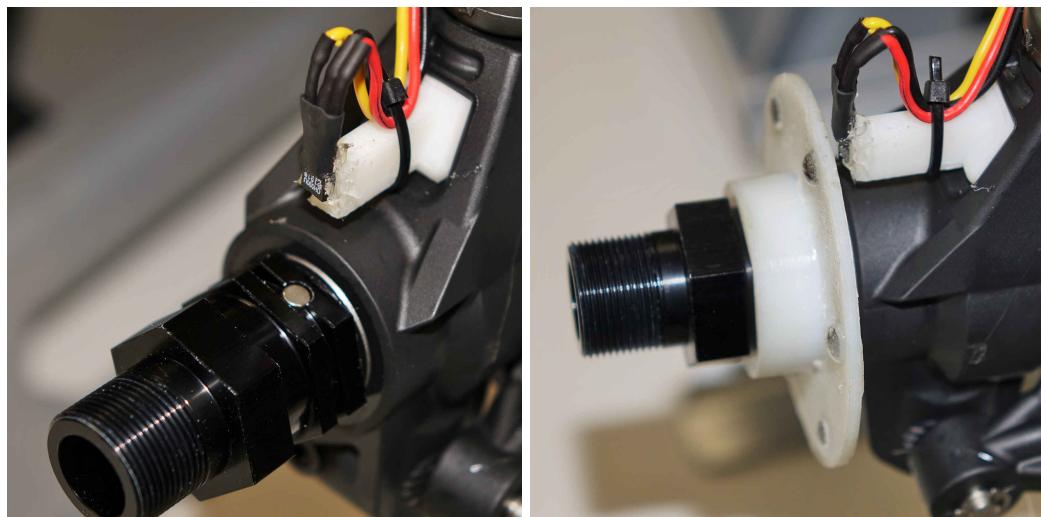


- f. Install the 3D printed rear rotation sensor mounts as shown in the photo. **Note that the lock nut should be installed with the protrusion facing downward as shown in the photo.**

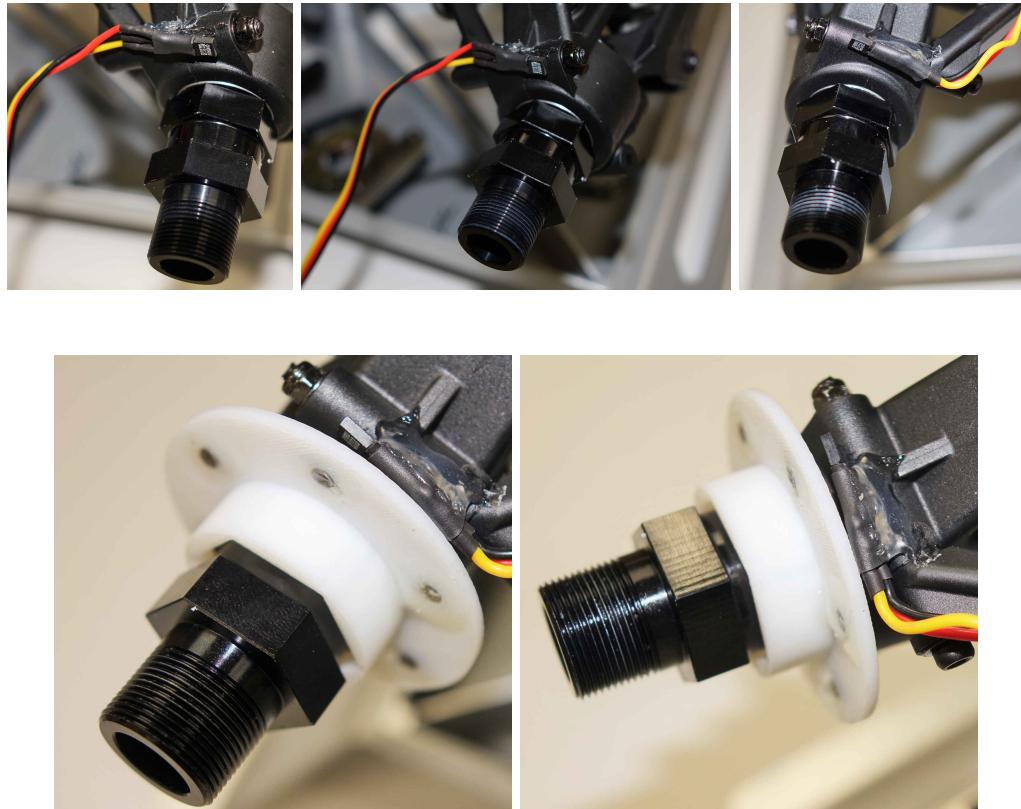


- g. Hot glue one sensor assembly to each of the sensor mounts. **Carefully align the sensor with the magnets on the rear rotation sensor magnet mount** in order to ensure that the sensor will reliably detect each magnet as it passes the sensor face.

- h. Slide the assembled rear magnet mounts from the section “Wheel Rotation Sensor Magnet Mounts” onto the rear axles with the large protrusion facing outward.



- i. Only complete this step if you are installing front wheel rotation sensor magnet mounts and not using front brakes. Use hot glue to secure one of the sensor assemblies to each of the front hubs. Carefully align the sensor with the magnets on the front rotation sensor magnet mount/brake disc in order to ensure that the sensor will reliably detect each magnet as it passes the sensor face.



Note that only 4 sensor assemblies are required for the chassis; 2 of the 6 assemblies are spares.

13 Front Brakes, Disc Aligner

Time 3 hours 0 minutes

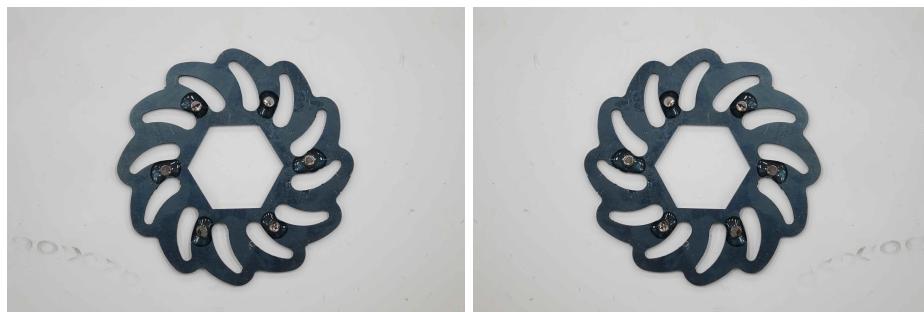
Parts

- Mecatech front brake kit
- Brake bleeding kit
- 3D printed master cylinder mount
- 2 3D printed front brake disc aligners
- Fabricated master cylinder plate
- 12 1/8" diameter magnets
- 3 M3×10mm screws
- 3 M3×12mm screws

- 2 M3×50mm screws
- 2 M4×6mm screws (can use M4x14 from above and just pad with washers if needed)
- 4 M4×14mm screws (same as for the motherboard in the compute box)
- 4 M4 nuts
- M4 washers
- Throttle pivot set
- Brake rod set
- F 25 servo horn that came with the Baja (25 tooth for Futaba)
- 3 Bleed valve caps
- 1 Futaba J connector assembly (2 3x1 housings, 1 connector cover, 3 male 0.1 inch crimps, 3 female 0.1 inch crimps)
- Servo Cable
- Zip ties
- Epoxy

Instructions

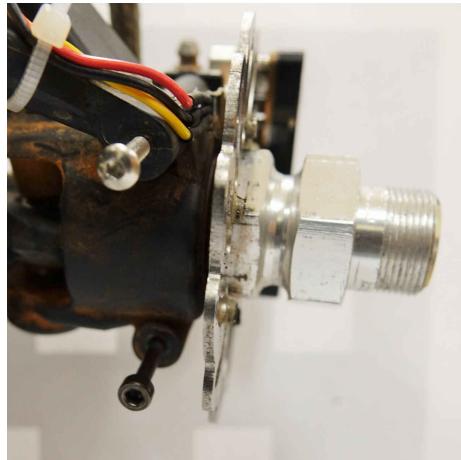
- a. Epoxy 6 magnets to each of the brake discs such that the south pole of each magnet faces inward towards the rotation sensor. To determine the south pole side of the magnet, use the test circuit detailed in the previous section. The correct face is different for each brake disk, refer to the pictures below (left disc shown on left, right disc shown on right). **Pay close attention to the location of the magnets, as they must be aligned with the sensor but not interfere with the brake caliper or the 3D printed front brake disk aligner.** Let the epoxy cure for at least two hours.



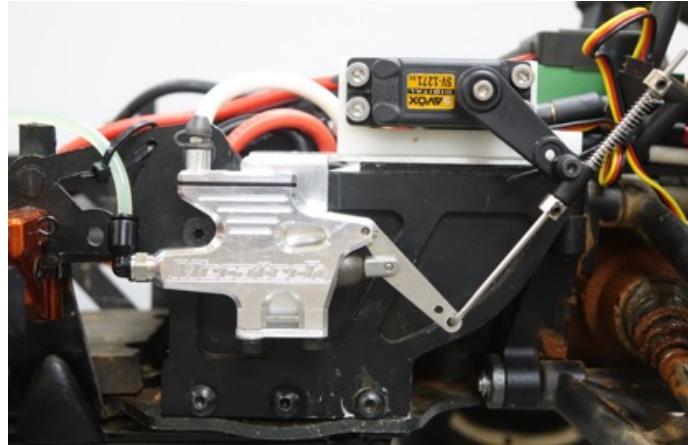
- b. Remove the outermost of the two M3×42mm screws from the top of each front hub carrier and reserve for later use.
- c. The disk caliper and caliper adjuster (provided in Mecatech kit) should be assembled first using the M3 screws provided in the kit. Slide the left and right brake discs onto the front axle extenders with the magnets facing inward. Secure the brake caliper assemblies and 3D printed brake disc aligners onto the front wheel hubs with the reserved M3×42mm and a M3×50mm screw. Once loosely attached, adjust the location of the disk aligner and the screws on the calipers to allow the axles to spin freely. The hose plug on the caliper should be facing upward on each side. For reference, the pictures shown below are for the left side.



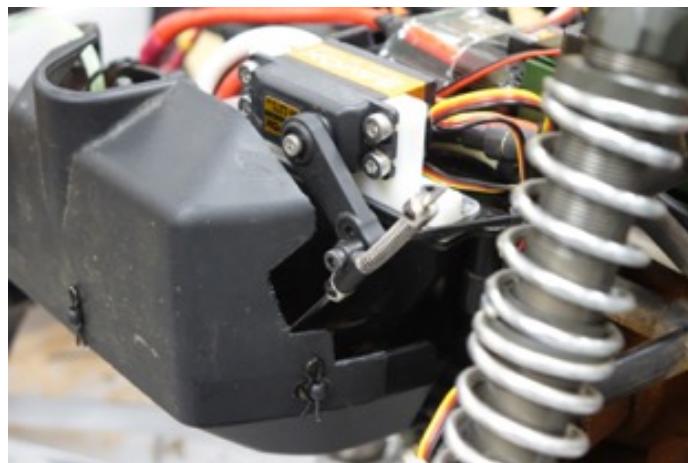
- d. Verify that the magnets are aligned with the sensors hot glued to the hub and that the magnets clear the calipers when spinning. Adjust the sensor locations if required.



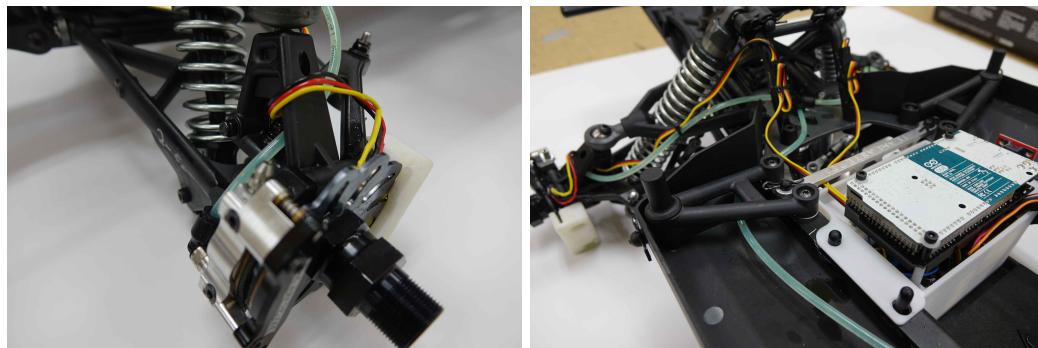
- e. Attach the master cylinder to the aluminum master cylinder plate using 2 M4×6mm screws and, if necessary, use M4 washers to keep the screws from bottoming out. (The Mecatech instruction says to use the pedestal, but do not use the pedestal.) Slide brake rod through the last hole in the master cylinder arm with the rod on the side of the arm away from the bracket.
- f. Remove the 3 M3 button head screws from the top of the conversion kit top plate on the left side of the chassis (opposite side as the transmission).
- g. Attach the 3D printed servo mount and master cylindrical plate onto the chassis using 3 M3×12mm screws, make sure to use low temp (red or blue) threadlock.
- h. Attach the servo to the 3D printed servo mount with the servo gear facing the back of the chassis using 4 M4×14 screws and M4 nuts.
- i. Install the pivot linkage as shown in the picture in the next step to attach the brake rod to the F 25 servo horn through the outermost mounting hole. You may have to use a longer M3 screw than comes with the pivot kit to attach the pivot to the servo horn.
- j. Attach the F 25 servo horn to the servo in a position that is parallel to the master cylindrical arm. Make sure the servo is in neutral position before attaching the servo horn (you can do this by powering the servo and sending it a neutral signal).



k. Make a 10 inch servo extension cable with the Futaba J connector assembly.



1. Follow the normal instructions for connecting brake lines and bleeding. The brake lines should not be rubbing against the tires or any moving component of the vehicle, but the lines should still have enough slack to allow the wheel to steer from side to side. Refer to the pictures below for the correct routing of the tubing. Make sure to measure and cut the tubing to the exact desired length before putting it into the valve. Instructions on bleeding the brake can be found at [Mecatech Brake Bleed Tutorial](#). The bleeding process should be repeated multiple times from each opening to ensure the elimination of all air bubbles within the tubing. Close all the valves tightly to ensure that air bubbles do not form.



- m. Secure the brake line with a few zip ties to the chassis so they do not snag on chassis parts when the steering actuates and install a bleed valve cap on the brake caliper and master cylinder bleed valves once done bleeding.
- n. Cut the brake rod so that it doesn't extend beyond the linkage. You will also have to cut a little of the motor shroud to allow the linkage to freely actuate once the shroud is reinstalled.

14 Tire Foams

Time 2 hours 0 minutes

Parts

- Zero-growth tire foams front (red)
- Zero-growth tire foams back (blue)

Instructions

- a. Refer to the Baja 5SC manual for tire foam replacement diagrams
- b. Remove all of the bolts on both sides of the tire. Remove the beadlocks and slide off the rubber tire and remove the inner foams.



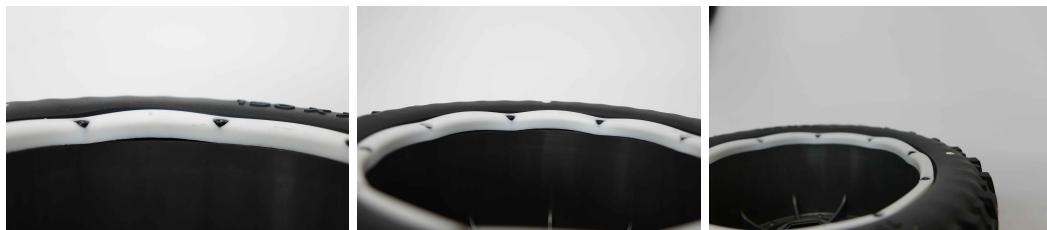
- c. Slide the new front tire foams onto the front tire rims. Front foams are 1cm narrower than the rear.



- d. Slide the new rear tire foams onto the rear tire rims. **Rear foams are 1cm wider than the front.**
- e. Slip the tire rubber over the foams and begin to screw in the bolts in an alternating pattern. Refer to the HPI Baja 5SC manual for example diagrams. It may be difficult to align the bolts and holes for the rear tires.

15 CUT ROLL CAGE

- i. Ensure that the rubber tire material is properly seated into the respective slots. Then ensure that the rims slots properly align with the tire material.
 - ii. This step may require more than one person.
- f. Make sure the beadlocks sit flat and do not pucker when the screws are installed. If there is puckering, loosen the screws, realign the tire rubber and then retighten. Properly seated rubber inserts will make it easier to get the beadlock to sit flush against the tire. **The photos show good and bad examples of seated beadlocks.**
- g. The photos below show bad examples



- h. The photos below show acceptable examples



15 Cut Roll Cage

Time 0 hours 10 minutes

Parts

- Large zip ties
- Roll cage from Baja 5SC

Instructions

- a. Cut the roll cage just in front of the rear shock tower. The blue tape in the photos below shows the approximate location at which to cut.



- b. Remove all roll cage components forward of the cut. The remaining components are shown below.



- c. Secure remaining cut ends to shock tower with large zip ties



- d. Cut center roll bar off just above side rail guards. Discard the part of the roll cage shown below.



16 RC Transmitter

Time 0 hours 30 minutes

Parts

- Futaba 4PLS transmitter
- Futaba receiver

Instructions

- a. Refer to the included Futaba 4PLS manual or the PDF file in the [manuals/](#) folder to locate and set the specified parameters.
- b. Apply power to the receiver while the transmitter is on and verify the transmitter connects to the receiver. If not, follow instructions in the manual to pair the devices.
- c. On the transmitter, configure RX MODE to be T-FH (NORM).



- d. On the transmitter, set the Throttle Channel (THR) to Reverse (REV).



- e. On the transmitter, configure PS1 to operate Channel 3 (CH3).
- f. On the transmitter, configure PS2 to operate Channel 4 (CH4).
- g. On the transmitter, configure the PS2 mode to ALT (alternate).



17 ESC

Time 0 hours 20 minutes

Parts

- Castle Serial Link software installed from [Castle Serial Link](#)
- Castle Link programmer

Instructions

- a. Connect ESC to Castle Link according to the Tuning With Castle Link section in the Mamba XL X Driver's Ed Guide.
- b. Use Castle Link software to change the following settings

- i. Basic → BEC Voltage to 7.5 V.
 - ii. Basic → Auto-Lipo Volts/Cell to 3.1V.
 - iii. Power → Start Power to High.
 - iv. Advanced → Throttle Dead Band to 0.0625 ms.
 - v. Advanced → Link Live Enable to Enabled.
 - vi. Logging → Sample Frequency to Disabled
- c. Save the ESC settings by pressing the Update button in the Settings Control area of the Castle Link software

18 Castle Serial Link

Time 0 hours 20 minutes

Parts

- Castle Serial Link installed
- Castle Link Programmer

Instructions

- a. Connect Castle Serial Link to Castle Link according to instructions.
- b. Use Castle Link software to change the following settings
 - i. Basic → Communication Mode to TTL Serial (with PPM Input)
 - ii. Basic → TTL Serial Baud Rate to 115200
 - iii. Basic → Fail Safe Output to Center (1.5ms)
- c. Save the Castle Serial Link settings by pressing the Update button in the Settings Control area of the Castle Link software

19 ProtoShield Assembly

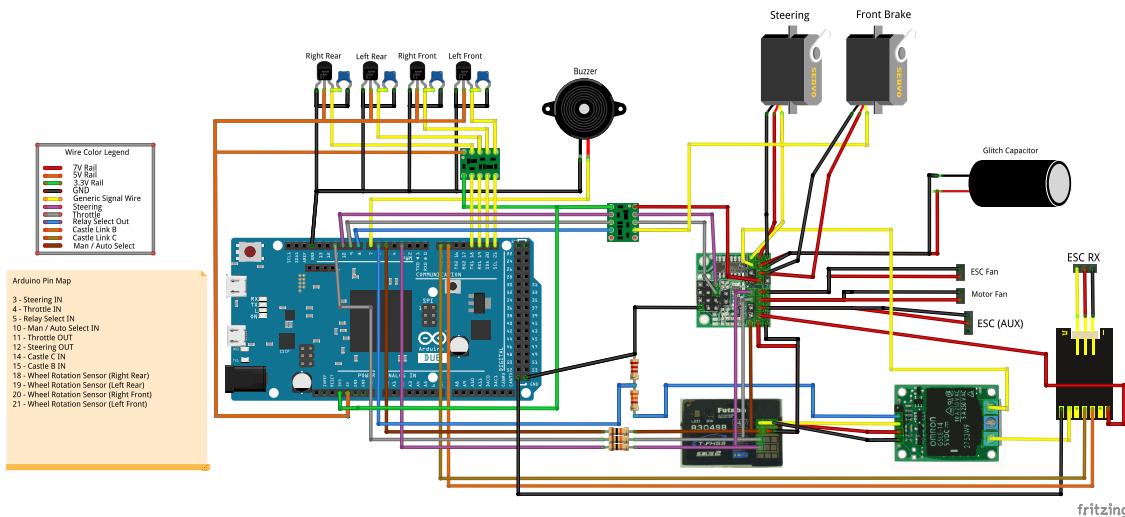
Time 5 hours 0 minutes

Parts

- Adafruit ProtoShield
- 2 Pololu Level Shifters
- 4 20pF capacitors
- 3 10kΩ resistors
- 1 3.3kΩ resistors
- 1 2.2kΩ resistors
- Adafruit 5V Buzzer
- 26 AWG wire
 - 20" blue
 - 7" red

- 26” yellow
- 5” black
- Servo cable
 - 76” yellow-red-black
 - 18” green-blue-purple (any 3-conductor ribbon cable, preferably different colors than the YRB servo cable)
- 4 Male Futaba J-Connectors
 - 12 crimps
 - 4 housings
- Female 0.1” Crimped Headers
 - 3 single-position
 - 3 two-position
 - 3 three-position
 - 1 seven-position

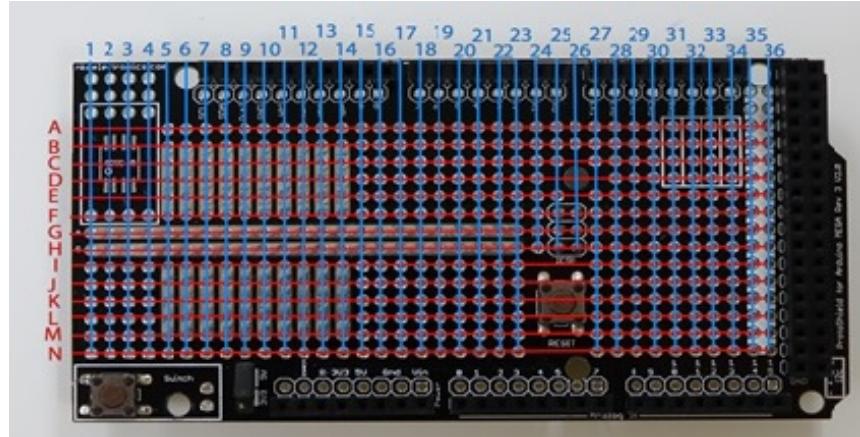
The following diagram shows the schematic for the components within and connected to the Electronics Box. This schematic defines the connections we will be making on the ProtoShield.



NOTE: A scalable version of the drawings (AutoRally Electronics Box) is available in the folder [wiringDiagrams/](#).

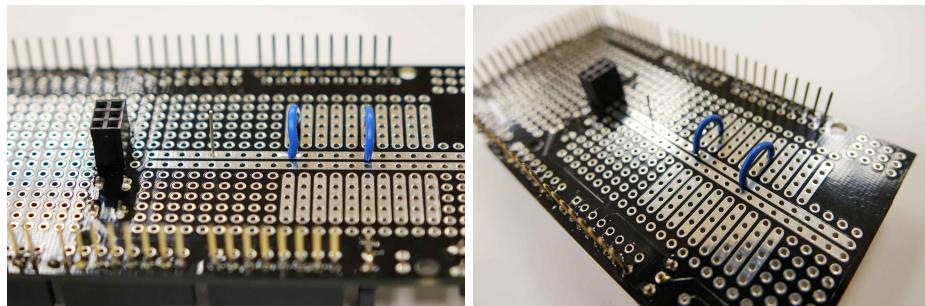
If you have not soldered before, or would like a refresher course, please consider watching this [Adafruit Soldering Tutorial](#).

During the following instructions, individual pads on the ProtoShield grid will be identified using the coordinates defined in the following diagram.

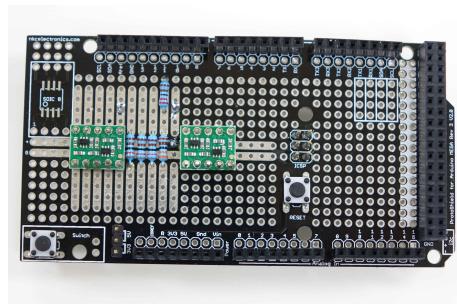


Instructions

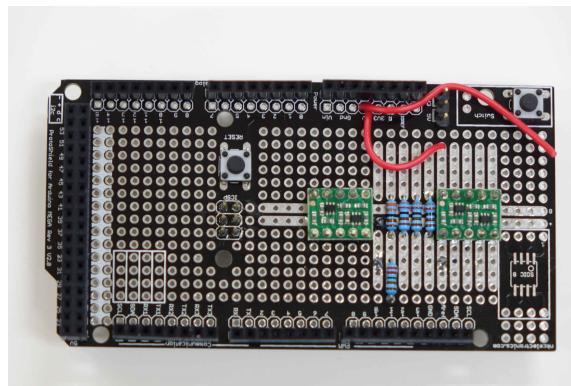
- Assemble the base protoshield kit, including its various headers, buttons, and jumpers.
- Make sure the voltage selection jumper on the ProtoShield is set to 3.3V.
- Cut two 1" lengths of blue wire and one 1/4" length of uninsulated wire (or scrap leads cut from capacitors or resistors). Solder one blue wire to connect pads D9 to G9 and D14 to G14. Solder the uninsulated wire to connect pads F19 to G19.



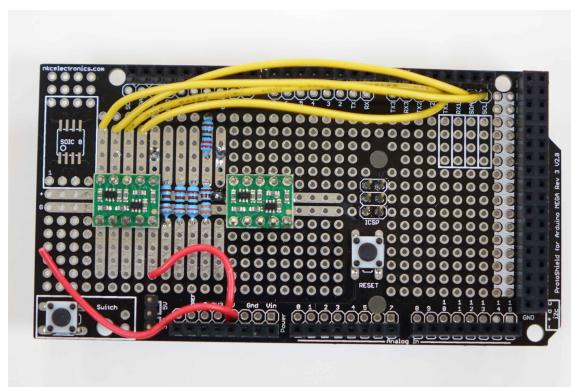
- Place and solder 2 level shifters. Pin 1 of the first level shifter (octagonal pad next to the exposed circular pad) should be placed in pad I9. Pin 1 of the second level shifter should be placed in pad I19.
- Place and solder three $10\text{k}\Omega$ resistors connecting F10 - F12 to I10 - I12.
- Place and solder a $3.3\text{k}\Omega$ resistor connecting F13 to I13. Solder a $2.2\text{k}\Omega$ resistor connecting D13 to A13.



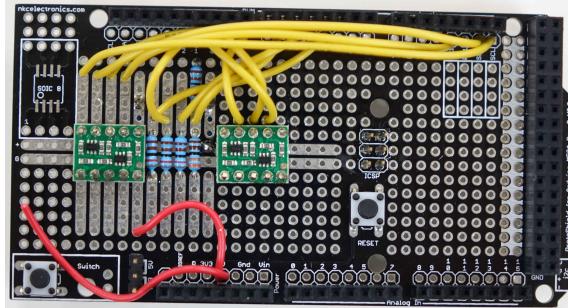
- g. Cut two short lengths, one about 1 1/2" and one about 2" of red wire. Solder one end of each wire to the 5V output pin of the arduino footprint. Solder the other end of the 1 1/2" length wire to via M9.



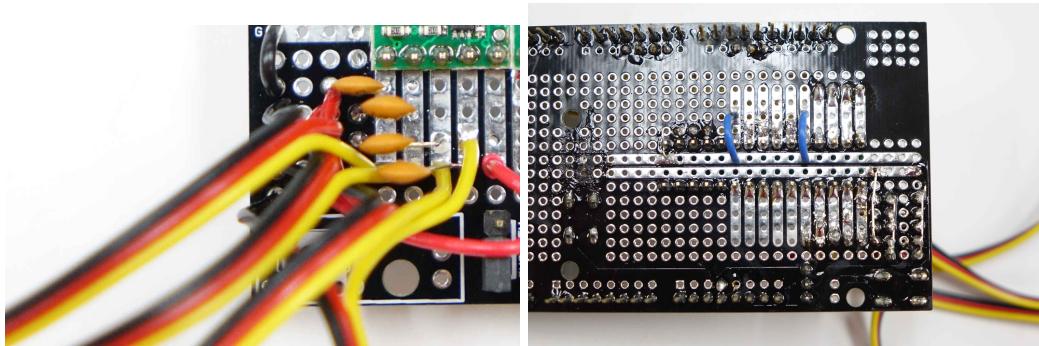
- h. Cut four 3 1/2" lengths of yellow wire. Solder these wires to connect pads B5 to D I/O 21 (SCL), B6 to D I/O 20 (SDA), B7 to D I/O 19 (RX1), and B8 to D I/O 18 (TX1).



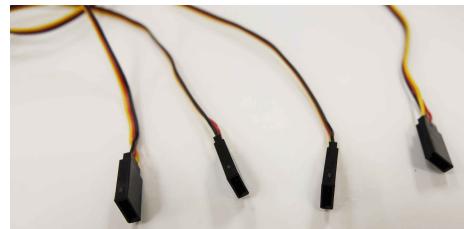
- i. Cut seven 1 1/2" lengths of yellow wire. Solder these wires to connect the following via pairs.
- E10 - D I/O 3
 - E11 - D I/O 11
 - E12 - D I/O 5
 - E13 - D I/O 6
 - E16 - D I/O 8
 - E17 - D I/O 9
 - E18 - D I/O 10



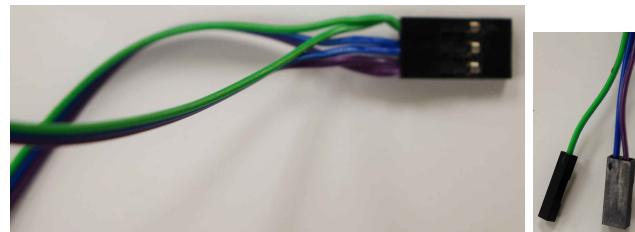
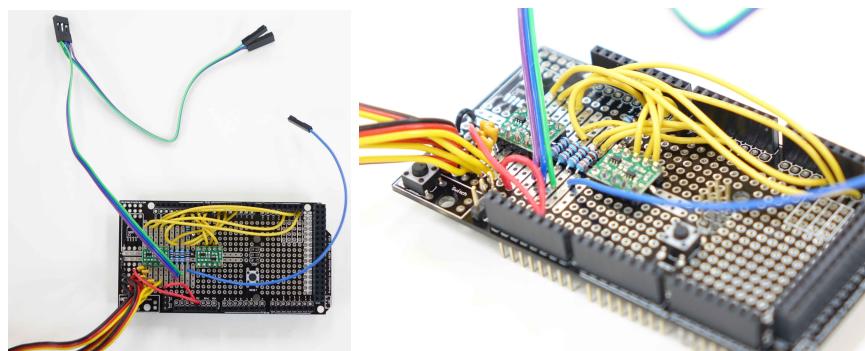
- j. Cut four lengths of Yellow-Red-Black servo cable. Two of length 13" and two of length 22". These will be used for the wheel rotation sensors. Also, cut one 1/2" length of black wire. Solder the black wires of all of the servo cables to pads K1 through N1. The order is not important. Solder the short black wire to connect J1 to H1. On the bottom side of the shield, connect this row of black wires with a length of uninsulated wire.
- k. Solder all of the red wires of the servo cables introduced in step 8 to pads K3 through N3. Solder the longer red wire from step 4 to via J3. Use a section of uninsulated wire to connect all of these red wires on the bottom side of the board.
- l. Solder four 20pF capacitors to connect the following pads.
 - i. J4 and J5
 - ii. K4 and K6
 - iii. L4 and L7
 - iv. M4 and M8
- m. Using a short length of uninsulated wire, connect pads H4, J4, K4, L4, and M4 on the bottom side of the board.
- n. Solder the yellow wires of the servo cables into the following pads.
 - i. M5 (13" cable)
 - ii. M6 (13" cable)
 - iii. M7 (22" cable)
 - iv. L8 (22" cable)



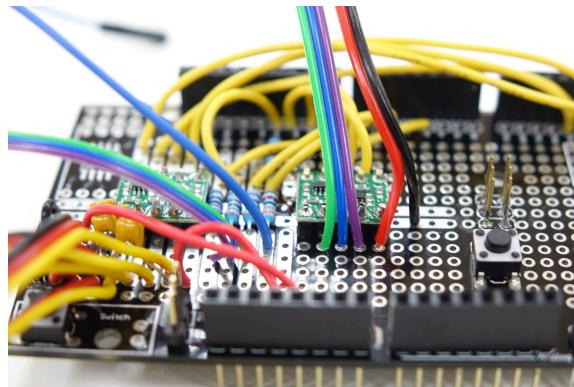
- o. Crimp a male Futaba J connector, with outer housing, to the end of each of the wheel rotation sensor servo cables.



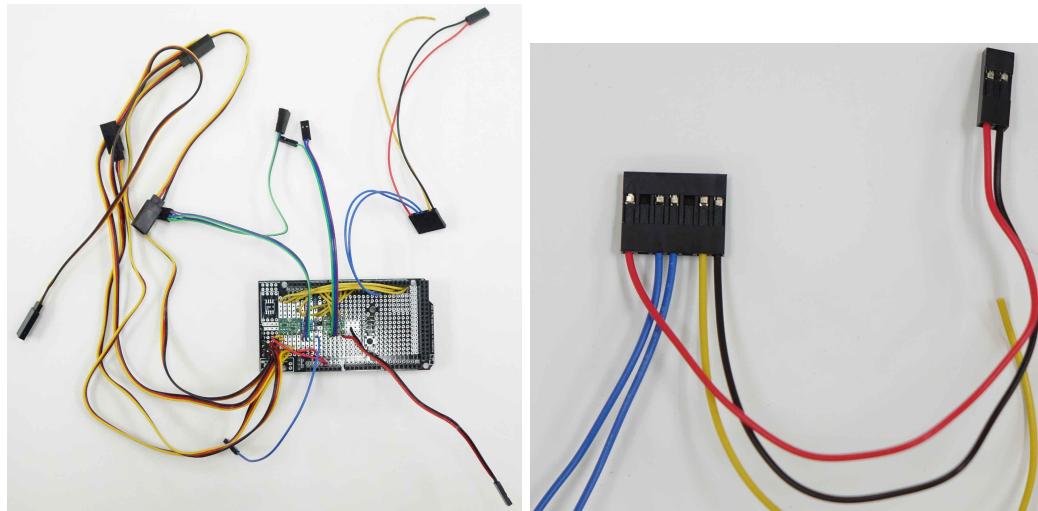
- p. Cut a 6" length of blue wire. Crimp one end into a single-position, female 0.1" header. Solder the other end to via J13.
- q. Cut two 6" lengths of Green-Blue-Purple servo cable. Crimp one end of each cable into the same three-position, female 0.1" header to form a Y-cable harness. On the other end of one cable, add female crimps to all three wires. Then, insert the blue and purple wires into a two-position, female 0.1" header and the green wire into a single-position, female 0.1" header.
- r. Solder the remaining end of the Green-Blue-Purple servo cable Y-harness to the following pads
 - i. K10 (Purple)
 - ii. K11 (Blue)
 - iii. K12 (Green)



- s. Cut a 6 length of Green-Blue-Purple servo cable. Crimp the green end of this cable to a , female 0.1 Then, insert and crimp the blue and purple wires into a two-position, female 0.1 header and the green wire into a single-position, female 0.1 header. Solder the other end to pads J16 (Green), J17 (Blue), and J18 (Purple).

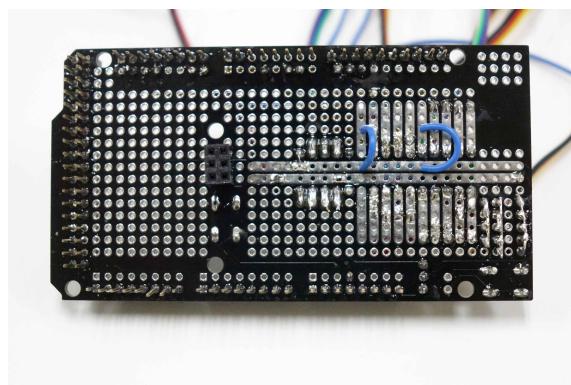


- t. Cut a 6" length of Yellow-Red-Black servo cable. Remove the Yellow wire to create a single Red and Black servo cable. Crimp and insert one end of each servo wire into a two-position, female 0.1" header. Solder the other end to pads J19 (Red) and H21 (Black).
- u. Cut two 6" lengths of blue wire. Cut a 6" length of yellow, red, and black wire. (Individual wires, not a servo cable). These wires will be used to create the harness for the Castle Creations Serial Link.
 - i. Solder one end of one blue wire to D I/O 15 (RX3) and crimp and insert the other into the third space of a seven-position, female 0.1" header.
 - ii. Solder the other blue wire to D I/O 14 (TX3) and crimp and insert its other end to the fourth space of the same seven-position header.
 - iii. Crimp and insert the red wire into the first position of the same seven-position header.
 - iv. Crimp and insert the red wires other end into the first space of a two-position, female 0.1" header.
 - v. Crimp and insert one end of the black wire into the seventh space of the same seven-position header use in step iii.
 - vi. Crimp and insert the other end of the black wire into the second space of the same two-position, female 0.1" header used in step iv.
 - vii. Crimp and insert one end of the yellow wire into the sixth space of the same seven-position header, leaving the other end exposed.

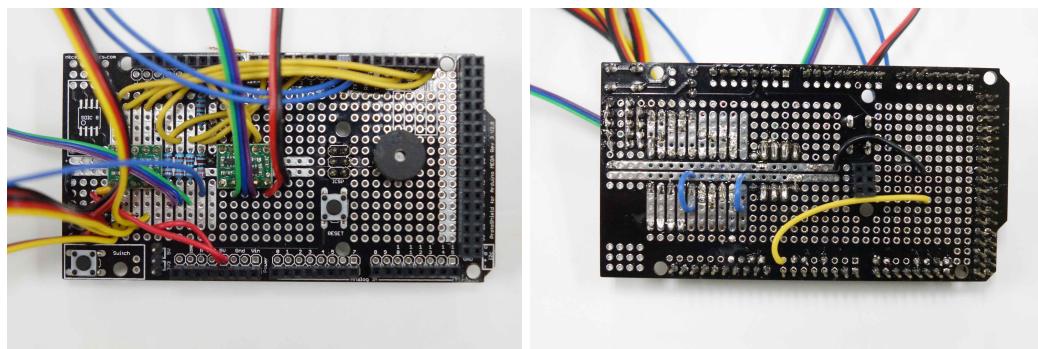


v. On the bottom of the ProtoShield, use excess solder to connect the following sets of pads. Be careful not to accidentally short neighbouring pads with the extra solder.

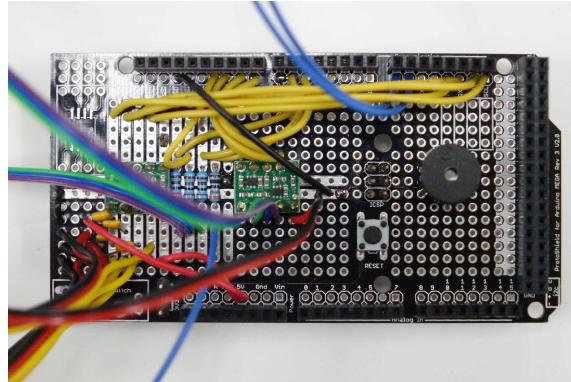
- i. I19, J19, and K19
- ii. I18 and J18
- iii. I17 and J17
- iv. I16 and I16
- v. E18 and F18
- vi. E17 and F17
- vii. F16 and F16
- viii. F19 and G19



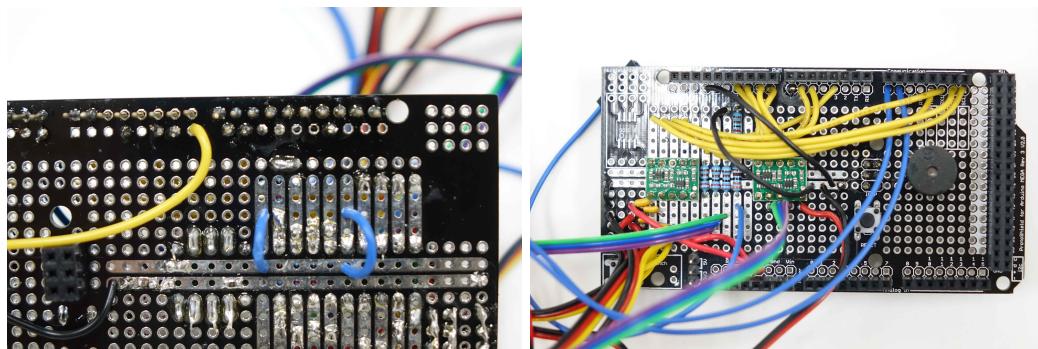
w. Attach the Adafruit 5V Buzzer to the protoshield. The positive (long) lead should be placed in pad E30. The negative (short) lead should be placed in pad H30. Cut a 2 length of yellow wire and connect pad E30 to D I/O pin 7. Cut a 1 length of black wire and connect H30 to H23 (ground rail).



x. Cut a 1 length of black wire and connect pad H22 (ground rail) to the GND pin on the digital pin side of the Arduino.



- y. Solder a 2 inch black wire A12 to H21. On the underside of the protoshield. Connect A12 to A13 with solder.

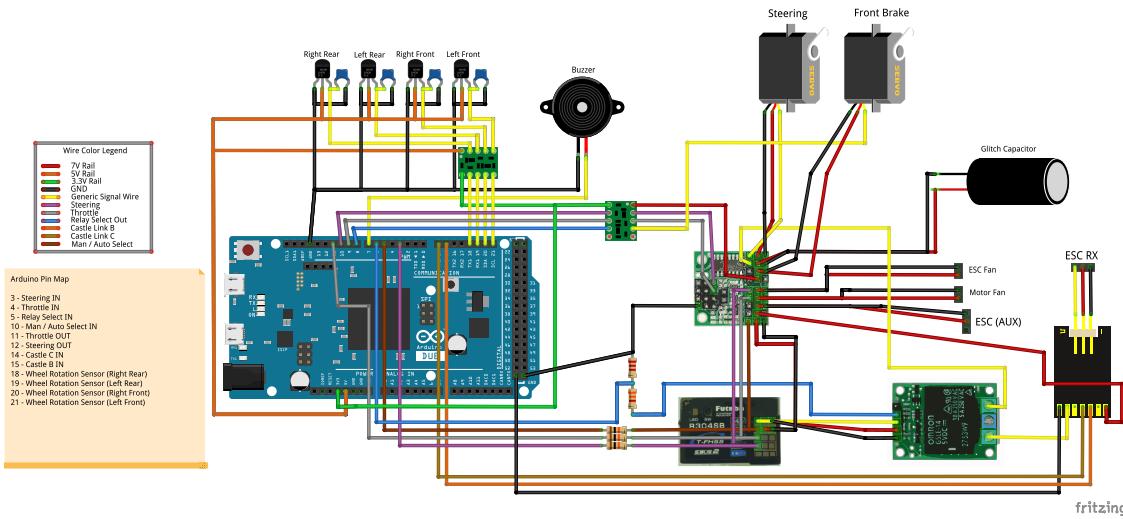


20 Electronics Box Assembly

Time 2 hours 0 minutes

Parts

- Arduino DUE
- Assembled ProtoShield from previous step
- Castle Creations Serial Link
- Pololu RC Relay
- Pololu Servo Multiplexer
- Futaba RC Receiver
- 1 assembled 6" female-to-female servo cable extension
- 6" of 26 awg yellow wire
- 6" of 26 awg black wire
- 3 single-position, 0.1" header housings with female crimps
- 2 two-position, 0.1" header housings with female crimps
- Racers Edge Glitch Buster Power Capacitor (optional)



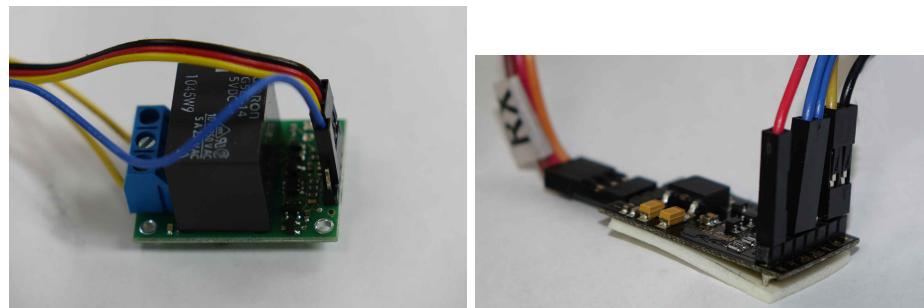
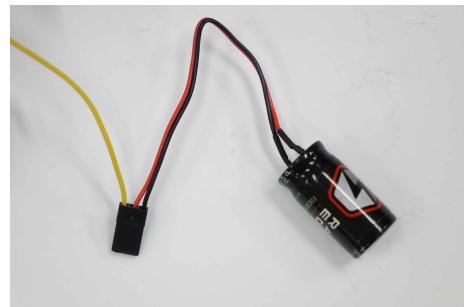
NOTE: A scalable version of the drawings (AutoRally Electronics Box) is available in the folder [wiringDiagrams/](#).

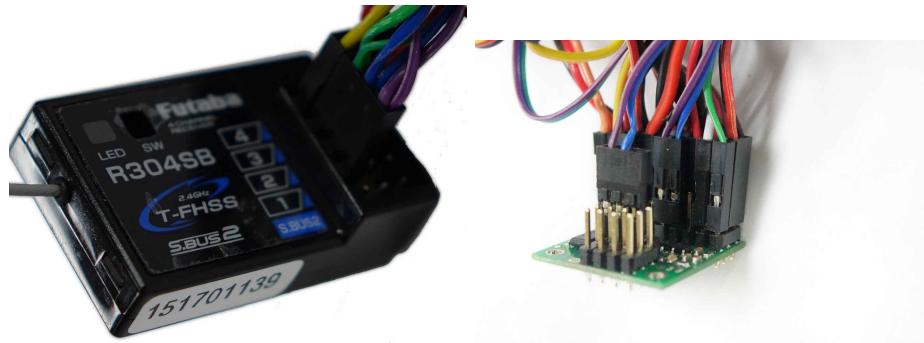
Instructions

- Upload code to Due and verify it is sending data using a serial monitor (data values should be garbage right now).
- Mount assembled Protoshield to the Arduino DUE.
- Plug the middle connector of the Green-Blue-Purple Y-harness to the signal pins of channels 1, 2, and 3 of the Futaba RC Receiver, with the purple wire plugged into channel 1.
- Plug the remaining end of the Y-cable into the Pololu Servo Multiplexer. The purple and blue wires should plug into master channel signal pins 1 and 2 (M1 and M2), respectively. The green wire should plug into the select signal pin (SEL).
- Plug the non-Y, Green-Blue-Purple harness, connected to pads J16 through J18 on the ProtoShield, into the Pololu Servo Multiplexer. The purple and blue wires should plug into slave channel signal pins 1 and 2 (S1 and S2), respectively.
- Create a female-to-female Black-Red jumper cable by crimping and inserting each end of a 6" length of red wire and a 6" length of black wire into a two-position, 0.1" female header.
- Plug one end of the female-to-female two-wire, red-black jumper cable into the power (red) and ground (black) pins of the select channel (SEL) on the Pololu Servo Multiplexer.
- Plug the other end of the female-to-female two-wire, red-black jumper cable into the power (red) and ground (black) pins of channel 3 of the Futaba RC Receiver.
- Plug the single, blue wire from the Protoshield into the output pin on the Pololu RC Relay.
- Create a female-to-female Yellow-Red-Black jumper cable by crimping and inserting each end of a 6" length of a Yellow-Red-Black servo cable into a three-position, 0.1" female header.
- Plug one end of the female-to-female servo cable extension into channel 4 of the Futaba RC Receiver.
- Plug the other end of the female-to-female servo cable extension into the input (yellow), power (red), and ground (black) pins of the Pololu RC Relay.
1. Crimp one end of the 6" length of yellow wire. If you have the Racers Edge capacitor, insert this end into the first-position of the three-position, 0.1" female header on the Racers Edge

capacitor, and plug this into output channel 2 (OUT2) on the Pololu Servo Multiplexer. If you do not have the Racers Edge capacitor, insert this end into a single-position, 0.1" header and plug this into output channel 2 (OUT2) on the Pololu Servo Multiplexer.

- n. Insert the exposed end of the 6" yellow wire into the Pololu RC Relay screw terminal labelled "NO".
- o. Plug the Black-Yellow end of the Castle Creations Serial Link harness (made in protoshield assembly step s) into the ground and D pins of the Castle Creations Serial Link
- p. Plug the seven-position header Castle Creations Serial Link harness (made in protoshield assembly step s) into the seven header pins on the Castle Creations Serial Link. The first position of the header (red wire) should connect the +BUS pin and the seventh position should connect to the GND pin. The blue wire from Protoshield D I/O pin 15 (RX3) should connect to pin A (TX) and the other blue wire from Protoshield D I/O pin 14 (TX3) should connect to pin B (RX).
- q. Insert the exposed yellow wire of the Castle Creations Serial Link harness into the Pololu RC Relay screw terminal labelled "COM".
- r. Connect the Red and Black two position wire from the Castle Creations Serial Link harness into the master channel 3 (M3) pins on the Pololu Servo Multiplexer.
- s. Connect the Red and Black wire from the protoshield (made and installed in step r) of protoshield assembly) into OUT 4 on the Pololu Servo Multiplexer.
- t. Crimp both ends of a 6 length black wire and insert both ends into single-position, 0.1" headers. Use this wire to connect the GND rail of S4 to the GND rail of OUT1 on the Pololu Servo Multiplexer.





21 Electronics Box Installation

Time 1 hours 30 minutes

Parts

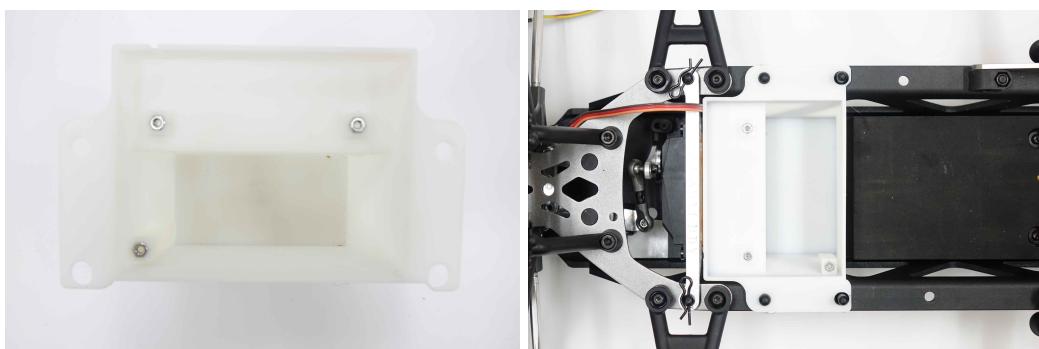
- Printed electronics box
- Electronics box assembly from previous step
- 4 completed wheel rotation sensor assemblies
- 2 reserved plastic supports (Baja part number 85420-6) reserved from fuel tank removal
- 3 M3 nylon washers
- 4 M3 hex nuts
- 1 M3×6 mm screw
- 3 M3×30 mm screws
- 3 M3×13 mm nylon spacers
- 2.0m male weather-proof USB 2.0 cable
- USB breakout board
- Zip ties and zip tie saddle
- Double-sided sticky foam

Instructions

- a. Epoxy nuts to the electronics box plastic supports. To do this, first place the nuts into the supports along with hot glue. Screw the 3 M330 mm screws into the 3 nuts and ensure that they stand vertically in order to ensure that the nuts are placed horizontally inside the supports. Refer to the picture below. Remove the screws once the epoxy is set.



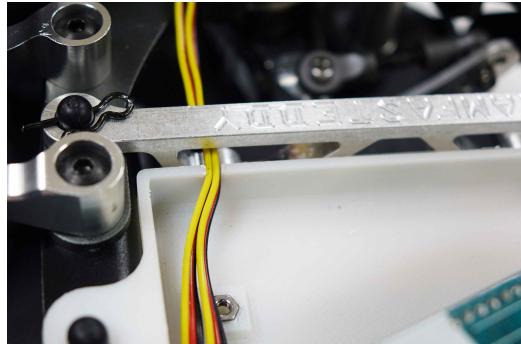
- b. Install the M3×6 mm screw and an M3 nut in the hole at the bottom of the electronics box with the head of the screw on the bottom of the electronics box. Place electronics box assembly in chassis with the mounting holes pressed over the plastic supports on the chassis.



- c. Route the steering servo cable into the electronics box through the steering servo cable hole on the front of the box (near the base of the box).



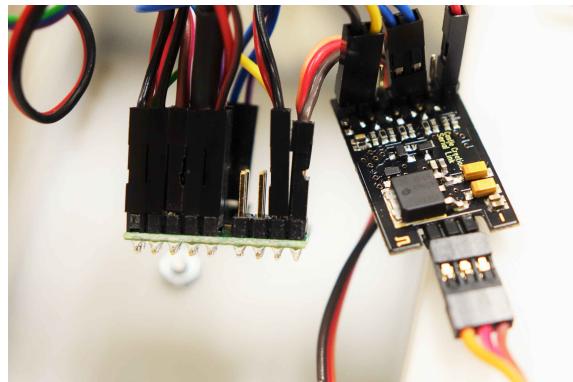
- d. Plug the steering servo cable into the appropriate pins on the servo multiplexer per the diagram.
e. Bring the components put together in the previous section near the box to install them inside. Route only the front rotation sensor harnesses through the slot in the box as shown in the picture below. The rear rotation sensor harnesses should go out the back where they will eventually go through the split loom.



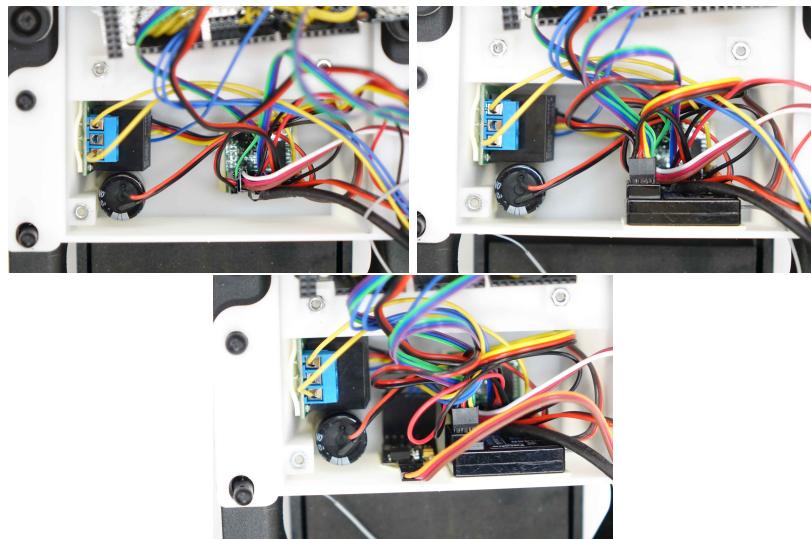
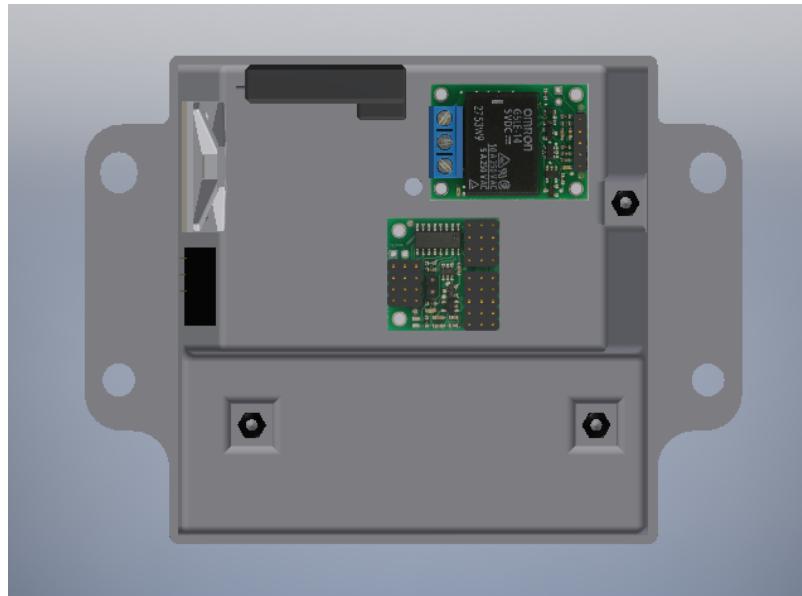
- f. Replace the 3×1 female housings of the motor shroud fan and the ESC fan cables with 2×1 female housings.



- g. Plug the motor shroud fan wires and ESC fan wire into the connections specified in the schematic.
h. Plug the castle serial link wire to the RX wire of the ESC and the AUX wire from the ESC to the multiplexer as per the schematic. The RX wire has an orange signal line while the AUX has a white signal line.

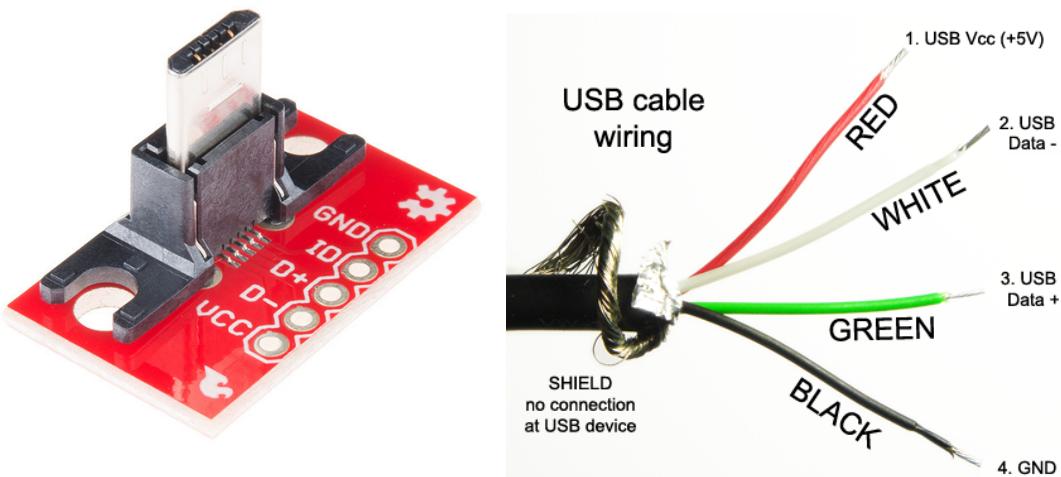


- i. Route the receiver antenna wire through the small hole near the back right top corner of electronics box. Put a piece of double-sided sticky tape to the back of the receiver, castle serial link, relay and multiplexer in order to start securing them to the walls of the electronics box. **Do not remove the sticky-tape cover. The cover is to be removed only once you are sure where you want to secure the components.** Now secure the components to the walls and the base of the electronics box. Refer the diagram and photos below for component placement.

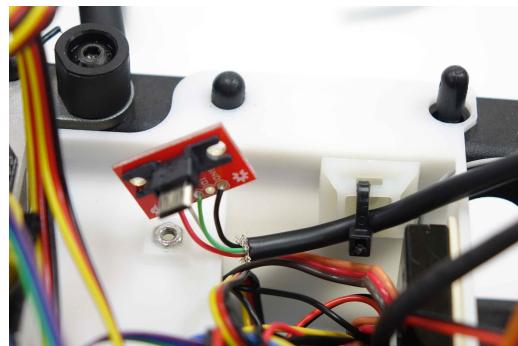


- j. Cut the USB cable down to a 2' length.
- k. Solder the 4 wires into the appropriate pin slots of the USB breakout board as shown in the images below.

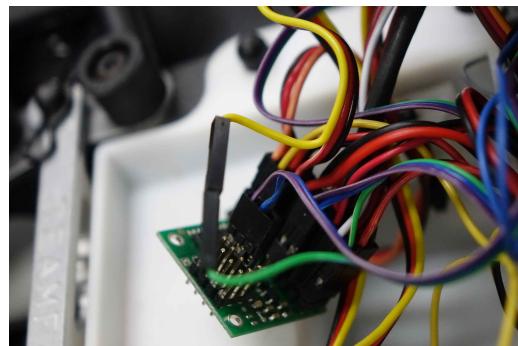




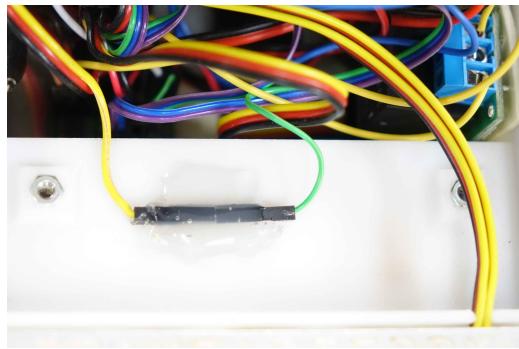
1. Secure the USB wire to the wall of the electronics box using a zip tip saddle and two zip ties as shown in the images below. Note the position of the zip-tie saddle in between the castle serial link and the receiver.



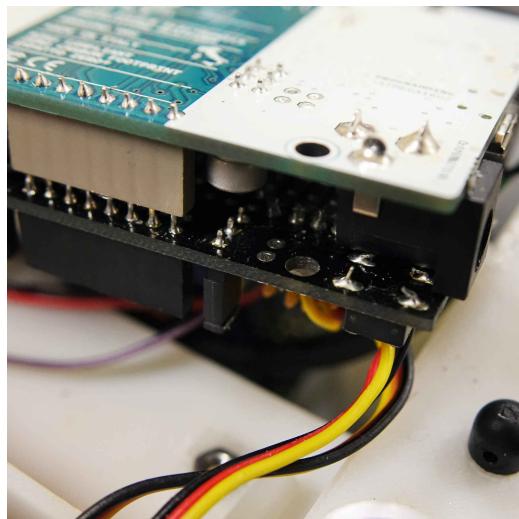
- m. Route the brake servo extension cable to the electronics box. Connect the green female 0.1 header wire from the non-Y, Green-Blue-Purple cable of the proto-shield to the yellow male 0.1 header wire of the brake servo extension cable.



- n. Hot glue the connection between these two header wires to the side of the electronics box towards the front of the chassis.



- o. Use pliers to flatten the solder tips of the button of the protoboard.



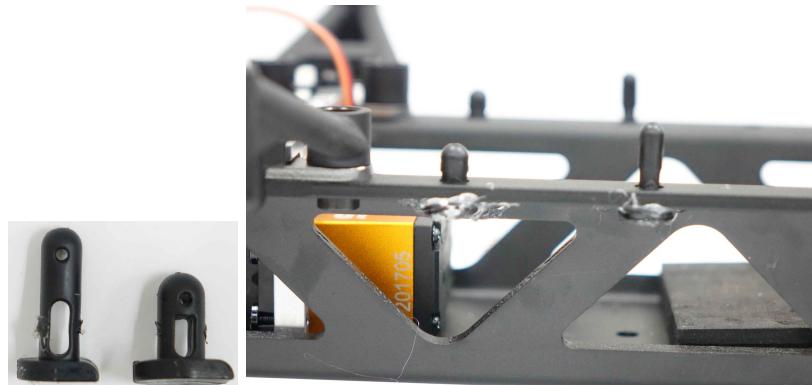
- p. Clip-off two of the nylon washers as shown in the images as they do not sit flat on the Arduino.



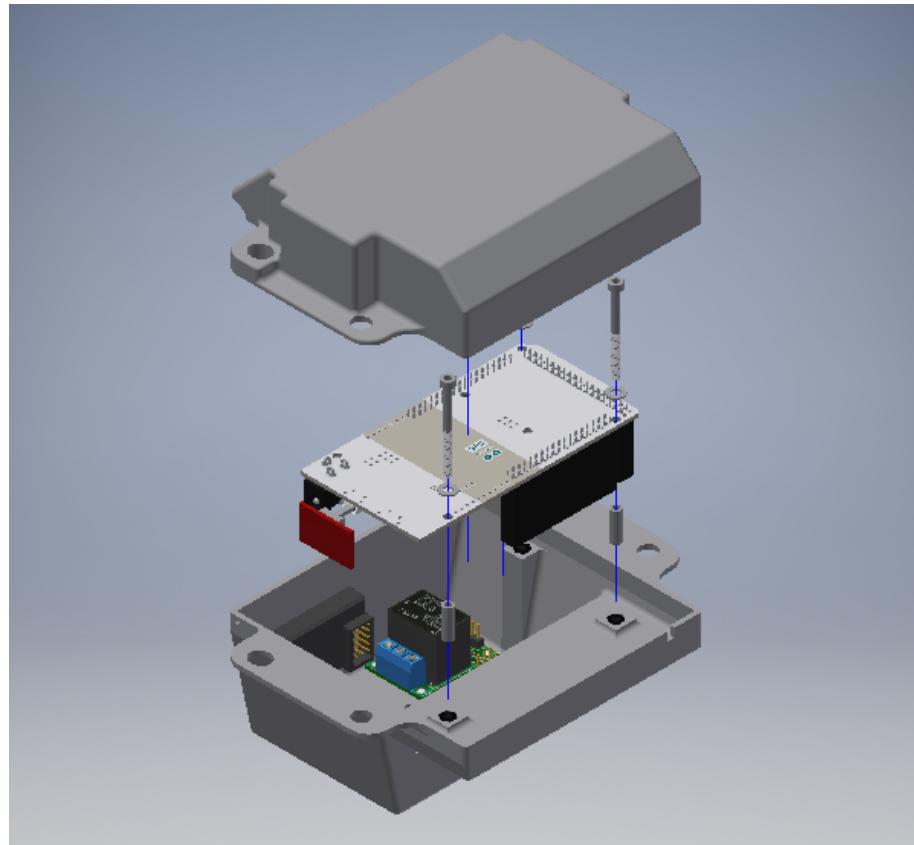
- q. Attach the Arduino Due to the electronics box using 3 M3x40 mm screws, 3 M3 nylon washers, 3 M3x18 mm nylon spacers to the 3 nuts epoxied in Step 1; do not over-tighten. Refer to the image to see which clipped-off washer goes where.



- r. Plug the USB breakout board into the programming port of the Arduino Due.
- s. Hot glue the rear bumpers (Baja part number 85420-6) to the underside of the chassis to ensure that they do not fall off when the body clips are secured.



- t. Each wheel rotation sensor wire assembly has 2 parts. One going from the sensors to the shock tower with Futaba J female connector assembly. And, the other part starts from the Due proto-shield and goes into the Futaba J male connector assembly. Connect the parts coming out of the proto-shield into the cable harness connectors at the front and back shock towers.



22 Test Electronics Box

Time 1 hours 0 minutes

Refer to the Operating Procedures document to power the chassis, for the ESC power sequence, and transmitter usage.

Instructions

- a. Calibrate ESC by following the How to Calibrate the ESC in the Castle Creations Mambla XL X Driver's Ed Guide. **You will have to toggle the throttle relay by pressing the button on the controller grip immediately after powering the ESC before it begins signal check.**
- b. Turn on the transmitter and power the ESC after sucessful calibration.
- c. Verify that steering is connected correctly by turning the steering control on the transmitter.
- d. Verify that throttle is connected correctly by using the throttle control with the transmitter set to manual mode.
- e. Verify that you can switch between autonomous and manual mode.
- f. Verify that pressing the run stop button on the transmitter handle disables throttle control.
- g. Connect electronics box USB cable to a computer.
- h. Use a serial monitor to connect to the USB cable and verify all data is being read and transmitted by the Arduino:

- i. Castle Serial Link data is being transmitted (battery voltage, motor speed, ...).
- ii. Spin each axle to verify the wheel rotation sensors are mounted properly and plugged into the correct spot.
- iii. Manual and autonomous mode are correctly detected.
- iv. Run stop state is correctly detected.
- v. Manual throttle and steering commands from the transmitter are sensed correctly.

23 GPS Box Assembly

Time 4 hours 0 minutes

Parts

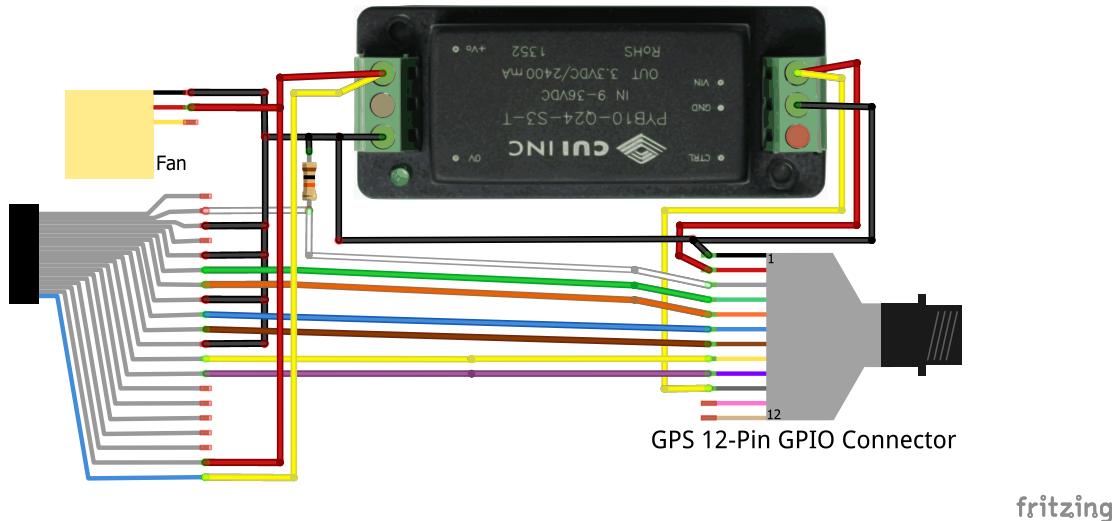
- GPS box
- GPS box lid
- GPS box tab
- 15" 12-pin GPS cable
- Hemisphere P307 GPS unit
- GPS antenna cable
- 4 1/4" 6-32 screws for the GPS antenna
- 12" 20-pin ribbon cable
- 12-pin male solder cup connector
- 2 rubber bushings
- Cui 3.3V isolated voltage regulator
- 10k Ω Resistor
- 1" piece of black servo wire
- 2 4" pieces of servo cable
- Copper conductive tape
- Sunon UF3F3-500 fan
- 2 M1.4 fan screws
- 2 M1.4 fan nuts
- 4 M3×8 mm screws
- 6 M3×12 mm screws
- 10 M3 nuts

Instructions

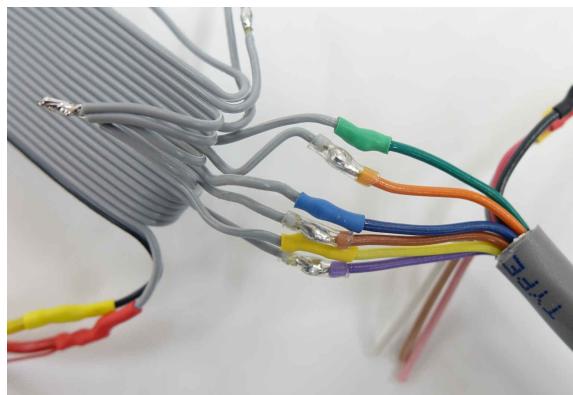
- a. Cover the top of the GPS box lid with a single layer of copper conductive tape. Cut out the larger holes and poke through the smaller holes.



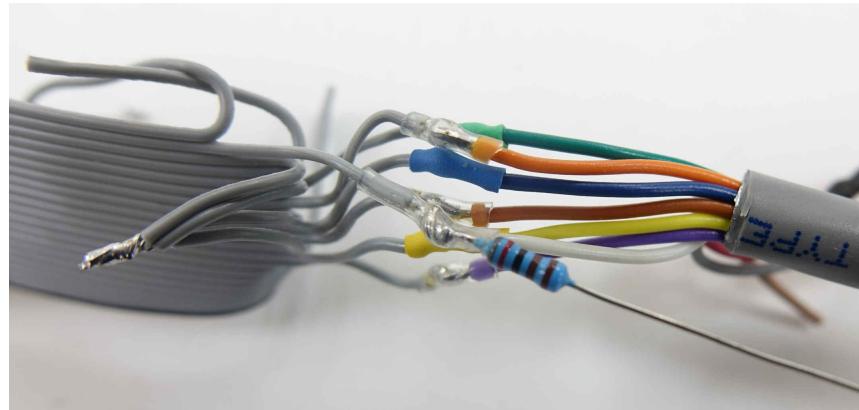
- b. Cut the 20-pin ribbon cable down to 4”.
- c. Strip approximately 1.5” insulation off one end of the 15” piece of GPS cable.



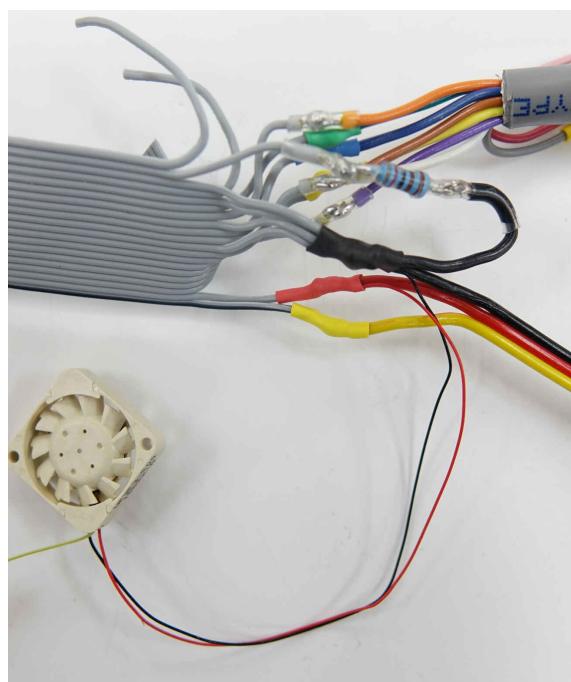
- d. Referring to the wiring diagram above, solder all through-wires from the ribbon cable to the GPS cable. **Remember to slip a small piece of heat shrink over the wires before soldering.**



- e. Referring to the diagram above, solder one end of the resistor to the white wire in the GPS cable. Solder the ribbon cable corresponding to the white wire to this junction. Solder all of the ground wires from the ribbon cable together. **Remember to slip a small piece of heat shrink over the ribbon cable wire before soldering.**

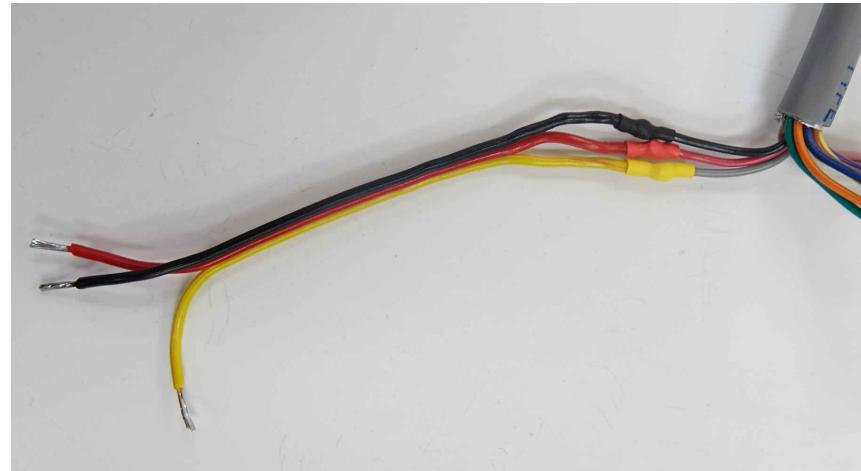


- f. Solder a small piece of black servo wire to the other end of the resistor. Slide a small piece of heat shrink over the resistor and the solder joint between the resistor and the black servo wire. Solder the other end of the black servo wire to the ribbon cable ground wires, the black lead of a 4" piece of servo cable, and the ground lead of the fan. **Remember to put a piece of heat shrink over the ribbon cable ground leads before soldering.**
- g. Referring to the wiring diagram above, solder the red and yellow leads of the same servo cable to the corresponding wires in the ribbon cable and fan. **Remember to slide a small piece of heat shrink over the wires before soldering.**

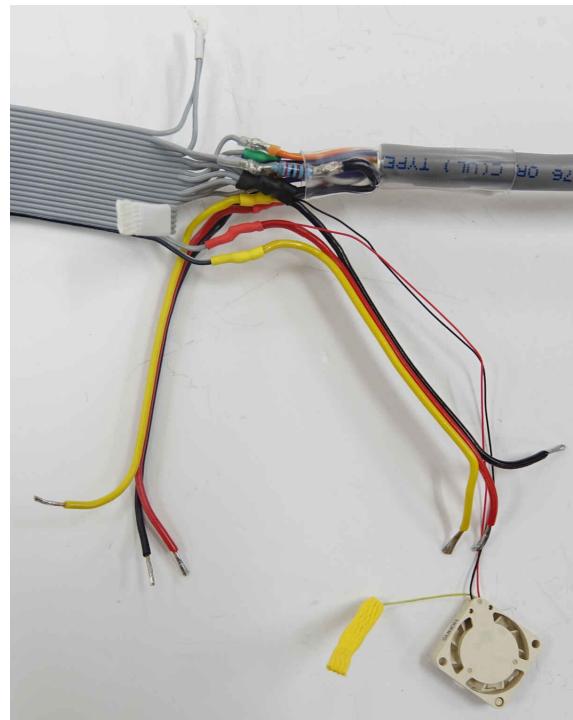


- h. Tin the leads on the other end of the servo cable.
- i. Referring to the wiring diagram above, solder another 4" piece of servo cable to the corresponding

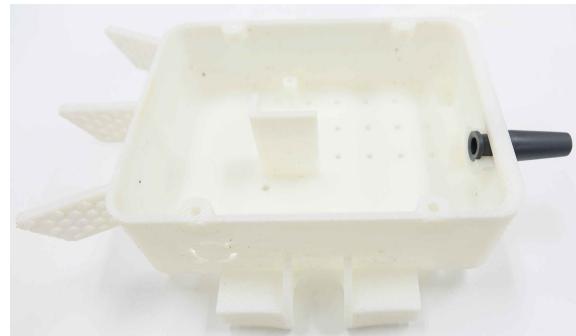
wires in the GPS cable, and tin the leads on the other end. **Remember to slide a small piece of heat shrink over the wires before soldering.**



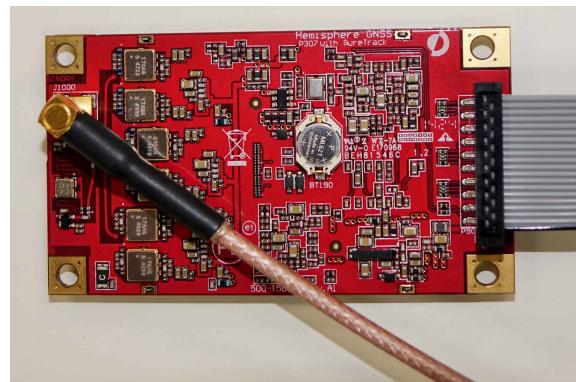
- j. Use a heat gun to heat all heat shrink ensuring that it covers all exposed wire and solder.
- k. Put small pieces of heat shrink over all the free wires from the GPS cable and ribbon cable. Slide a large piece of heat shrink over the GPS cable as far over the exposed wires as possible.



- l. Referring to the wiring diagram above, connect the servo cable leads to the appropriate terminals of the voltage regulator.
- m. Pinch one of the bushings in half and push it through the hole in the GPS box.



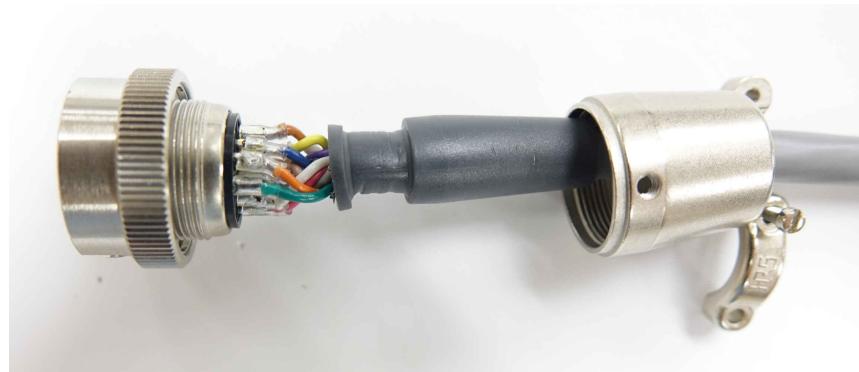
- n. Push the GPS cable through the bushing so the ribbon cable and voltage regulator are inside the box. Connect the ribbon cable to the GPS unit. The colored wire should be connected to the pin labeled with the small diamond mark on the GPS unit. Connect the antenna to the GPS unit.



- o. Screw the GPS unit in place with 4 M3×12 screws. Screw the fan in place with 2 M1.4 fan screws. Screw the voltage regulator in place with 2 M3×12 screws. Carefully fold the ribbon cable so that all items – fan, cable, and GPS unit, voltage regulator – fit into the box.



- p. Attach the antenna to the lid and screw the lid into place using 4 M3×8 screws and 4 M3 nuts. Put a dab of hot glue onto the nuts to hold them in place.
- q. Slide a bushing over the free end of the GPS cable. Remove the lock nut from the male 12-pin connector, unscrew the connector housing, loosen the clamp screws, and slide the housing over the end of the GPS cable and the bushing.
- r. Strip approximately 0.5" insulation off this end of the GPS cable.
- s. Referring to the wiring diagram above, solder the wires from the GPS cable to the appropriately numbered solder cups in the 12-pin connector. Slide a small piece of heat shrink over each wire before soldering, and shrink it after soldering. **This step is easiest if you start with the soldercup furthest from you at the bottom of the connector. Then work your way up and over.**



- t. Slide the bushing up to the edge of the insulation. Then, slide the housing up and screw it onto the connector. Tighten the screws on the clamp down on the bushing.



- u. Replace the lock nut in the 12-pin connector.

24 GPS Box Installation

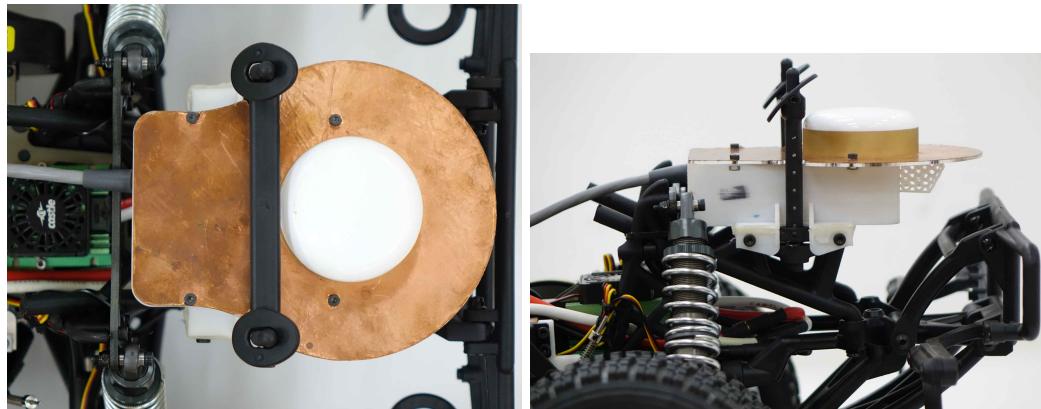
Time 0 hours 20 minutes

Parts

- Assembled GPS box
- Chassis
- 4 M4×20 mm screws

Instructions

- a. Mount the GPS box to the rear body mount area of the chassis (part 85417-3: see photo for exact placement) using 4 M4×20 mm screws.



25 Wire Management

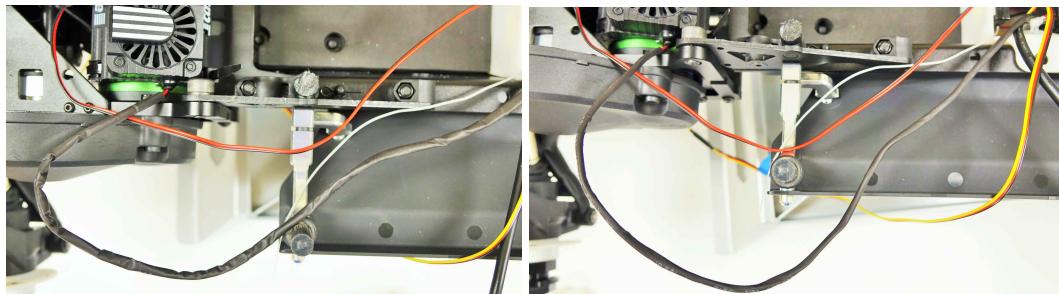
Time 0 hours 20 minutes

Parts

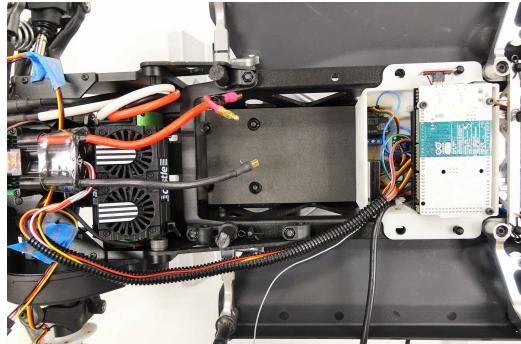
- 0.5" outer diameter split loom
- Small zip ties
- Electronics box lid
- 4 small body clips

Instructions

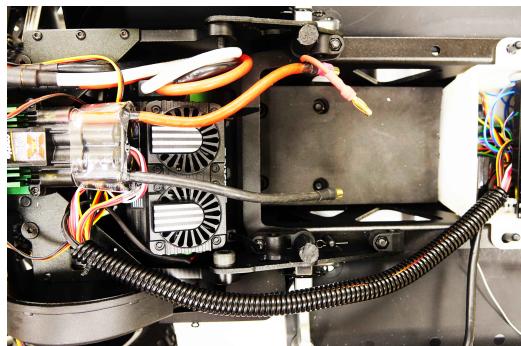
- a. Heat shrink the motor shroud fan wire.



- b. Cut an 11.5" piece of split loom.
- c. Route all fan wires from the ESC and motor, the ESC RX and AUX wires, the rear wheel rotation sensor wires and the front brake servo wire (if installed) from the electronics box through the split loom.



- d. Attach zip ties on each end of the split loom to hold the wires in place.



- e. Zip tie the split loom to the chassis near the electronics box using the hole that exists in the chassis, the engine mount brace above the side rail guards, and the hole in the back plate under the ESC.



- f. Zip tie antenna to the split loom and the USB cable harness to the engine mount brace as shown in the picture. This point acts as a pivot for movement of the USB cable which will be plugged into the compute box.



- g. Hot glue Futaba J male housing of the wheel rotation sensor wires to the shock towers of the chassis.



- h. Loop the front wheel rotation sensor wires around the front supports in order to reduce slack to the minimum required to route these wires, if needed.



- i. Zip tie front and rear wheel rotation sensor wires over the connector housings hot glued to the shock tower.
- j. Install the 4 small body clips into the plastic electronics box supports. Ensure that the USB cable, split loom, and front wheel rotation sensor cables are routed through the appropriate cutouts.



- k. Connect the engine guards to the under guard using body clips. Then, install the under guard and secure it with a body clip at the rear of the chassis. See below for pictures.



26 Sticker Removal

Time 0 hours 30 minutes

Parts

- Baja 5SC body

Instructions

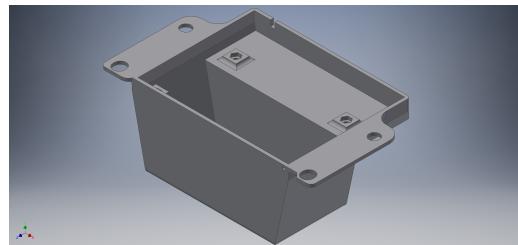
- a. Remove all stickers from the body.



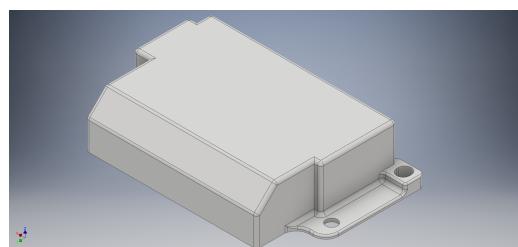
27 Appendix A: Parts

27.1 3D Printed Parts

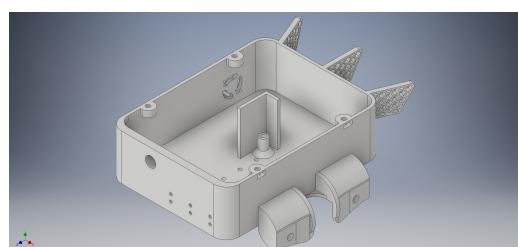
- Electronics box



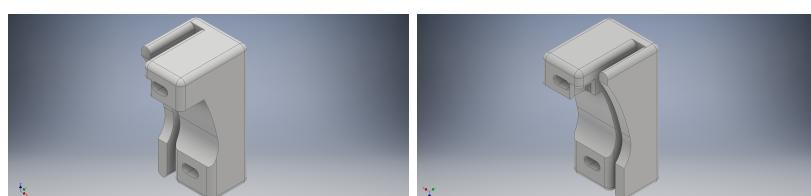
- Electronics box lid



- GPS box



- Front brake aligners



- Rear wheel rotation sensor mounts



- Wheel rotation sensor magnet mounts

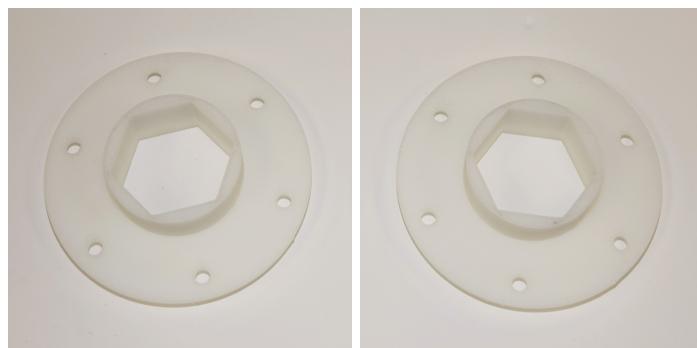
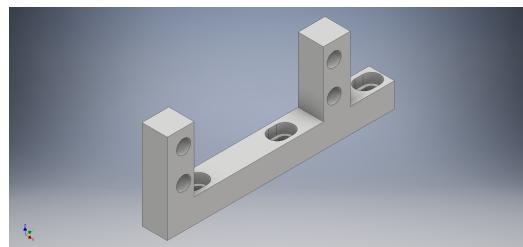


Figure 1: Front (left) and back (right) wheel rotation sensor magnet mounts

- Brake servo mount



27.2 Laser Cut Parts

- GPS Ground Plane

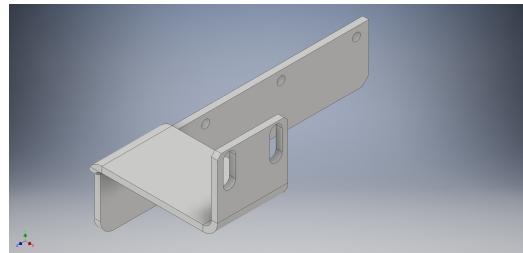


- Battery Foam



27.3 Fabricated Parts

- Brake master cylinder plate

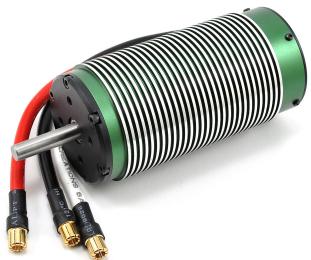


27.4 Upgrade Kits

- Castle Creations Mamba XL-X Electronic Speed Controller



- Castle Creations 2028 electric motor



- Castle Creations motor fan



- Conversion hardware kit. Either Castle Creations Baja conversion hardware (left) or Rovan Baja conversion hardware (right).



- Turtle Racing Billet Servo Saver



- Integy side rail guards



- Team Fast Eddy Battery Box Eliminator Kit



- Savox SV-0235MG steering servo (left) and SV-1271TG brake servo (right)



- Shock springs, front, rear long, rear short



- Shock Fluid, Factory Team 60w, 59 ml



- Darksouls Baja Axle Extender Set



- Mecatech front brake kit for Baja



- Zero-growth tire foams



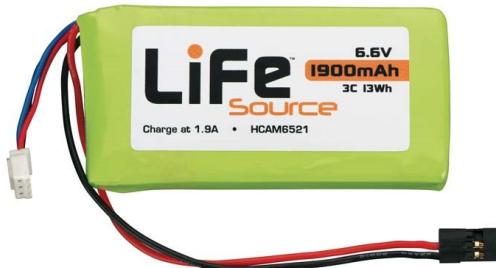
Figure 2: Red front tire (left) and Blue back tire (right)

27.5 Electronic Components

- 9000 mAh 4S 14.8v Chassis Battery Pair



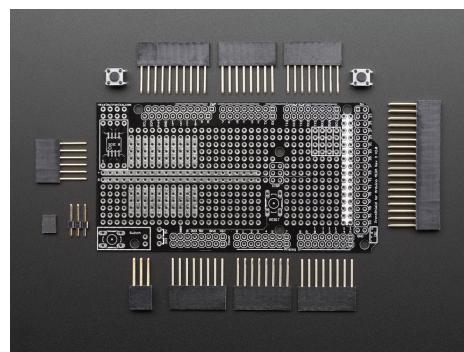
- 1900 mAh 2S LiFe 6.6V Transmitter Battery



- Arduino DUE



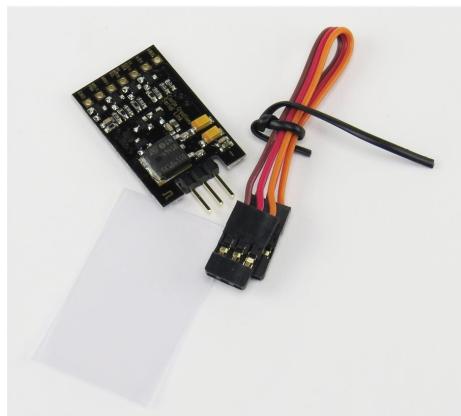
- Adafruit ProtoShield for DUE



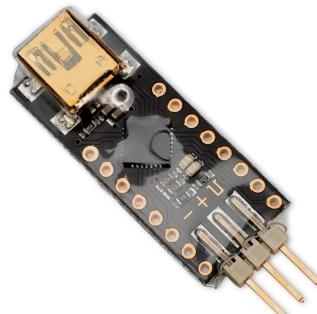
- Baja Series Adapter



- Castle Serial Link



- Castle Link Programmer



- CUI 3.3V 2.4A Voltage Regulator PYB10-Q24-S3-T



- Futaba 4PV Transmitter with R304SB Receiver



- Futaba FUTM1725 Charger for Futaba 4PV



- Glitch Capacitor



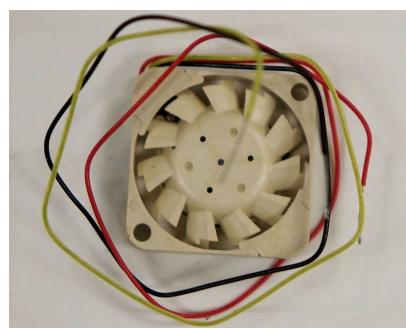
- GPS antenna



- GPS antenna cable



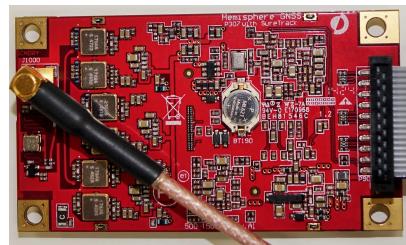
- GPS box fan



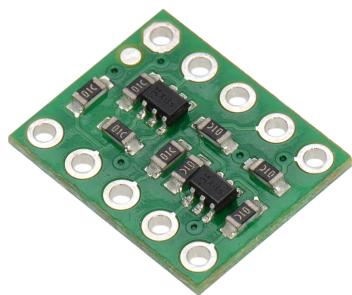
- Hallogic OH090U Hall-Effect sensors



- Hemisphere GPS P307



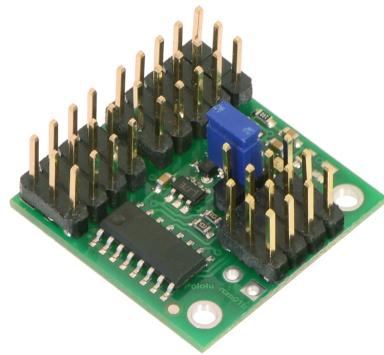
- Pololu Level Shifter



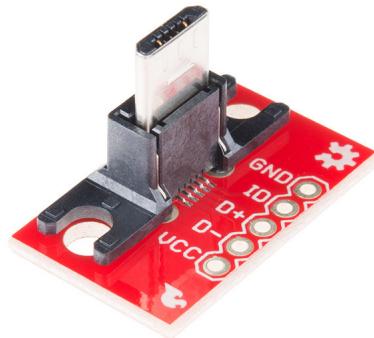
- Pololu RC Relay



- Pololu Servo Multiplexer



- USB breakout board



27.6 Connectors

- 1×1 0.1 in header housing



www.pololu.com

- 1×2 0.1 in header housing



www.pololu.com

- 1×3 0.1 in header housing



www.pololu.com

- 1×4 0.1 in header housing



www.pololu.com

- 1×5 0.1 in header housing



www.pololu.com

- 1×7 0.1 in header housing



www.pololu.com

- 0.1" Female Crimp Pins



www.pololu.com

- 0.1" Male Crimp Pins



Pololu

- Futaba J-Connectors



Figure 3: Male (left) and Female (right) Futaba J-Connectors

- 4mm banana plugs



- 6.5mm Bullet Connectors



- Hirose RM 12-pin plug, free hanging, male pins, 15mm



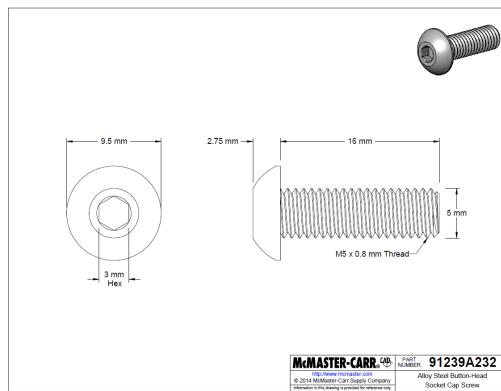
- Hirose RM bushing



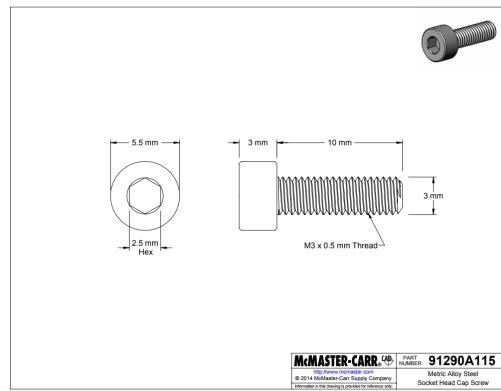
27.7 Extra Hardware

27.7.1 Conversion Hardware (If Using Rovan Baja Kit)

- 2 M5×16mm button head screws

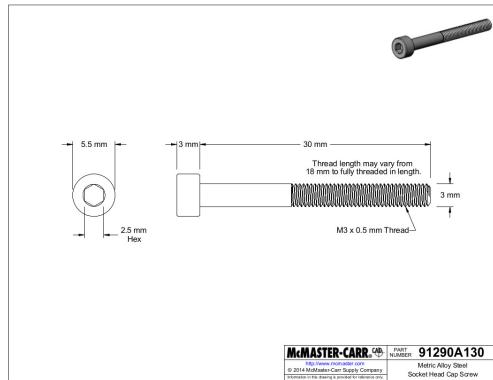


- 2 M3×10mm socket head screws

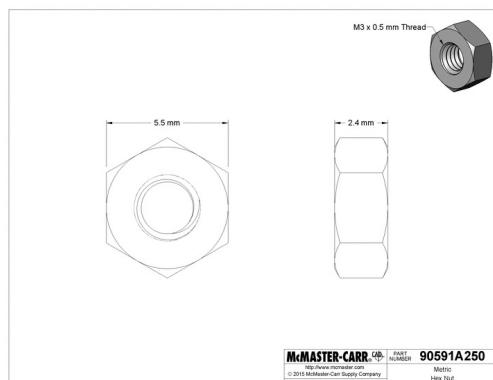


27.7.2 Electronics Box

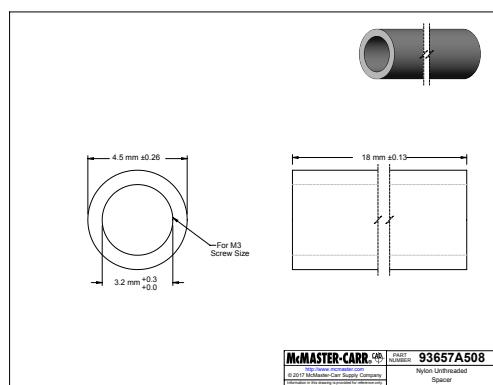
- 3 M3×30mm screws



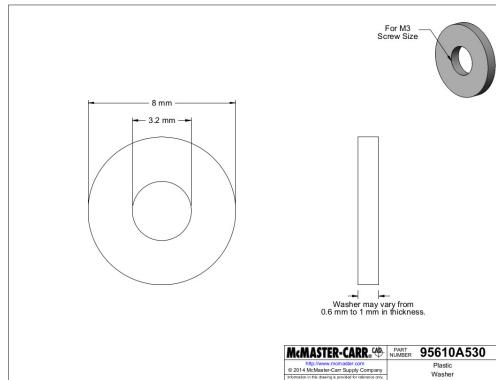
- 4 M3 hex nuts



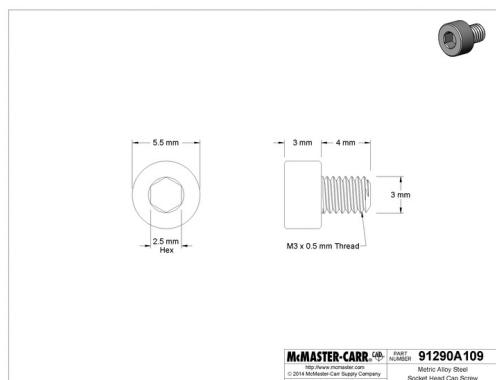
- 3 M3×18mm nylon spacers



- 3 M3 nylon washers

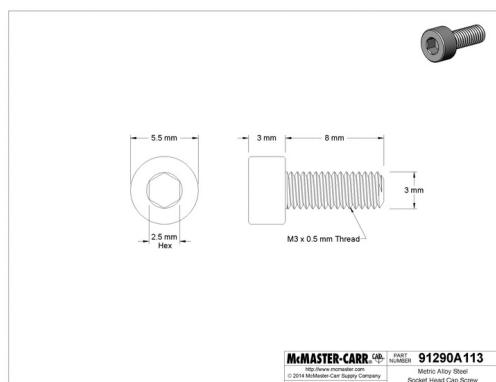


- 1 M3×4mm screw

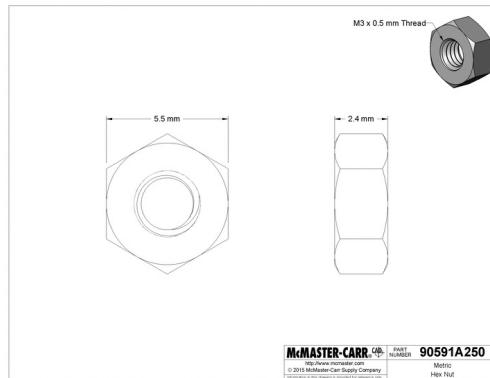


27.7.3 GPS Box

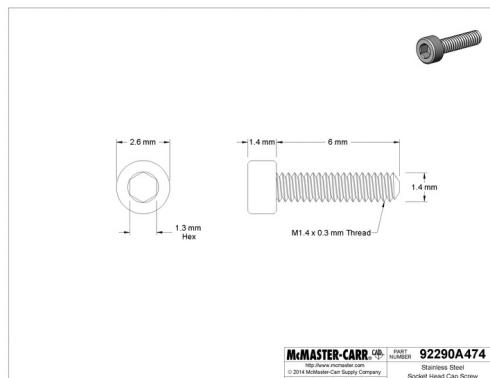
- 8 M3×8mm screws



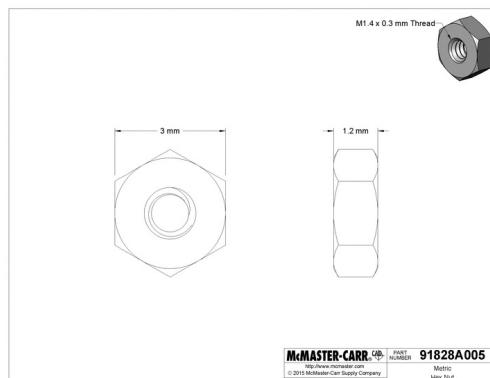
- 4 M3 hex nuts



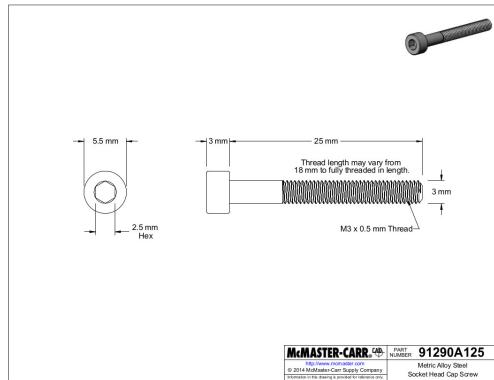
- 2 M1.4 fan screws



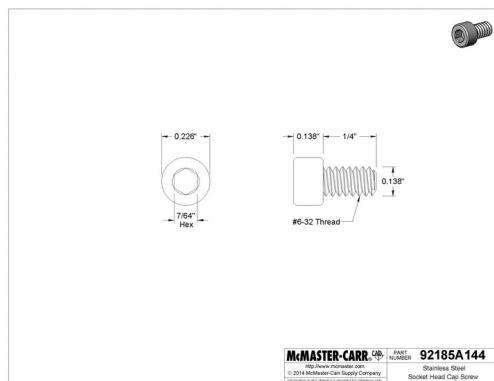
- 2 M1.4 fan nuts



- 2 M3×25mm screws

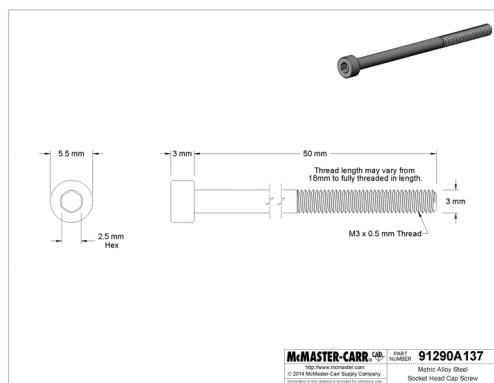


- GPS antenna screws 4 1/4" 6-32 screws



27.7.4 Front Brake

- 2 M3×50mm screws



28 Appendix B: Revision History

Revision	Date	Author(s)	Description
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1.0	April 2016	KS, MP, BG, created MB, SS, JM	
1.1	July 2016	KS, MP, BG, MB, SS, JM	updated electronics box instructions, updated images, cleaned up document
1.2	September 2016	BG, MB	Fixed error in GPS breakout cable in compute box diagram, spelling fixes
1.3	February 2017	BG	Moved GPS power supplies into GPS box, resolved inconsistencies between chassis wiring
1.4	June 2018	BG, AM, LP, NW	Updated GPS box for durability and electronics box to accomodate larger chassis batteries, front brake instructions included.

29 Appendix C: Contributors

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