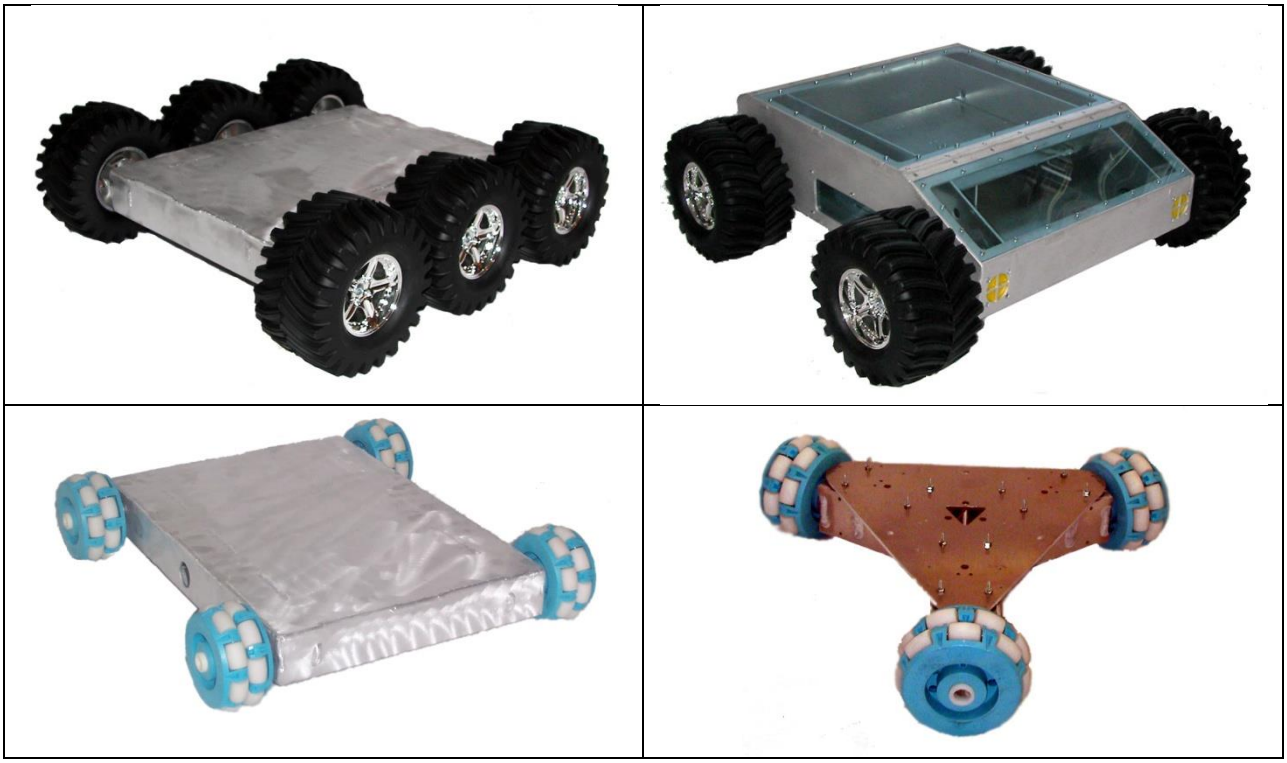
SuperDroid Robots

Robots, Parts, and Custom Solutions



Vectoring & All-Terrain Robots

Assembly and Operation

Revision Date: July 14, 2010

SUPERDROIDROBOTS.COM

SuperDroid Robots

Vectoring & All Terrain Robots

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Vectoring Robots & All-Terrain Robots Introduction

The SuperDroid Vectoring Robots (VR) and All-Terrain Robots (ATR) is an extension of the popular SuperDroid Trekker. The VRs and ATRs are a larger robot platform driven by gear motors using motor controllers versus servos. As with all SuperDroid products, they are flexible and can be customized to meet your needs. They can offer all the features of the Trekker, only with a larger platform. The VRs offer a new feature utilizing 3 to 4 independent motors that drive omni wheels. The wheels are at angles to one another and when they are driven in particular directions it results in the robot traveling in any direction (vectoring). This is a fun robotics platform that allows the robot to travel forward, and then instead of turning right, it just drives/vectors to the right….

The SuperDroid VRs and ATRs can be outfitted with microcontrollers, a PC, or wireless controlled with a PC enabling them to be autonomous. (Definition: Not controlled by others or by outside forces; independent in mind or judgment; self-directed). They can however be remotely controlled.

RC control is very popular for the robots too. The RC signal is a pulsed width from each channel usually intended for a servo. The DC motors that drive the VRs and ATRs need high currents. Motor controllers drive the motors, some controllers like the MD22 can interpret the RC signal and then drive the motors.

The intent of this manual is to allow the user to explore the many features of the SuperDroid VRs or ATRs with easy to follow steps. All the steps assume you have purchased all the parts to the SuperDroid VRs and ATRs needed to complete the desired assembly. ***The manual covers all our wheeled robot kits and many sections may not apply to your robot kit. The sections are organized such that if you do not have the discussed topic, you can skip to the next topic.***

Thank you for purchasing the SuperDroid Vectoring Robot or ATR and we are sure you will enjoy assembling and experimenting with the SuperDroid as you delve into the ever-advancing exciting robotics world.

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Chapter 1

Chapter 1: SuperDroid VR and ATR Description

The ATRs can go over a lot more aggressive terrain. The ATRs can be equipped with a large range of motors that can drive over curbs, up very steep hills and navigate very well using proportional skid steering (ie you steer by varying the speed and direction of the motors.

The VRs use omni wheels that are positioned at angles relative to one another. The basic principle is if you rotate to wheel towards each other they will propel the robot in the direction of the two motors. The way this is accomplished is with the omni wheels that allow both forward and sideways movement of the wheels.

The ATRs and VRs becomes more and more autonomous as you add on the peripherals. The SuperDroid VRs and ATRs will operate with just the OOPic driving the chassis wheels, but as sensors are added, the robot becomes more aware of its environment and is able to respond to obstacles. In order to understand what the Robot does, the following sections were written to explain the features and functions of the robots.

- How the SuperDroid's See
- SuperDroid Scanner Options
- SuperDroid Outputs (LCDs, Servos, and motor controllers)
- Programming the SuperDroid
- What the ATRs and VRs do

1 How the SuperDroid Sees"

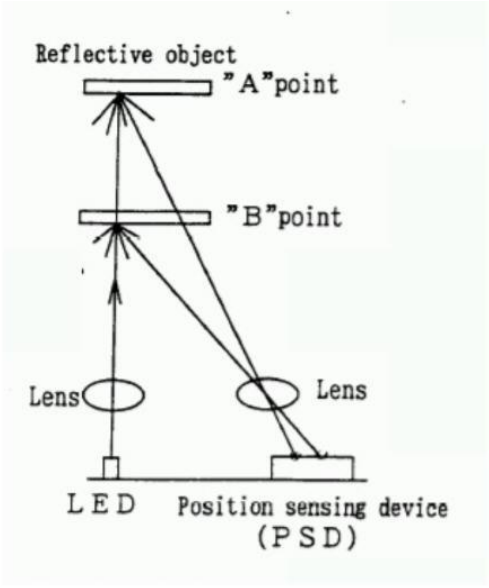
The SuperDroid products are currently sold with three ways of seeing:

- Infrared: This method sends an infrared signal out (invisible to the human eye) and times how long it takes for the signal to reflect off an object and return to the infrared receiver. The time it takes to reflect is then converted into a voltage. Using the OOPic code, an oIRRange Object converts the voltage to a distance. An IR signal is good at reflecting off most surfaces that have some reflective properties. The IR detectors sold by SuperDroid Robots are Sharp GP2D12 IR detectors that mount to the rear or front of the chassis, or as part of a sweeping detector. The IR detector will detect obstacles and cause the robot to stop. The IR detector can detect from a range of 4 inches to 30 inches.
- Ultrasonic: This method is similar to the IR except it uses sound to reflect off objects. The time it takes to return the sound is converted to a distance using the oSonar OOPic Object. The ultrasonic sound is considered the "ping" and the returned sound is called the "echo". The

ultrasonic signal is good at reflecting off most hard surfaces. Surfaces that absorb sound do not work as reliably. The ultrasonic sensors SuperDroid Robots use are Devantech SRF04 Ultrasonic rangers that mount anywhere an IR detector can mount. The Devantech SRF04 Ultrasonic detector can detect from a range of ~4 inches to ~10 feet. The SRF08 will work up to ~30ft.

- Bumper Switch: This acts as the name implies - if it bumps into something the switch contacts are closed and the OOPic gets the signal. The Robot can be programmed to stop and redirect once the bumper switch is activated. The VRs and ATRs can be equipped with bumper switches on the front and back.

The combination of the IR and Ultrasonic are good at detecting 95%+ of obstacles in the line of sight of the sensors. SuperDroid Robots offers these sensors on sweeping arms to increase the range of view. The other important item to consider is the reflection angle. If the IR or Ultrasonic Ping hits an angular surface, it may not reflect back to the detector, hence the instrument will not detect the obstacle. Again the sweeping arms help reduce this by varying the sweeping angle of the detector. See figure below:



Virtually every obstacle can be detected with these detections systems. An example of an object that may avoid detection would be a thin wire at a level above the limit switch, but at a height that the wire will hit the boards or scanners. Nothing is perfect - even humans bump into things. With the scanners attached, the SuperDroids have near perfect vision.

2 SuperDroid Scanner Options

The least expensive option is to start with just the Simple Chassis and OOPic II. The drive motors must be run with motor controllers from a different power source than the OOPic. If the VR or ATR is not equipped with any sensors, the OOPic can be programmed to drive for timed intervals and navigate blindly. Starting out with this is an excellent idea if you're new to autonomous robotics because it will allow you to program and experiment with the OOPic. We recommend using the Trekker OOPic Expansion Card, you can experiment with operating motors, LEDs, potentiometers, beepers, and

switches without having to worry as much about wiring up the different sensors and you can use our example programs with very little manipulation.

The SuperDroids have two basic types of scanners/detectors. They are:

- Fixed scanners: These are hard mounted to the chassis and can not have their field of view adjusted relative to the robot itself (i.e., to look to the right, the robot has to turn to the right)
- Sweeping scanners: These are scanners that are attached to a servo via a bracket and allow the scanner/detector to look with a field of view slightly greater than 180 degrees. They can look without the robot having to rotate/drive.
-

The simplest and easiest scanning capability starts with the Trekker IR packages that can be plugged into the Trekker Expansion Board. The OOPic can be programmed to drive and turn when it sees something in its way. You now have the start of a truly autonomous robot!

- The next evolutionary step is adding a sweeping scanner. The VR and ATR platforms have mounting locations in several spots for servos. Then using the Trekker sweeping sensors you can attach IR, Ultrasonic, or IR and Ultrasonic sweeping scanners to the VR and ATR platforms and the scanners can be programmed to oscillate/sweep as the robot scans the area for obstacles. Once an obstacle is detected, the scanner can look for a clear path.

3 SuperDroid VR and ATR Outputs

The big difference between the Trekker and the VR and ATRs is the use of gear motors instead of modified servos. With the use of motors, the method of driving the motors is the other big change. The motors can not be driven with a direct PIC output. The motors must have a motor controller to do the job. The VRs and ATRs can use many types of types of motor controllers,, the Magnevation controllers, Devantech MD22s or MD03s, SuperDroid Robots PWM, etc. They all do the same basic thing, they take a PIC output and dive the motor based on the signal. They both have their own features, and we discuss using them below.

It is always a good idea to get a Liquid Crystal Display (LCD) to help troubleshoot your programs or to display data. The LCDs plug straight into the Trekker OOPic Expansion Card. They can be mounted mechanically to the VR and ATR platforms with the supplied bracket.

Servos can also be driven via a RC controller or the OOPic. If the Trekker OOPic Expansion board is used the servos can be driven from there. The servos can be used for sweeping scanners as discussed above or with a camera pan and tilt system.

Chapter 2

Chapter 2: SuperDroid VR and ATR Assembly

1 Preface

This chapter discusses many of the possible assemblies of the SuperDroid VRs and ATRs. We now carry many types of ATRs too (Mini ATRs, standard ATRs, Large ATRs, Heavy Duty ATRs, Deluxe ATRs). Depending on what components you purchased certain sections of this chapter will not apply. SuperDroid ATRs are on the 2nd generation chassis too, both generations are discussed in this chapter. We now offer custom length ATR sides and a new style single wheel motor mount too for the IG32 and IG42 gear motors.

2 SuperDroid Motor Electrical Wiring

When using electric motors, one of the most important things to consider is motor noise. We sell several DC motors for our ATR and Vectoring Robot kits. With these motors we recommend you get a motor wiring kit too. The motor wiring kit provides protection and helps knock down the majority of the noise the motors put out. There are a lot of schools of thought on how to control the noise, below is what we have found is the best practice for noise suppression.

Tips:

- Motor Noise is a big issue with electronics. This section should be followed to ensure the motors noise is suppressed.
- Every setup is different. We have wired 100s of ATRs now, and very rarely do we get the same results with each one. If you experience noise issues (short RC range, irratic behavior, etc. try different things sometimes the capacitors will cause issues)
- Motors with encoders, we typically do not use the capacitors, just the ferrites to start with.

1. Take two capacitors and twist them together.

2. Scratch a spot on the motor between the two terminals as shown. Using soldering iron apply some solder. Then solder the twisted end of the two capacitors to the spot on the motor case as shown in Figure 1. You may need to use a high power soldering gun or torch to heat up the motor casing and ensure you get good adhesion.

3. Take the other end of the twisted pair of capacitors and insert one end to each motor brush terminal.

4. Place a third capacitor between each motor brush terminal.

5. Strip back the shielded wire leaving the two conductors about 2-3" out.

6. Slide the large ferrite ring over the shielded wire and cover it with the 3/8" heat shrink. If the cable is too large strip back the cable insulation and run the drain line around the ferrite as shown in Figure 2.

7. Insert the small ferrite rings into the 1/4" heat shrink (this is a real tight fit) and then slide over each wire conductor.

8. Place the wires on the motor brush terminals. You want to be consistent with which color wire goes to which terminal so all your motors are wired and hooked up the same. We place the white wire on the terminal with a red dot.

9. Solder the wires and the capacitors to each motor terminal being careful not to overheat any of the components.

10. Heat the shrink wrap on the wires securing the ferrite rings.

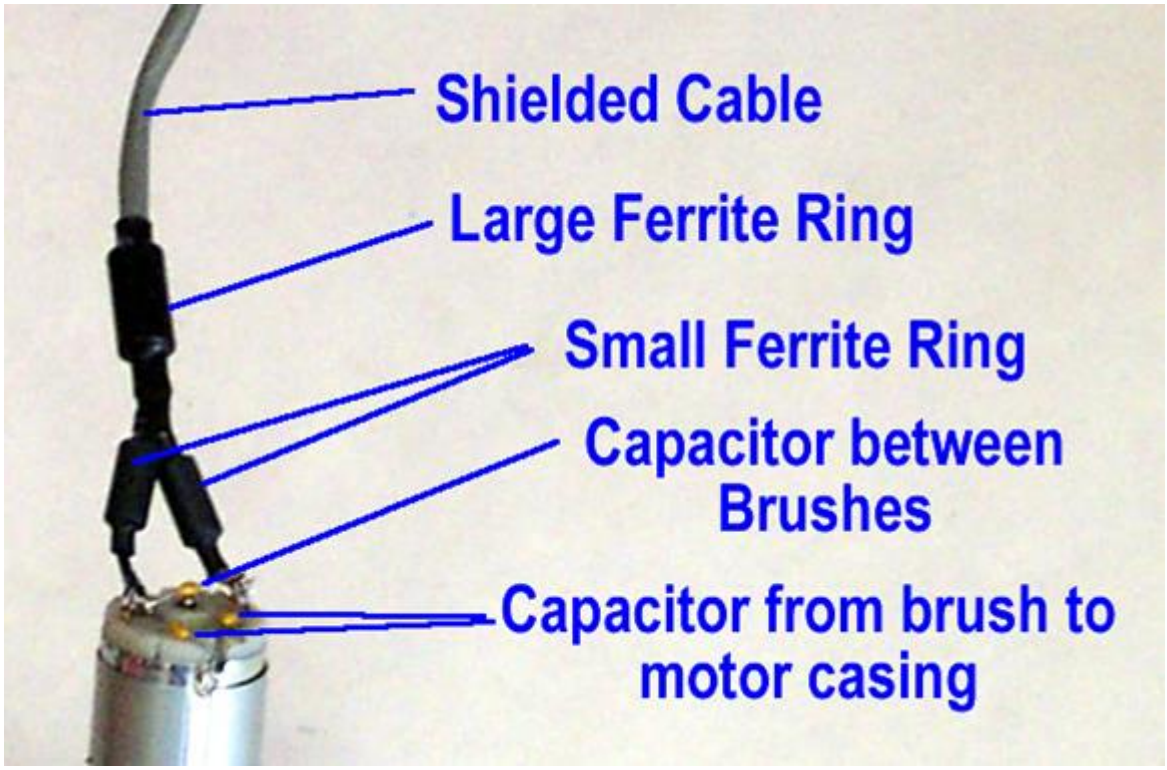


Figure 1: Gear Motor Wiring

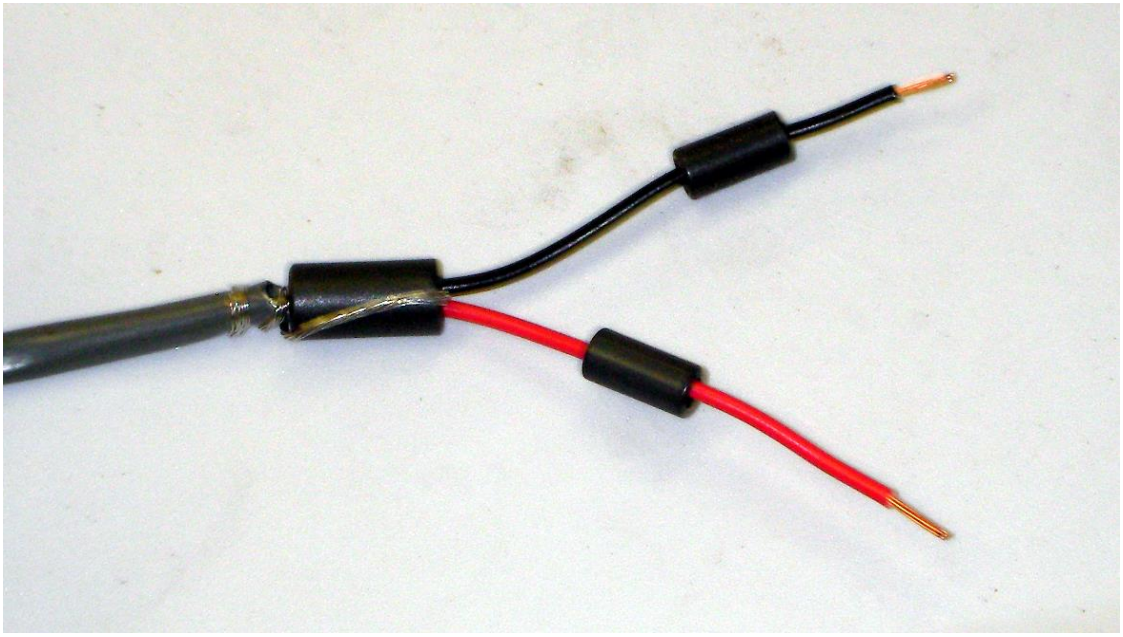


Figure 2: Gear Motor Wiring (larger diameter)

3 Mounting an Omni-Wheel onto the Shaft

This section applies to the assembling and omni-wheel onto the shaft that comes with the motor housing. This section has to be done before mounting the shaft to the motor.

1. Omni wheels need to be mounted onto the shaft by performing the following: (refer to Figure 3)

   - Slide the shaft into the omni wheel and match mark the 3 holes onto the omni wheels
   - Drill a small 1/8" hole in the wheel at each match mark.
   - Reinsert the wheel on the shaft and fasten with #2 screws. The shaft with the ¼" hole on 3/8" in attaches to the motor.

2. Mount the bearing and the lock collar as shown in Figure 4. The setscrew in the collar should be replaced with the larger setscrew provided and go into the hole in the shaft. The setscrew will be tightened onto the flat spot on the motor drive shaft when it is installed later. (both the double row and single row wheels are set up the same way)

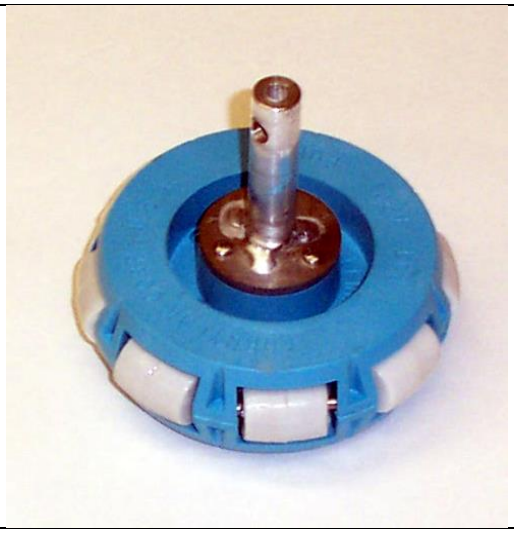


Figure 3: Mounting Single Row Omni Wheel

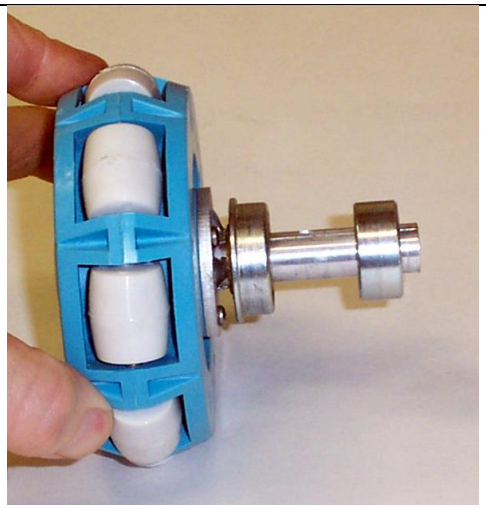


Figure 4: Bearing Mount for Omni Wheel

4 Mounting a Large ATR Wheel onto the Shaft

This section applies to the assembling and ATR wheel onto the shaft that comes with the motor housing. This section is best if before mounting the shaft to the motor.

1. The ID of the wheel hub needs to be opened up with a drill to accept a ¼-20 bolt. Do not over-enlarge the hole.

2. The ATR wheel shaft has is hex shape on the wheel side. This hex pattern fits into the opening of the ATR wheel hub to prevent it from spinning.

3. Securely clamp the motor shaft being careful not to damage it.

4. Insert a ¼-20 machine screw through the wheel hub into the end of the shaft.

5. Tighten the screw. If desired you can use a thread locking compound here, but be carefull. . **Be careful that the thread locking compound is compatible with plastic, otherwise your wheel hub will dissolve.**

6. If your shaft has a hex nut with a thread insert in it follow the next two bullets otherwise skip this step

   - as the screw is tightened it will go easily through the thread insert, then half way down it may get difficult as it intersects the aluminum threads, keep tightening.

   - slide a collar, bearing, and another collar on the shaft as shown in **Error! R eference source not found.**. The setscrew in the collar that couples to the motor should be replaced with the larger setscrew provided and go into the hole in the shaft. The setscrew will be tightened onto the flat spot on the motor drive shaft when it is installed later.

7. If your shaft is a machined piece of hex bar the fist collar is not needed as mentioned in step.

5 SuperDroid Motor and Housing Assembly

This section applies to the assembling gear motors to the motor mounts. These mounts are for generation 1 ATRs and the vectoring robots.

Tips:

- Go step by step and make sure all hardware is secure.
- Use a tread locking compound on the hardware to ensure it does not vibrate loose during use.

1. Mount 4 #4 machine screws through the base of the motor mount and fasten with a nut as shown in Figure 5.

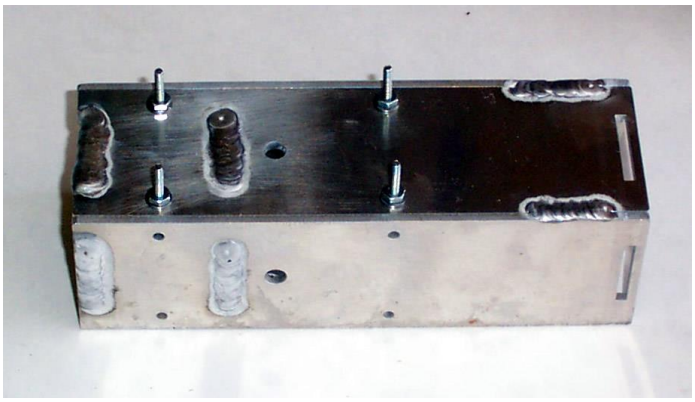


Figure 5: Motor housing mounting bolts

2. Mount the motor to the motor base plate using the supplied metric screws. (washers are not necessary as show). Use a thread locking compound on these screws because they are difficult to access and tighten later on. Refer to Figure 6 for details.

Figure 6: Motor Mounting Plate Assembly

3. Mount the motor and motor mounting plate into the housing as show in Figure 7. Use the supplied #4 machine screws and nylon spacers. Secure the screws with #4 nuts. The motor needs to be oriented so the shaft is concentric to the bearing hole located on the housing.

Figure 7: Motor Mounting into Housing

4. Slide a shaft collar onto the shaft (only for ATR tires)

5. Slide a bearing onto the shaft so the flange of the bearing is facing towards the wheel

6. Put the shaft color on the end of the shaft and replace the standard set screw with the larger set screw provided. The setscrew should go through the hole on the end of the shaft.

7. Install the shaft and the bearing into the motor housing and onto the motor shaft as shown in Figure 8. The bearing needs to be pressed into the hole, two pairs of pliers or channel locks work best for this (pinch the flange to the inside face of the housing). If you only have one pair just work it back and forth until it's inserted. If the housing bearing plate is bent during this operation straighten it out before proceeding.

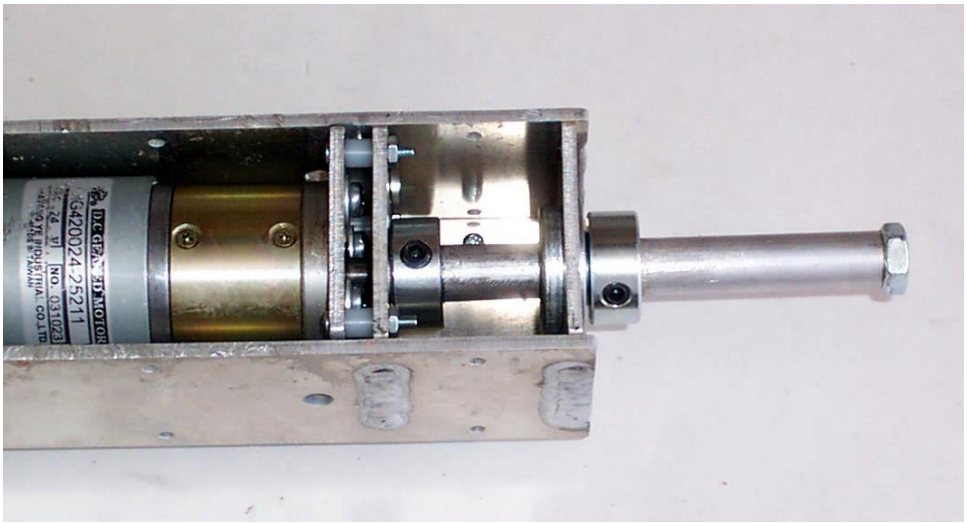


Figure 8: Motor Shaft Insertion

8. Slightly loosen the 4 bolts that hold the motor base plate to the motor housing.

9. Attach the motor to a 12 or 24V DC supply/battery and let the motor spin and find its center.

10. Slowly tighten the 4 bolts loosened in step 8 in an alternating pattern making sure the motor continues to rotate freely. Try different tightening techniques and patterns until the motor spins freely and evenly (this can be monitored by sound, the motor should not be straining unevenly during a revolution). Its ok if the screws are not tightened all the way as long as they are snug. This serves as a pseudo flexible coupling for inherent misalignments.

11. Apply thread locking compound to the threads of he bolts so they will not work free. We generally just put a drop of superglue at the end of the nut onto the threads of the machine screw.

6 SuperDroid Motor to the 2nd Generation ATR Base Assembly

This section applies to the assembling gear motors to the motor mounts, which are integral to the ATR 2nd Generation frames.

Tips:

- Go step by step and make sure all hardware is secure.
- Use a tread locking compound on the hardware to ensure it does not vibrate loose during use.

1. Mount the motor to the motor base plate using the supplied metric screws. (washers are not necessary as show). Use a thread locking compound on these screws because they are difficult to access and tighten later on. Refer to Figure 9 for details.

Figure 9: Motor Mounting Plate Assembly

2. Mount the motor and motor mounting plate into the frame as show in Figure 10. Use the supplied #4 machine screws and nylon spacers. Secure the screws with #4 nuts. The motor needs to be oriented so the shaft is concentric to the bearing hole located on the housing.

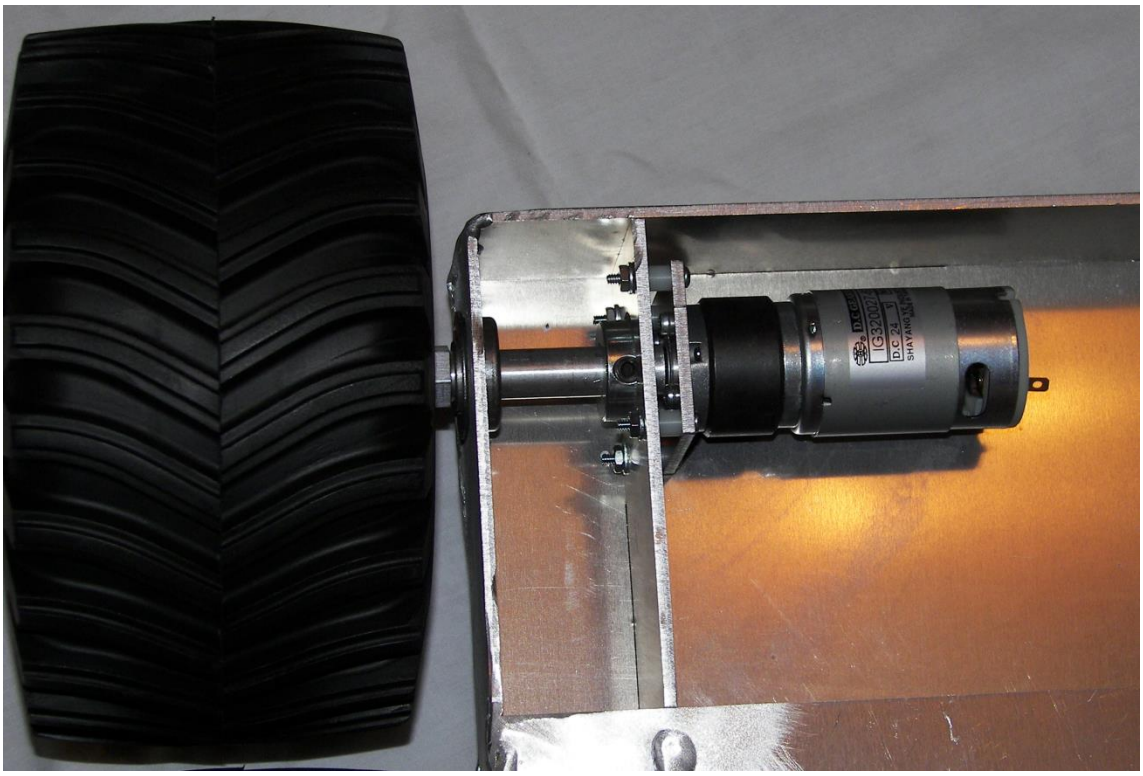


Figure 10: Motor Mounting into Housing

3. Mount the bearing in the outside face of the frame so the flange is on the outside face. They are press fits, but will go in with a little persuasion. Using a piece of wood and working the bearing edges back and forth will get the bearings to go in. Another method for pressing it in is to use two pairs of pliers or channel locks (pinch the flange to the inside face of the housing). If you only have one pair just work it back and forth until it's inserted. If the housing bearing plate is bent during this operation straighten it out before proceeding.

4. Start the shaft through the bearing hole, but do not fully insert it leaving room for the next step.

5. Put the shaft color on the end of the shaft and replace the standard set screw with the larger set screw provided. The setscrew should go through the hole on the end of the shaft.

6. Push the shaft on the rest of the way over the motor shaft. Orient then set screw so it it's over the flat of the motor shaft. (Its easiest to turn the motor shaft so its facing up so you can tighten the screw easily with an allen wrench) The shaft should go on so that it is fully seated on the motor shaft (past the flat spot) to ensure it's concentric.

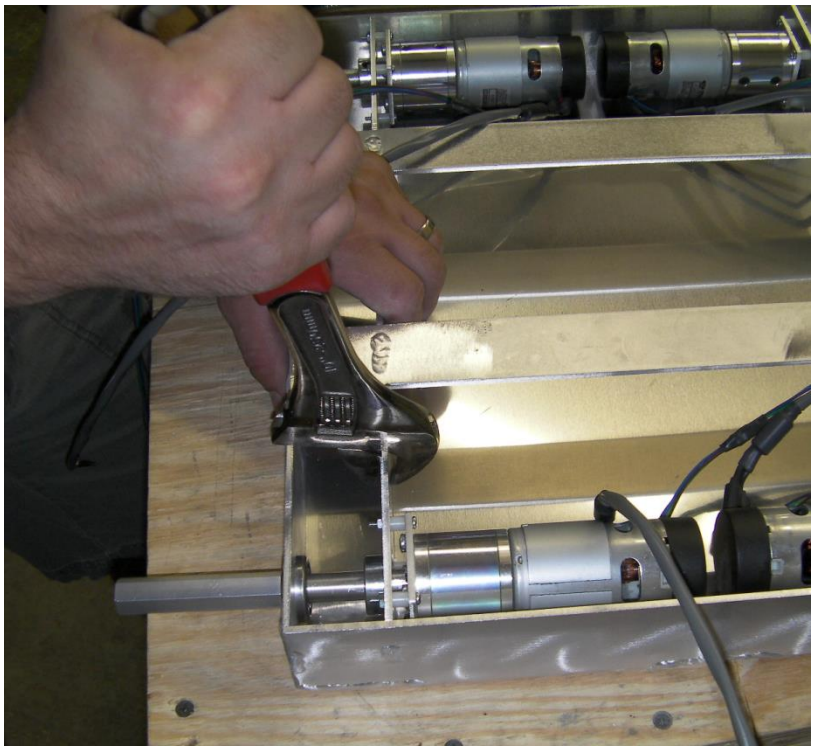
7. Slightly loosen the 4 machine screws that hold the motor base plate to the motor housing.

8. Attach the motor to a 12 or 24V DC supply/battery and let the motor spin and find its center.

9. Slowly tighten the 4 machine screws loosened in step 8 in an alternating pattern making sure the motor continues to rotate freely. Try different tightening techniques and patterns until the motor spins freely and evenly (this can be monitored by sound, the motor should not be straining unevenly during a revolution). Its ok if the screws are not tightened all the way as long as they are snug. This serves as a pseudo flexible coupling for inherent misalignments.

10. Apply thread locking compound to the threads of he bolts so they will not work free. We generally just put a drop of superglue at the end of the nut onto the threads of the machine screw.

11. If you continue to have trouble with the alignment the chassis may be slightly out of alignment. This can be fixed by bending the motor mount wall slightly as shown below. With the motor running use the crescent wrench to flex the wall of chassis until its running smooth.



7 SuperDroid Motor Mounting to Custom Length and single motor housings.

This section applies to the assembling gear motors to our new style motor mounts. These mounts are will not fit our ATR kits, they are intended as motor mounts for your own custom robot.

Tips:

- Go step by step and make sure all hardware is secure.
- Use a tread locking compound on the hardware to ensure it does not vibrate loose during use.
- Only the single motor mount is discussed. The custom length motor mount is the exact same mounting, just two motors and shafts.

1. Mount the motor to the motor base plate using the supplied metric screws. (washers are not necessary as show). Use a thread locking compound on these screws because they are difficult to access and tighten later on. Refer to Figure 6 for details.

Figure 11: Motor Mounting Plate Assembly

2. Mount the motor and motor mounting plate into the housing as show in Figure 7. Use the supplied #4 machine screws. Secure the screws with #4 nuts.

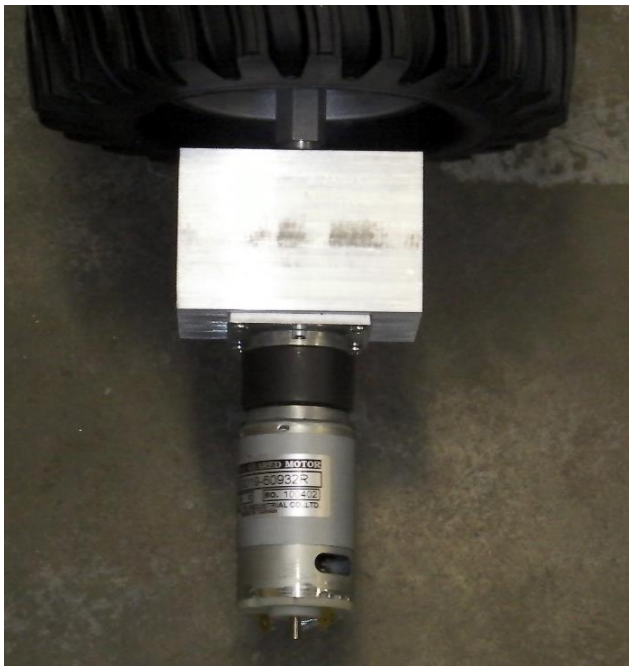


Figure 12: Motor Mounting into Housing

3. Slide a bearing onto the shaft so the flange of the bearing is facing towards the wheel. Optionally you can insert the bearing into the housing first.

4. Put the shaft color on the end of the shaft and replace the standard set screw with the larger set screw provided. The setscrew should go through the hole on the end of the shaft.

5. Install the shaft and the bearing into the motor housing and onto the motor shaft as shown in Figure 8. The bearing needs to be pressed into the hole, two pairs of pliers or channel locks work best for this (pinch the flange to the inside face of the housing). If you only have one pair just work it back and forth until it's inserted. If the housing bearing plate is bent during this operation straighten it out before proceeding.

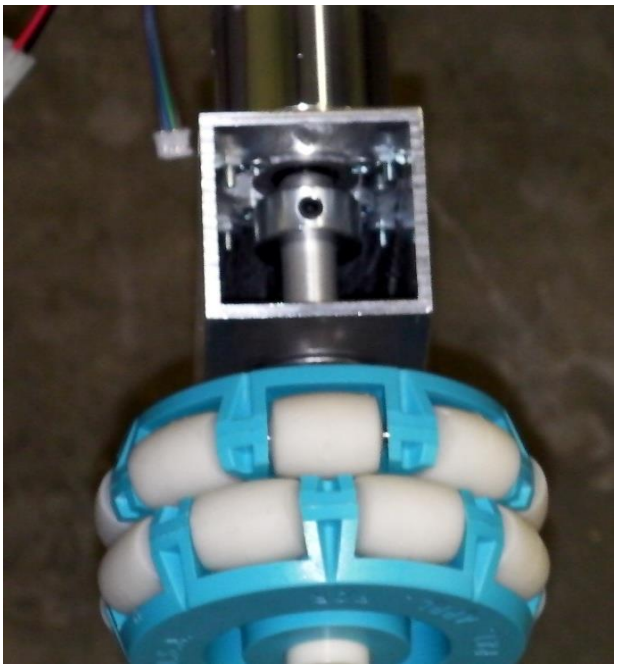


Figure 13: Motor Shaft Insertion

6. Slightly loosen the 4 bolts that hold the motor base plate to the motor housing.

7. Attach the motor to a 12 or 24V DC supply/battery and let the motor spin and find its center.

8. Slowly tighten the 4 bolts loosened in step 8 in an alternating pattern making sure the motor continues to rotate freely. Try different tightening techniques and patterns until the motor spins freely and evenly (this can be monitored by sound, the motor should not be straining unevenly during a revolution). Its ok if the screws are not tightened all the way as long as they are snug. This serves as a pseudo flexible coupling for inherent misalignments.

9. Apply thread locking compound to the threads of he bolts so they will not work free. We generally just put a drop of superglue at the end of the nut onto the threads of the machine screw.

8 Mounting a Motor Housing onto the Base Plate

This section applies to the assembling the motor housings onto the base plates.

1. All the base plates SuperDroid Robots sells are predrilled to accept all the motor housings. The rectangular plates have holes both straight out the side and at a 45 degree angle.

2. To insert an omni wheel refer to Figure 14. Fasten the motor housing on with washers and #4 nuts.

3. To attach a ATR wheel refer to Figure 15. Fasten the motor housing on with washers and #4 nuts.

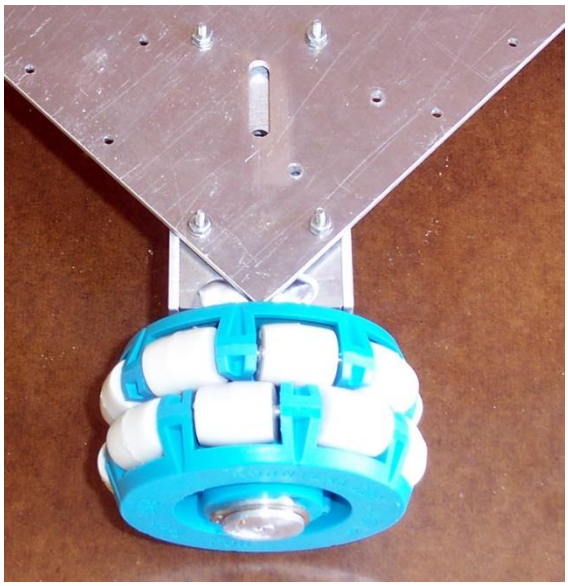


Figure 14: Omni-Wheel and Motor Attachment

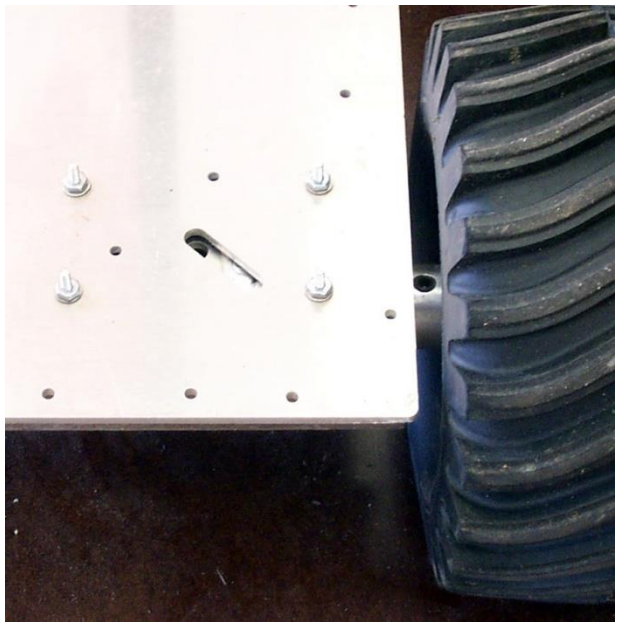


Figure 15: ATR Motor and Wheel Attachment

9 ATR Foam Filled Tire Options

This section applies to filling the ATR tires with foam. The foam will make the air filled tires harder so they will not deflect as much under heavier loads. The foam will result in the tires being hard, which will also make them so they do not absorb as much impact or conform to the terrain as much.

Tips:

- The expanding urethane foam is a mess to work with. Regardless of how manly you think your hands are, if this stuff gets on it, it comes off once your skin dies. Finger nail polish remover works if its not fully cured (real finger nail polish, not the water based unscented junk).
- Follow all the precautions on the can of foam.

1. Drill 3 or 4 holes as shown in Figure 16. The holes should be about ½" so the urethane foam can dry properly.

Figure 16: Drilled Holes in ATR Wheel for Foam Filling

2. Tape the air breather holes inside the wheel hubs as shown in Figure 16

3. Tape the exposed surfaces of the tire. If the foam gets on the tire, it will not come off. See Figure 17

4. We use a jig to hold the tire to shape, wire strapping, etc can also be used. This prevents excess foam from deforming the wheels.

Figure 17: Taping of ATR Wheels for Foam Filling

5. We used Great Stuff Big Gap Filler. There are other brands. A can costs about $6 at any building supply store.

6. Put the wand on the can and stick it all the way in each hole and work the foam around so it is evenly sprayed all the around the tire. Do not fill the tire more than half way. It will not take much.

7. Squish the tire around working the foam around. Do this step immediately after filling the tires. Afterwards, do not touch the tires again until it cures. With the great stuff atomizing some water into the holes after a bit helps it cure faster.

8. Some Foam may ooze up the holes, don't worry if it does or does not, just let it dry. It will take several days to fully cure, especially if the holes were plugged with the foam. You can break off the tits of foam after about 1-2 hours. It is important not to deform the tires until the foam is hard inside (could be a couple days). If you collapse it when its drying, its done for and you will have a void.

9. After all is done, if there are still some soft spots or voids, just open up the hole with a old screwdriver and spay more foam in and let it dry.

10. All told, it will likely take a couple applications of foam and some patience. When its cure the tires will be very hard.

10 Mini ATR assembly

Tips:

- You should pre-wire the motors to make assembly a little easier.

1. Insert the 4 motors into their spots and secure them with 4 machine screws each. Refer to Figure 18 for details.

2. Slide the wheel shaft over the motor shaft (one side of the hex coupling is drilled to 6mm – the side with the set screw).

3. Tighten the set screw onto the flat of the shaft.

4. Mount the tires on to the hex shafts and secure with the provided 1/4-20 machine screw. If you use thread locking compound here, be careful. **Be careful that the thread locking compound is compatible with plastic, otherwise your wheel hub will dissolve.**

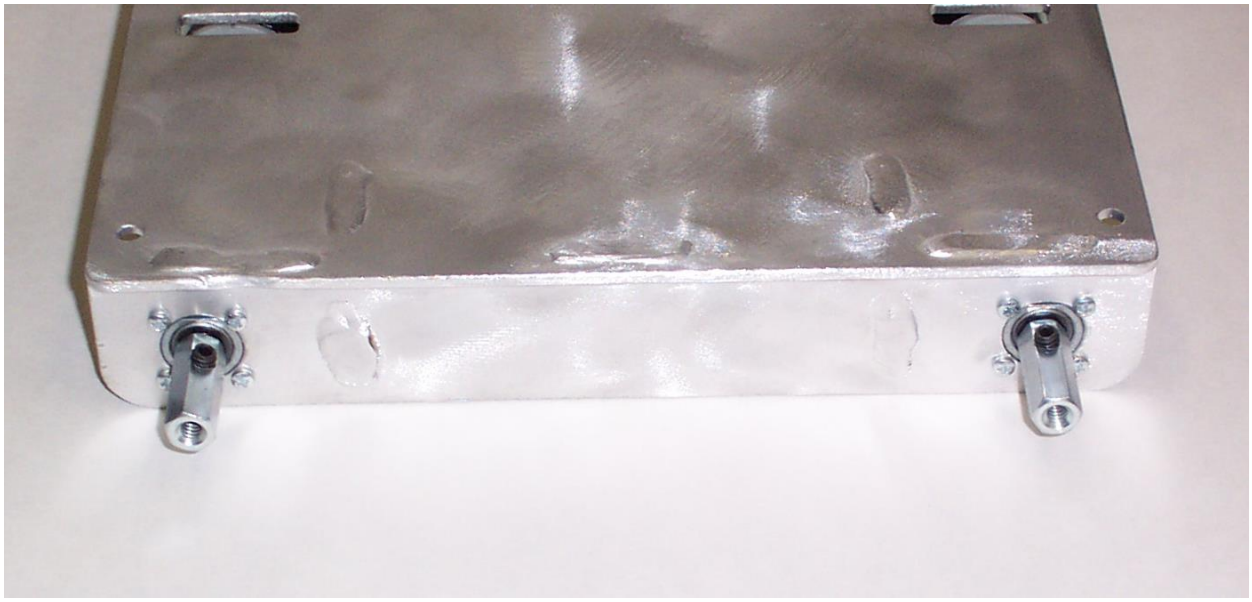


Figure 18: Mini ATR Motor and Shaft Mounting

5. If you purchased the acrylic base, it can be attached as shown in Figure 19 using the hex bolts and nuts as shown.

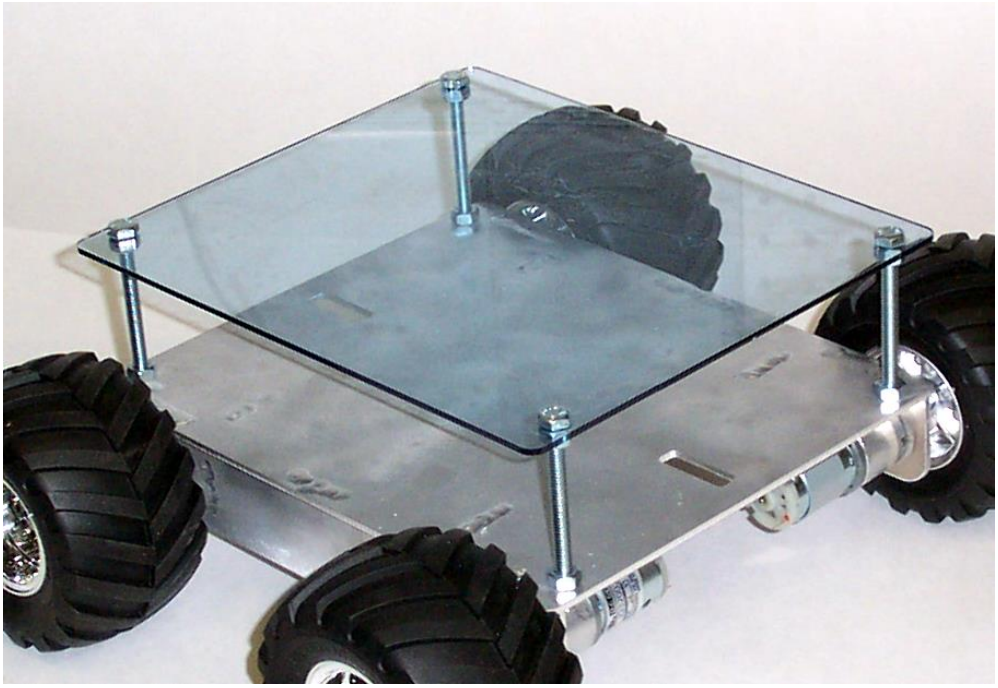
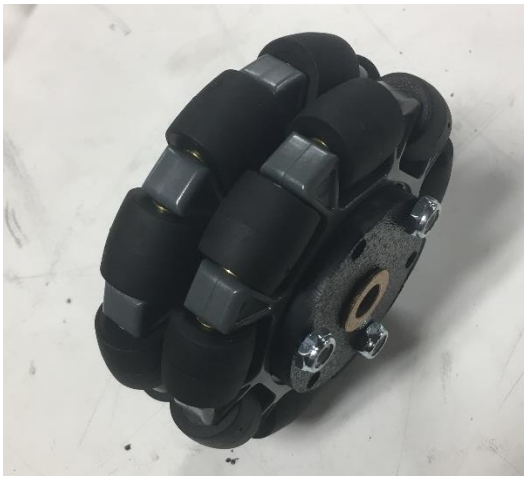


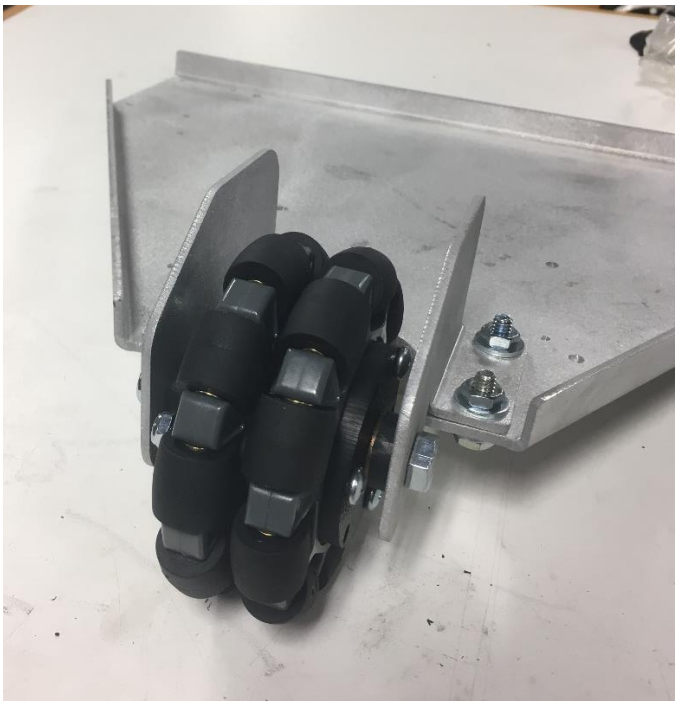
Figure 19: Mini ATR Top Cover Assembly

11 IG32-SB2, 2WD Tube Mount Robot Mechanical Assembly

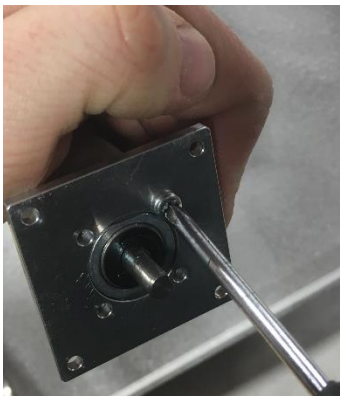
1. Assemble omni wheel caster using the three #10-32 x 2" screws and ¼" ABS bearing plates. Insert bronze bearings into plates.



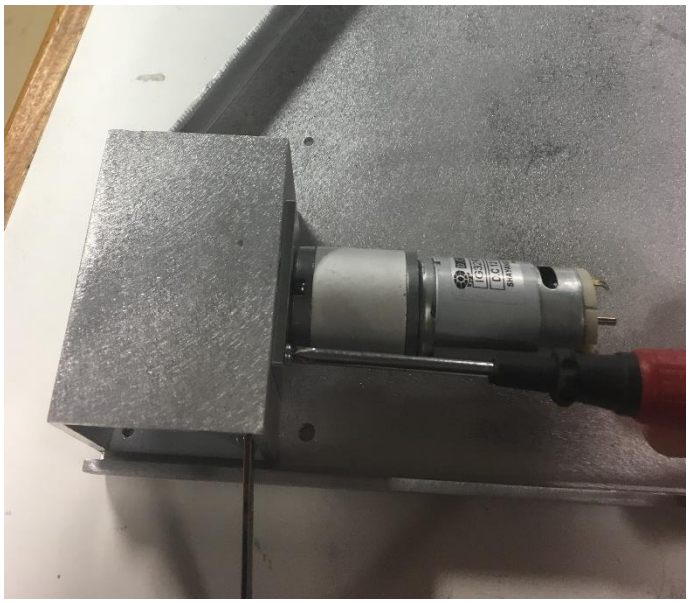
2. Mount caster brackets using the ¼"-20 hardware provided. Mount the omni wheel on the 3/8" bolt and using the ¼" ABS spacers as shown.



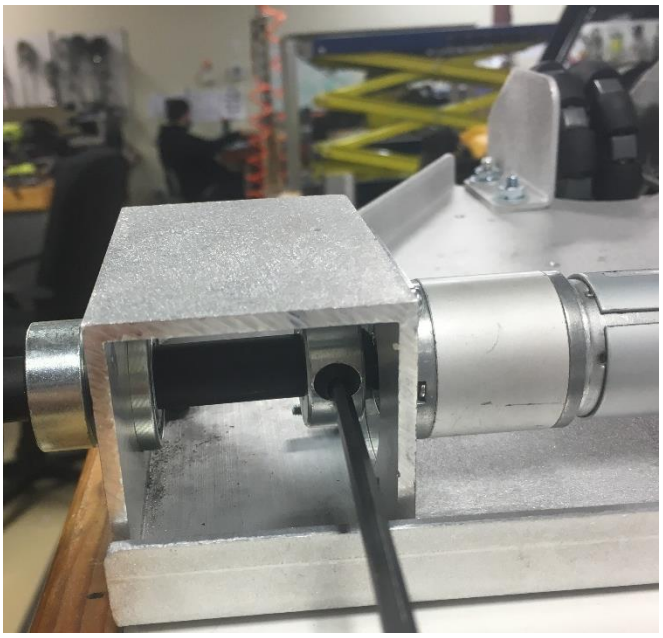
3. Mount motors to motor plates. Then mount the motor plate to the motor mount tube.



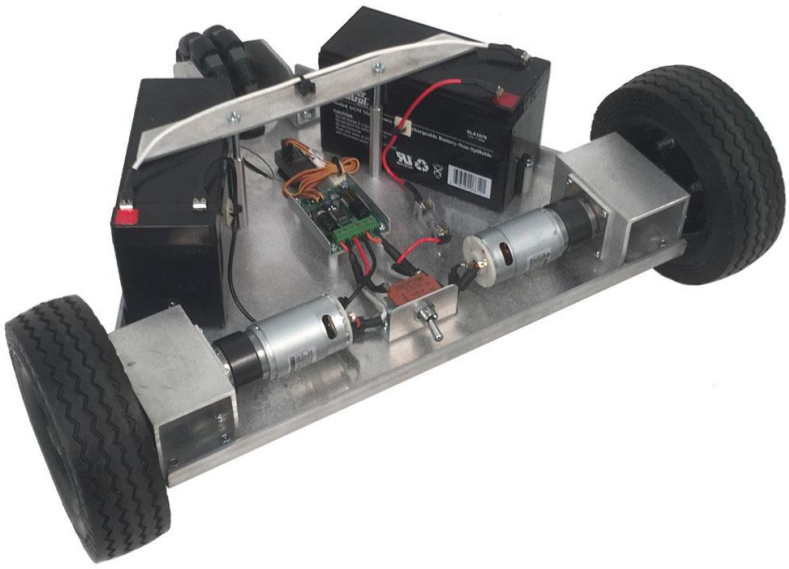
4. Mount the motor assembly to the chassis as shown with the provided #4-40 hardware.



5. Using the provided 6mm hardware, mount the tire wheel assembly to the drive axle. Slide the ½" ball bearing into the motor mount tube, then slide the drive axle through a lock collar, then the bearing, then another lock collar (with long set screw), and then over the motor shaft. Fix the drive axle to the motor output shaft by tightening the set screw against the flat spot on the motor.



6. If you ordered lead acid batteries and a battery bracket, mount using #10-32 hardware and aluminum standoffs. Mount motor controller using the hardware provided in the ATR and Vectoring robot hardware kit.



12 Enclosed and Standard Heavy Duty ATR motor mounting

This section applies mounting the motors in Standard Heavy Duty and Enclosed ATRs. The motors are not direct coupled with wheel shafts so the procedure is very different than the aforementioned ATR/VR motor mounting.

Most of the images show the old style Enclosed ATR (formally called the Deluxe ATR), the new style is a sloped front and large flat top. The old style is a sloped front and back and a flat top in the middle.

Tips:

- Use the proper size screwdriver on the screws.
- Wire the motor before installing it as described above

1. The motors need a motor spacer plate between them and the slots cut out in the ATR. Refer to Figure 20.

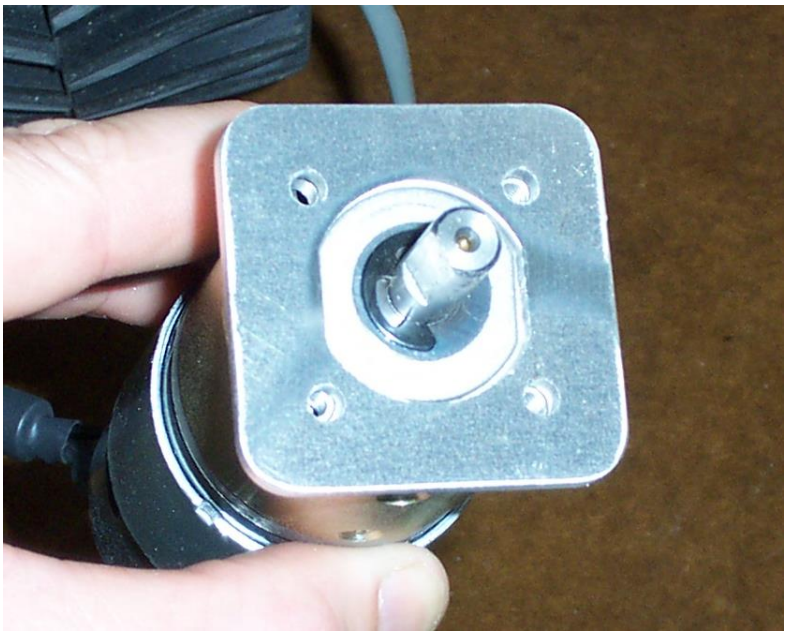


Figure 20: Motor Spacer Plate

2. Using the metric machine screws and washers mount the motors shown in Figure 21 and Figure 22. The images show timing belts, we now use only chain drive, but still shows how to mount the motors accurately. You do not need to fully tighten until you have installed the belts, etc. For the Heavy Duty ATR, follow the same procedure, only there is not a access panel, just access slots for the motors.

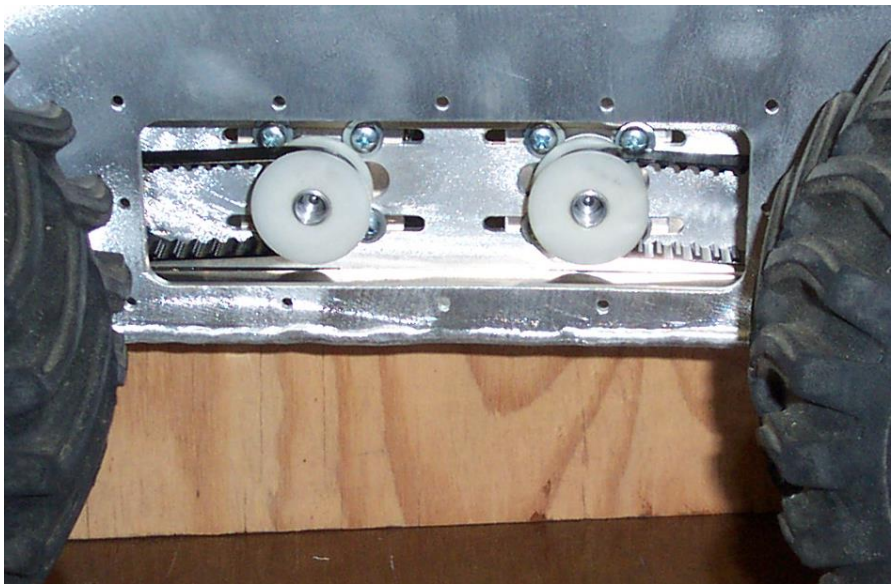


Figure 21: Deluxe ATR motor mounting

Figure 22: Enclosed ATR motor mounting

3. Mount the bent metal EMF shield over the motors. Cut outs will be need for the holes to the mount the top plates. Wires cutouts will also be needed on what ever side you plan on putting the motor controller(s). Refer to Figure 23

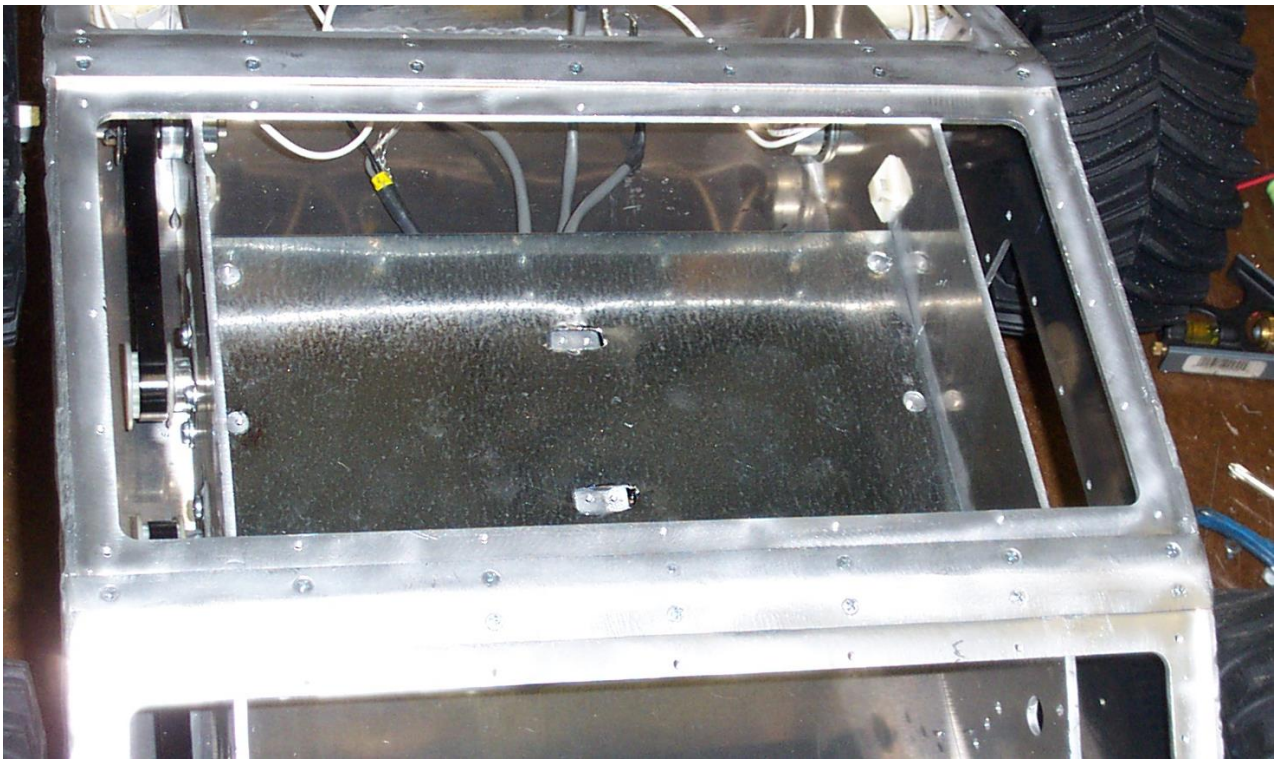


Figure 23: Enclosed ATR motor EMF shield

13 Mounting the Lights in the Enclosed Heavy Duty ATR

This section applies mounting the lights in the Enclosed Heavy dury ATRs. .

Tips:

- You will want to do this step before mounting the shafts and wheels to make life easier on yourself..

1. The glass is high temperature glass that is resistant to thermal shock. The problem with the glass is it is fragile. Both sides of the glass should be coated with a 100% pure silicone as shown in Figure 24. Let the bead of silicone to dry

2. The glass on the light will also bread if its brought in hard contact with metal. The backing plate shown in Figure 24 should also be coated with silicone and then the light can be set into it. Don't push the light too hard or you will squish all the silicone out. Let it dry

3. Place 4 flat head #4 screws in the light opening holes on the ATR.

4. Insert the glass lens

5. Insert the light followed by the backing plate that is siliconed to the light.

6. Place #4 washers and nuts on the snug up the backing plate compressing slightly the silicone beads. Don't over tighten or the light or glass lens will crack.

7. Solder wire on the terminals of the lights. The light terminal must be allowed to get real hot during the soldering to allow the solder to flow and adhere to the terminal. After the solder cools you should not be able to move or twist the wire on the terminal, if you can repeat allowing the terminal to get hotter.

8. We usually put a little bit of expanding insulation over the back of the light so the heat won't reflect back into the robot.

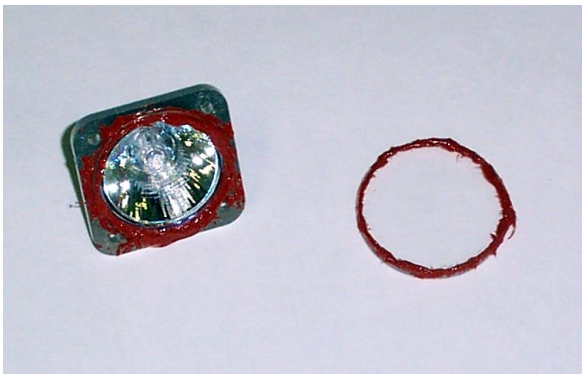


Figure 24: ATR Light Gasket

14 Mounting the Shafts for the Heavy Duty and Enclosed ATR

This section applies mounting the bearings and wheel shafts in Heavy Duty and Enclosed ATRs. The motors are not direct coupled with wheel shafts so the procedure is very different than the aforementioned ATR/VR motor mounting.

Tips:

- Don't mount the wheels until later.
- Make sure the shafts fit well with their respective pulley. You may need to open the pulley up some by running a half inch drill back and forth through it (do NOT hold the pulley in you hand when doing this) or maybe debur the shaft.

1. The first thing you need to do is press all the bearings in. They are press fits, but will go in with a little persuasion. Using a piece of wood and working the bearing edges back and forth will get the bearings to go in. The flange of the bearings should be on the outside surfaces pointing towards the pulley. The hex step of the shaft will keep the outside bearing in, the lock collar on the inside bearing will keep it in. Refer to Figure 25 and Figure 26.

Figure 25: Deluxe ATR bearing mounting

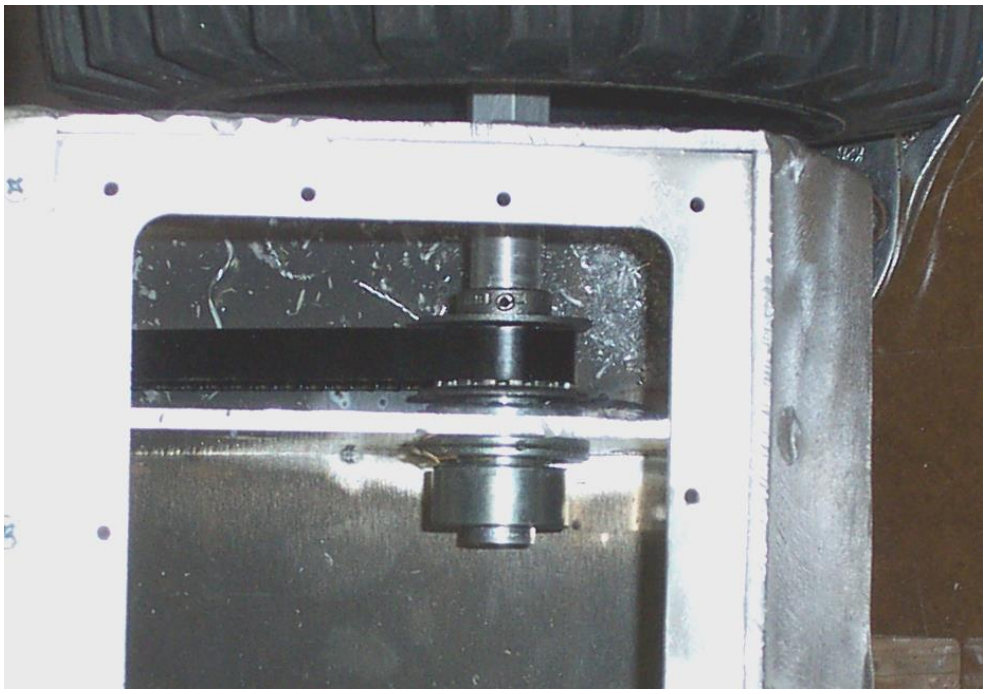


Figure 26: Deluxe ATR bearing mounting

2. Slide the wheel shaft in through the outer bearing, then insert the pulley , the timing belt, then through the inside bearing, then place the lock collar on and pull everything together and tighten the lock collar.. Refer to Figure 26

3. Repeat for all four shafts. For the HD ATR, there are two sizes of belts make sure you use the short ones for the shafts closest to the motors.

15 Mounting Pulleys and Belts for the Heavy Duty and Deluxe ATR

This section applies mounting the timing belts and pulleys in Heavy Duty and Deluxe ATRs. The motors are not direct coupled with wheel shafts so the procedure is very different from the aforementioned ATR/VR motor mounting.

1. Mount the plastic pulleys on the motors. They should be pushed all the way against the inside plate with just a very small clearance for rotation.

2. Drill a hole trough the pulley and trough the motor shaft using the provided drill bit. You want to make sure you drill into the flat of the motor shaft and do not work the drill back and forth too much because the hole will wallow out too much. Refer to Figure 27.

Figure 27: Deluxe ATR pulley mounting

3. Push the roll pin through the hole so it's just below the surface of the pulley.

4. Put the belt on both pulleys and tighten the belt. The belt should only deflect about ¼" when firmly pushed with your thumb.

5. Make sure the set screws on the wheel shaft pulley are loose or not installed.

6. Run the motor and let the pulley find its sweat spot. You want to favor the pulley so it rides as close to the motor as possible so the load form the belt is not too far cantilevered out on the motor shaft.

7. Using the same drill bit as for the motor pulley drill through one of the set screw holes through the wheel shaft and then through the other side of the pulley. Refer back up to Figure 26.

8. Insert the roll pin for the wheel shaft.

9. Repeat for all 4 wheels

16 Mounting Sprockets and Chains for the Heavy Duty and Enclosed ATR

This section applies mounting sprockets and chains in Heavy Duty and Enclosed ATRs. The motors are not direct coupled with wheel shafts so the procedure is very different from the aforementioned ATR/VR motor mounting, but is somewhat similar to the pulley and belt mounting. Chains will be much stronger and less prone to slipping than the belts, but will require periodic lubrication and all will make more noise.

1. Mount the small sprockets on the motors. The hub should face the motor. They should be pushed all the way against the inside plate with just a very small clearance for rotation.

2. Remove the set screw and drill a 1/8" hole through the motor shaft and the opposite side of the sprocket. Then drift a roll pin through it. This step is very similar to Section 15 - Mounting Pulleys and Belts for the Heavy Duty and Deluxe ATR.

3. Mount the larger sprocket on the wheel shaft. Remove the set screws, don't drill it yet. You will want to run the motor and let the sprocket find its best spot. Again, these steps are very similar to Section 15 - Mounting Pulleys and Belts for the Heavy Duty and Deluxe ATR.

4. With the motor in its approximate middle position, measure out the required length of chain. Refer to Figure 28. You will want full links as shown in the figure to insert he master link trough. You will be removing the outer cross-links.

5. To cut the Chain, put it in a vise and grind/file the ends of the pins down. Then drive the pin through the chain. Refer to Figure 29, Figure 30, and Figure 31.

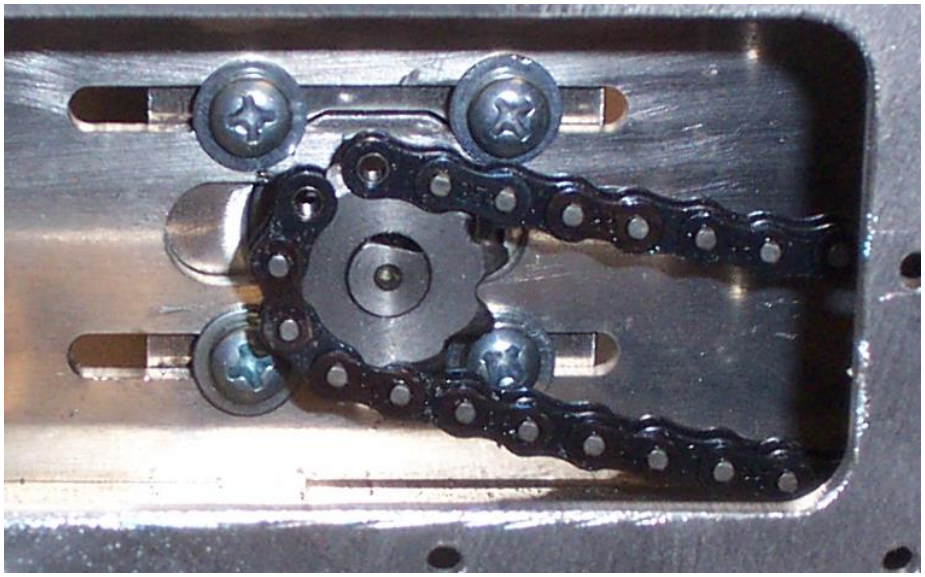


Figure 28: Chain Layout

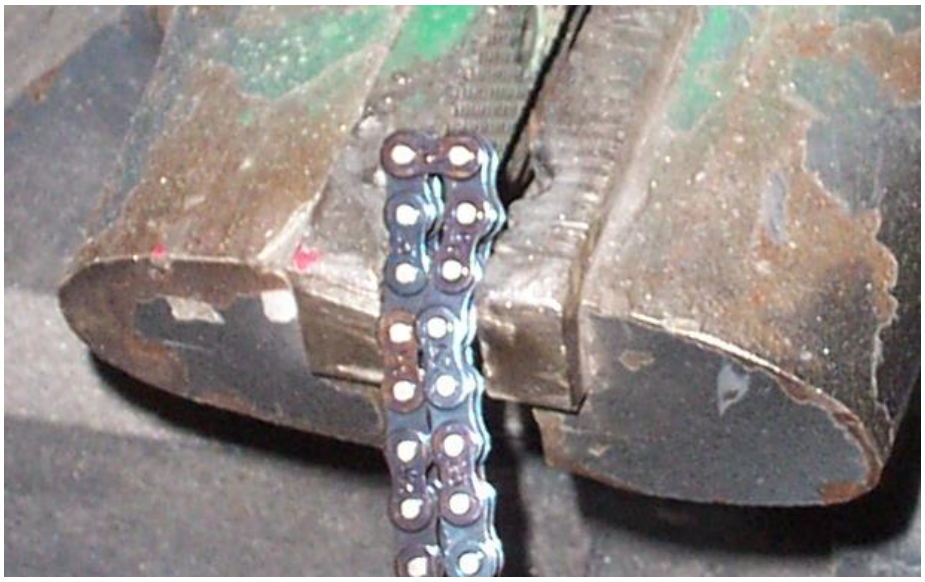


Figure 29: Chain Cutting Setup

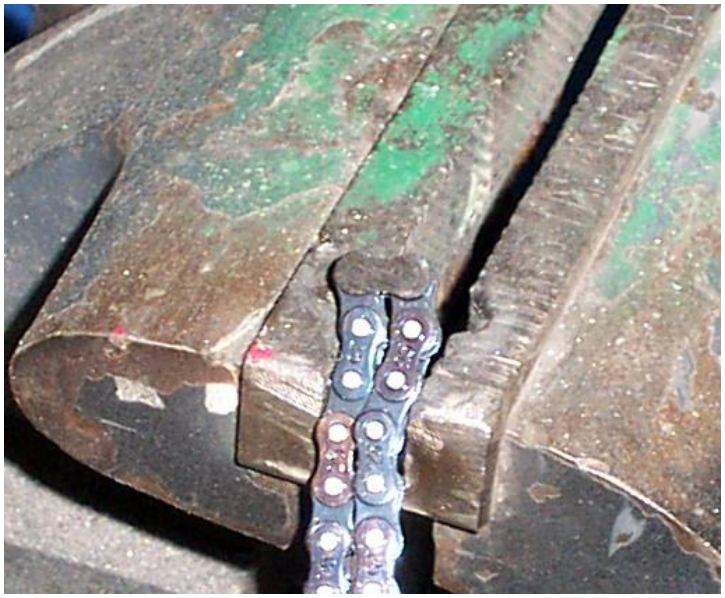


Figure 30: Chain grinding/breaking

Figure 31: Chain Link removal

6. Install the master link as shown in Figure 32.

7. Repeat for the other four wheels.

8. Run the motors and let the wheel shaft sprocket find its sweat spot and then install the roll pin in the same manner as in Section 15 - Mounting Pulleys and Belts for the Heavy Duty and Deluxe ATR.

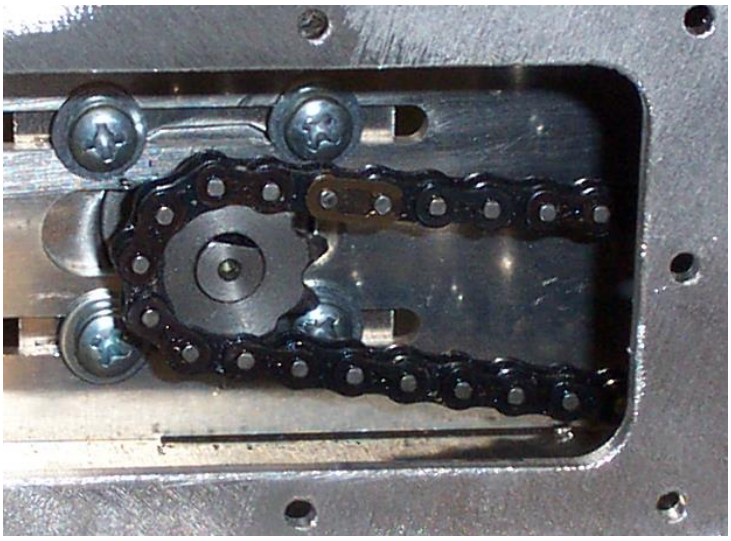


Figure 32: Master Link Installation

17 Mounting the Roll bar on the Enclosed ATR

This section applies mounting the roll bar on the Deluxe ATRs. .

Tips:

- This should be done about after the wiring and other assembly of the robot, just prior to placing on the covers.

1. Center the roll bar over the ATR so the holes are about ¾" below the top of the robot. Make sure its square and even on both sides. Refer to Figure 33.
2. Mark the hole locations
3. Drill 1/8" holes. Make sure to clean all metal out of the robot.
4. Mount the roll bar using #4 machine screws and nuts. We place a nut between the roll bar and the robot frame too to stand the roll bar off the welds.

Figure 33: Deluxe ATR Roll Bar Assembly

18 Mounting Covers, Fans and RC Antenna on the Deluxe ATR

This section applies mounting the roll bar on the Enclosed ATRs. .

Tips:

- This should be done about after the wiring and other assembly of the robot, just prior to placing on the covers.

1. The fan housings require some customization. We have included pictures below of how we mounted the front and back fans. There are flow arrows on the fans. The front to fans should blow in, and the back fans should exhaust.

2. Cut a top panel to the desired size using a fine tooted saw. Cut UHMW strips to make the shroud. Drill countersink small holes in the plastic and the UHMW. Screw everything together. We use silicone caulk on the UHMW to ensure water does not leak trough.

3. For the front cover we install a course dust filter that can be cut to size. And use UHMW strips to hold it down against the fan.

4. For the RC, the receiver is mounted so the antenna is far from any metal. The antenna kit can be used to hold the antenna. The outer antenna tube can extend trough the fan shroud for extra support.

5. Refer to Figure 34 and Figure 35 and back up to Figure 33 for details.

6. It is recommended to wire the motors with a disconnect so you can remove the lid and unplug the fans. See Figure 36.

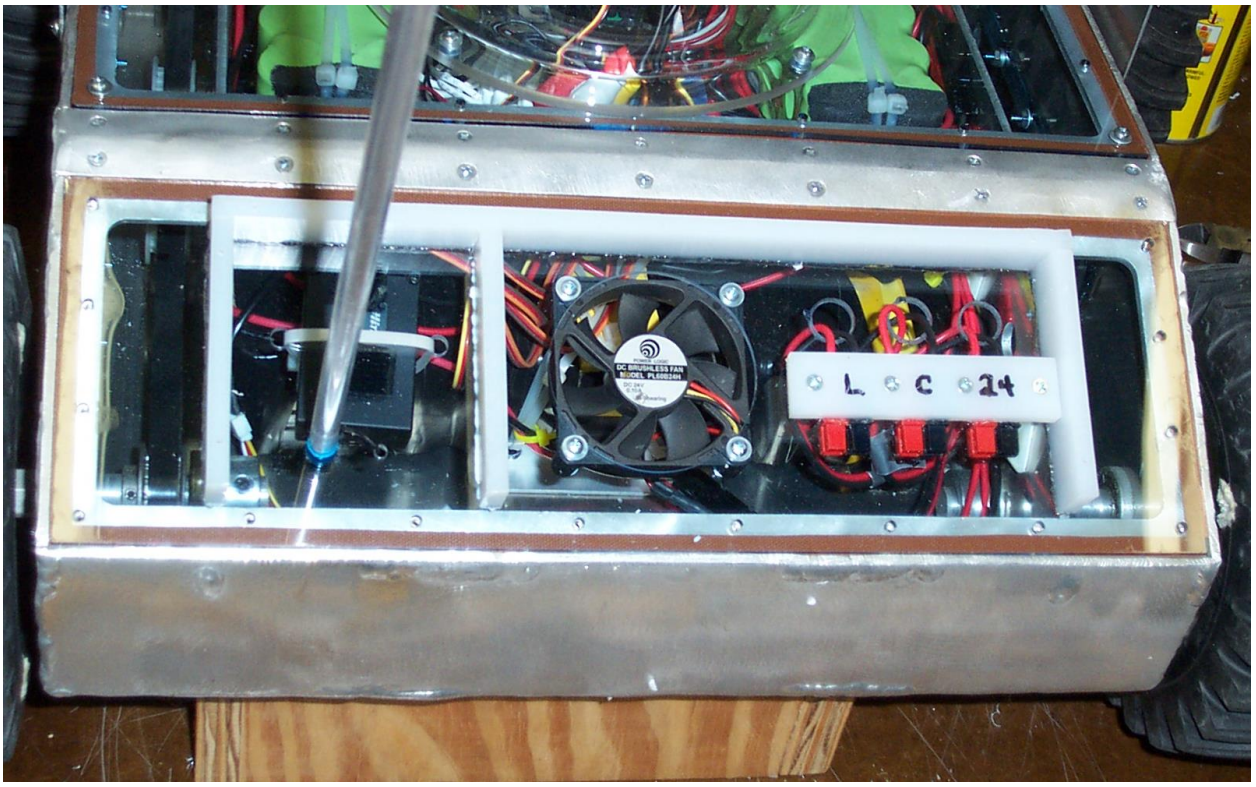


Figure 34: Deluxe ATR Rear Fan, Panel, and Antenna Mounting

Figure 35: Deluxe ATR Front Fan and Panel Mounting

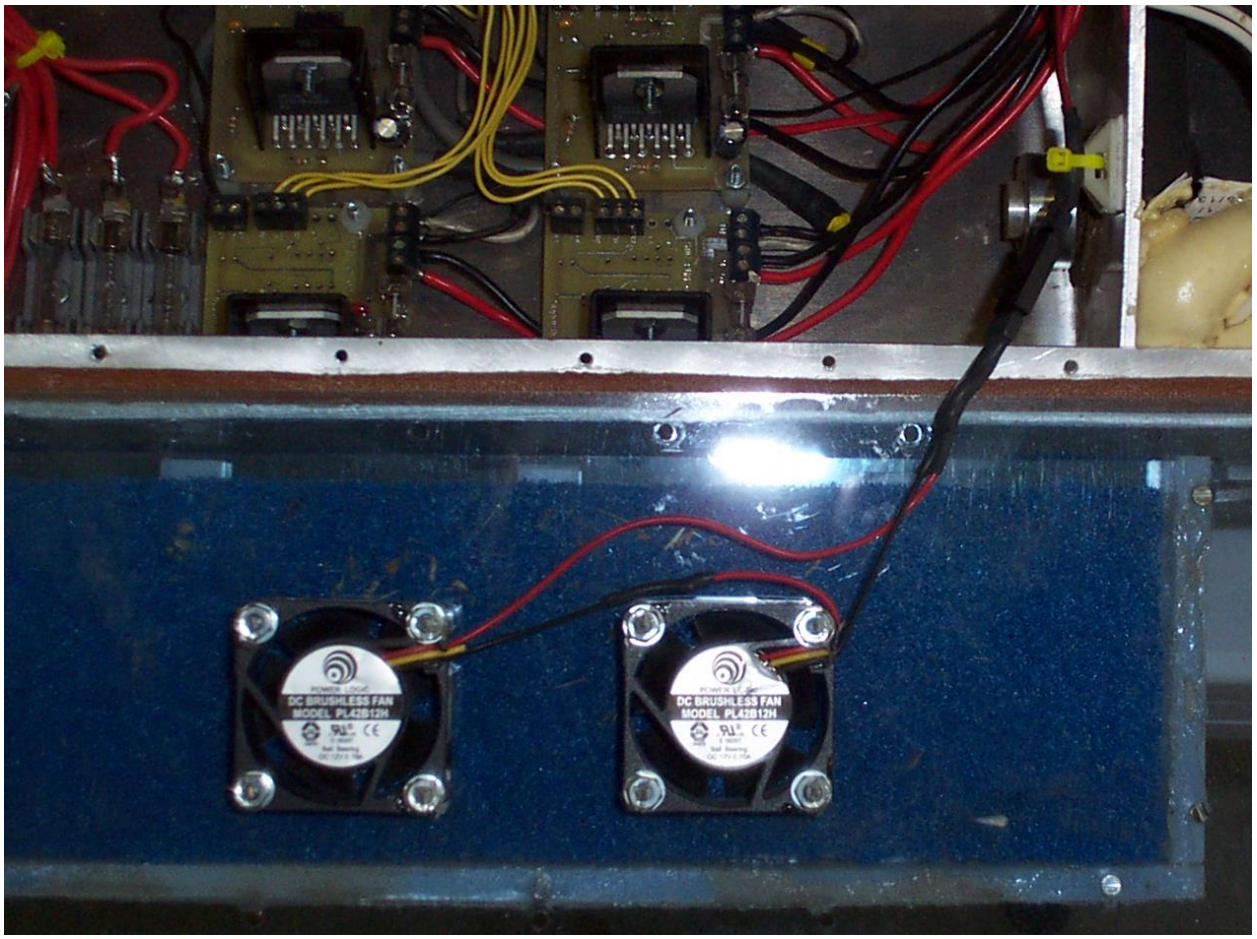


Figure 36: Fan wiring with disconnect

19 Crimping wires

For many parts of the assembly of the ATRs and VRs need to have wires crimped. This Section details how to crimp wires.

1. Strip back about 1/4" of insulation and crimp on the ends per Figure 37 using a crimping tool. Needle nose pliers can be used too by bending the folds down on the wire as shown in Figure 38.

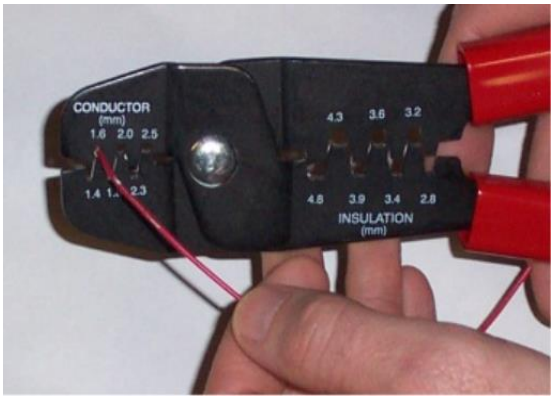


Figure 37: Crimping Tool

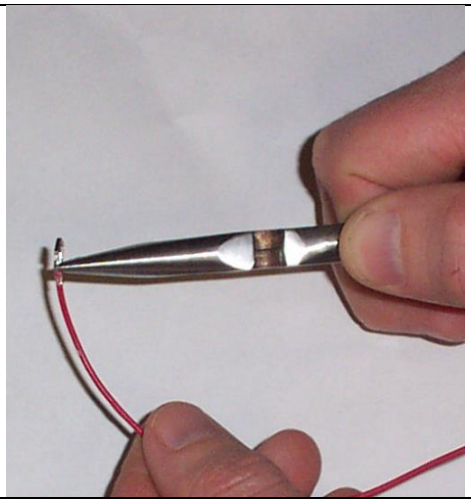


Figure 38: Crimping with Needle Nose Pliers

1. After the black and red wires have been crimped, it is a good idea to solder the crimp too, especially if you crimped it with needle nose pliers.

2. The crimps then get placed into the end of the terminal connectors. (In many cases the polarity of the wires is very important.) The terminals get placed in as show in

   Figure 39.

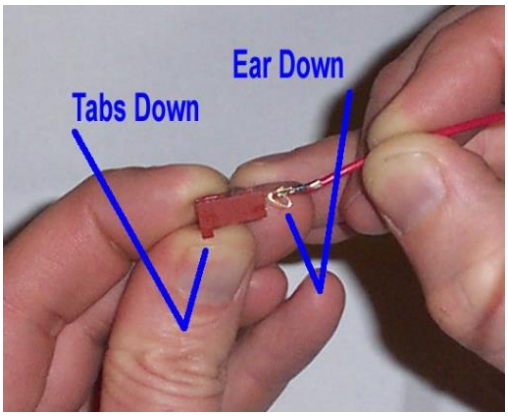


Figure 39: Insertion of Crimps into Connectors

20 Wiring the Power to ATRs and VRs

This section applies to wiring the power to the ATRs and VRs. The ATRs and VRs can be wired up many ways. We show some possibilities below

Tips:

- Keep all electrical leads as short as possible to minimize them acting like antenna and receiving or transmitting electrical noise.
- The controller battery and the battery for the motor should always be different sources to minimize noise, etc.

Caution:

- Be careful of polarities to ensure you do not damage any of the components. Double-check all your work before powering up.
- Check power without electronics attached at first and slowly add components to ensure nothing gets damaged. A simple mistake with the power can cost hundreds of dollars of damage.

1. Refer to Figure 40 below for details of how to wire the power for your robot.

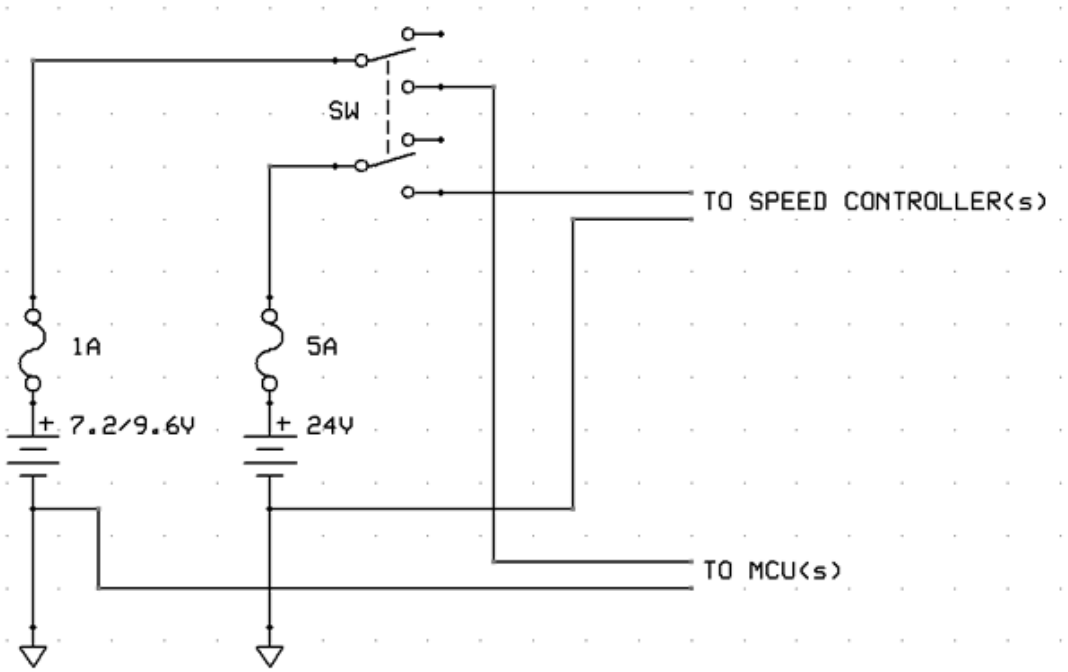


Figure 40: Power Schematic

1. Mount the power switch. The power Switch can be put in the deck as shown in **Error! Reference source not found.** and Figure 41 or in the electrical housing as shown in Figure 42 Figure 43.

2. Use the crimp terminals to mount the wires to the switch as shown in Figure 41.

3. Wire the fuses in as shown in the schematic in Figure 40

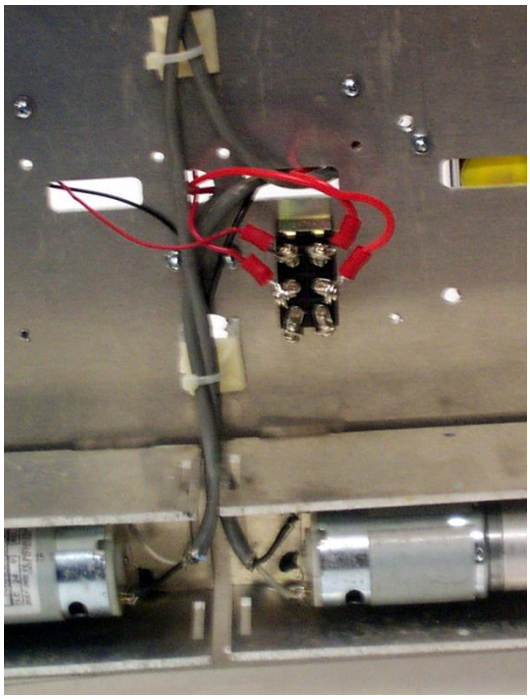


Figure 41: Power Switch and Motor Wire Routing

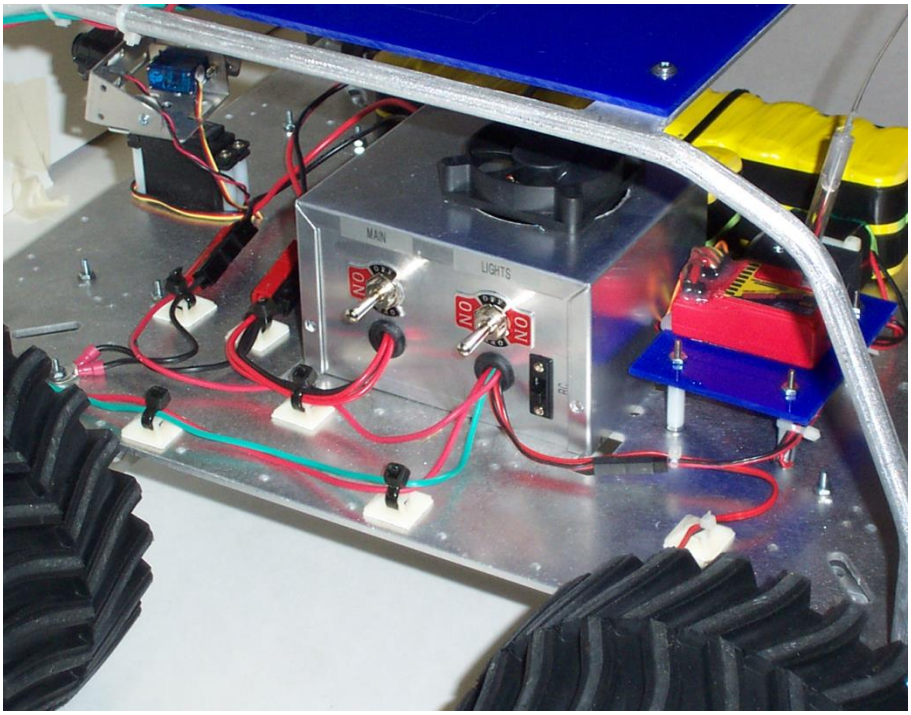


Figure 42: Electrical Power Hookup

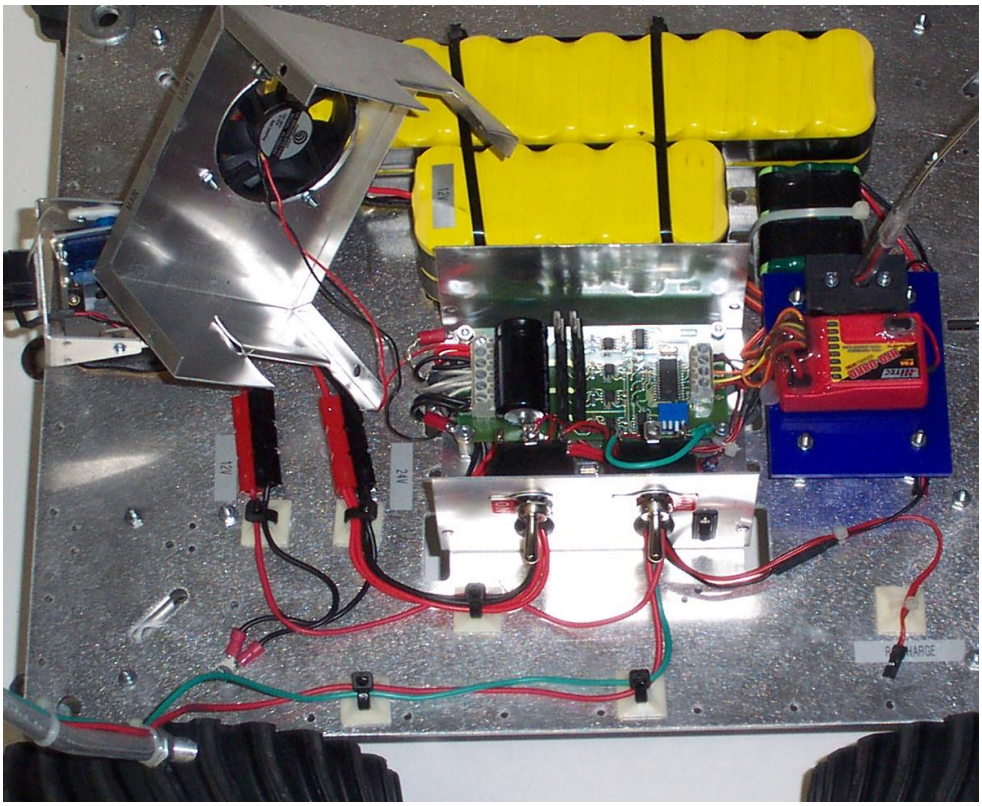


Figure 43: Electrical Power Hookup

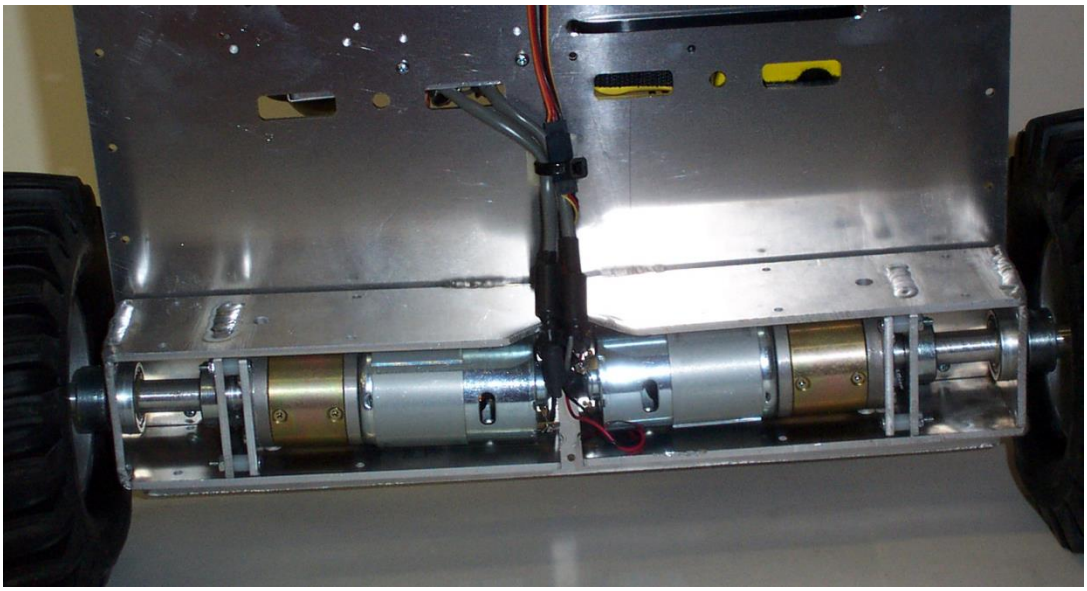


Figure 44: Motor Wire Routing

21 Enclosed ATR Power Switch

This section applies the deluxe ATR for one possible method of mounting the power switch. The Deluxe ATR is supplied with a heavy duty 4PDT switch. It is recommended each system gets its own pole to isolate the power. Control should be one pole, Drive motors, and lights on the next two poles, and the 4th pole is a spare for whatever you may fancy.

1. Drill a hole in the inside gusset and mount the switch as shown in Figure .

2. Cut a slot on the top cover to access the switch using a tool. A suggested tool design is shown in Figure 45 and Figure 46. The tool needs to be able to push and pull on the switch up and down. Suggest push down is off (so a simple screwdriver can turn it if on an emergency). We then put a flap of rubber on the top cover and cut a real small slot for the too.

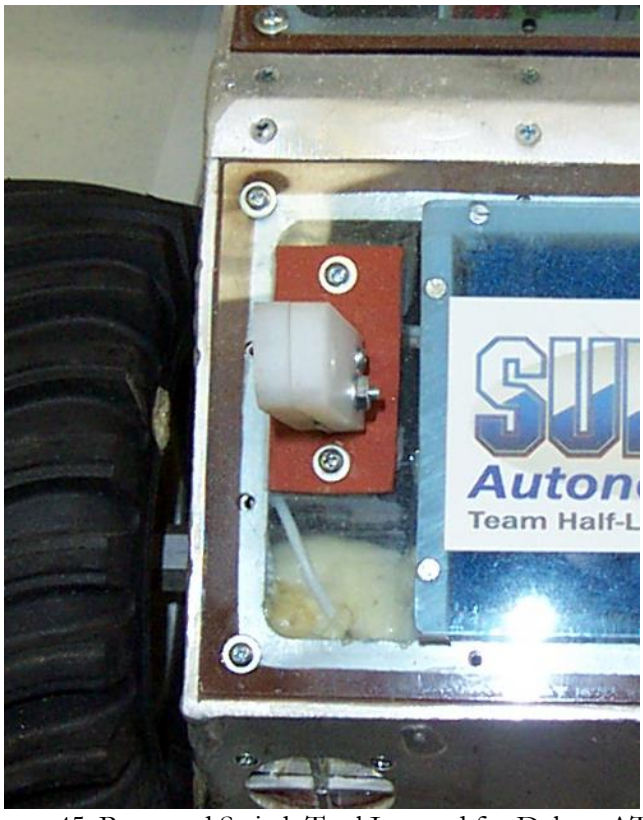


Figure 45: Proposed Switch Tool Inserted for Deluxe ATR

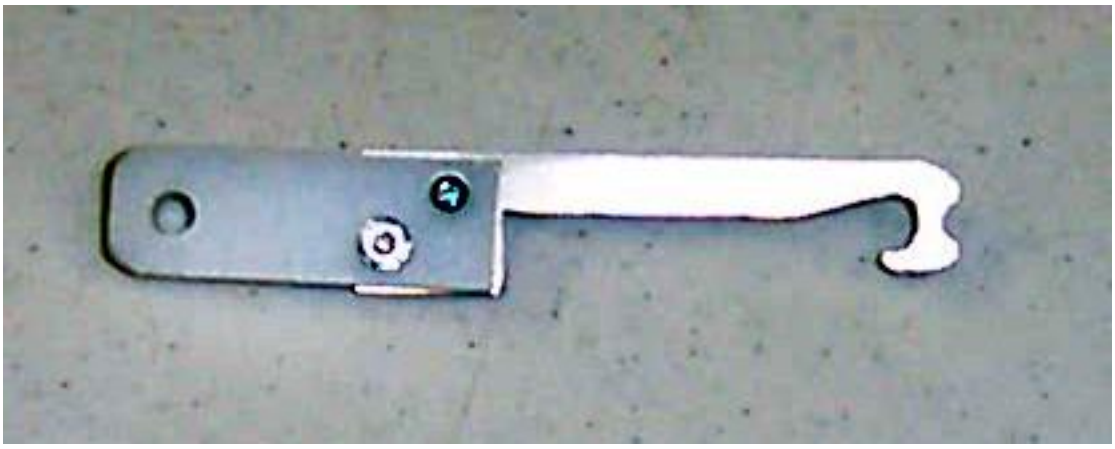


Figure 46: Proposed Switch Tool for Deluxe ATR

22 Wiring a big electric motor using a solenoid (4WD and 6WD Wheelchair ATRs and Snowplows)

To power an electric motor, determine the power consumption at maximum rate Then you can choose the correct wiring size. You can choose a wire size from the chart at the bottom of this section (Figure 48: Wire Guage Table).

Then you have to choose overcurrent protection. An auto reset circuit breaker (perfect for our sealed lead acid battery (SLA) based robot platforms) removes the need for disposable barrel fuses, and also serves as a convenient mounting point for 24V or 12V systems.
You will need a solenoid switch that holds the same amps or higher. Solenoids are a current-carrying coil of wire wrapped around an iron core. When energized, they create a magnetic field which produces high current and force. This makes solenoids very advantageous, because it allows for a low input while generating a larger output as in the case of a starter solenoid. This solenoid switch needs to be powered by a toggle switch. The toggle switch is the one in charge to turn on the solenoid switch.
The other thing you will need is a motor driver. A motor driver is a little current amplifier; the function of motor drivers is to take a low-current control signal and then turn it into a higher-current signal that can drive a motor.

Example: Powering a big electric motor
Suppose that the motors are going to be 24V-70A. We start by choosing the cable. We know the 12 AWG only holds 41A – but, instead of one, we use two cables. Now it can hold 82A. Another option is to use 8 AWG gauge – that one holds 73A. You can use whatever combination of cable, as long it holds more than 70A. By the way, you always want to leave the room for extra protection For this, we are going to stick with the 12 AWG. Because of the cable combination, we need overcurrent protection that holds between 70A and 82A. If we choose overcurrent protection higher

than the cable can hold, the cable will burn, and the protection will never actuate. Two auto reset Circuit Breakers – 24V, 40A will work.
The toggle switch can be wired with a smaller wire, like 18AWG, with a 10A breaker. For the switch, the SPST 24V 100A Solenoid Switch – Insulated Continuous would work. This switch holds 100A, which is more than enough, because t will support the 70A of the motors.
Now, the only thing we need is a motor driver that can hold 24V-70A. The Sabertooth Dual 60A motor driver holds two 60A motors totaling 120A. The figure below depicts how everything is connected.

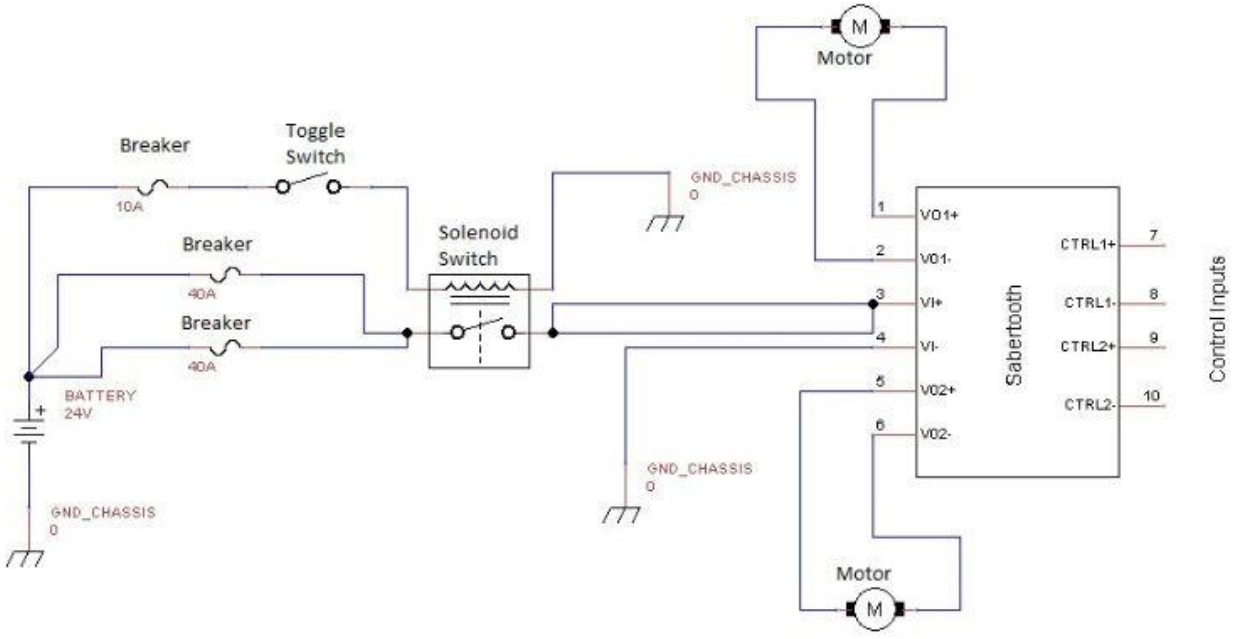


Figure 47: Solenoid Switch Schematic

AWG gauge	Diameter Inches	Diameter mm	Ohms per 1000 ft	Ohms per km	Maximum amps for chassis wiring	Maximum amps for power transmission
OOOO	0.46	11.684	0.049	0.16072	380	302
OOO	0.4096	10.40384	0.0618	0.202704	328	239
OO	0.3648	9.26592	0.0779	0.255512	283	190
0	0.3249	8.25246	0.0983	0.322424	245	150
1	0.2893	7.34822	0.1239	0.406392	211	119
2	0.2576	6.54304	0.1563	0.512664	181	94
3	0.2294	5.82676	0.197	0.64616	158	75
4	0.2043	5.18922	0.2485	0.81508	135	60
5	0.1819	4.62026	0.3133	1.027624	118	47
6	0.162	4.1148	0.3951	1.295928	101	37
7	0.1443	3.66522	0.4982	1.634096	89	30
8	0.1285	3.2639	0.6282	2.060496	73	24
9	0.1144	2.90576	0.7921	2.598088	64	19
10	0.1019	2.58826	0.9989	3.276392	55	15
11	0.0907	2.30378	1.26	4.1328	47	12
12	0.0808	2.05232	1.588	5.20864	41	9.3
13	0.072	1.8288	2.003	6.56984	35	7.4
14	0.0641	1.62814	2.525	8.282	32	5.9
15	0.0571	1.45034	3.184	10.44352	28	4.7
16	0.0508	1.29032	4.016	13.17248	22	3.7
17	0.0453	1.15062	5.064	16.60992	19	2.9
18	0.0403	1.02362	6.385	20.9428	16	2.3
19	0.0359	0.91186	8.051	26.40728	14	1.8
20	0.032	0.8128	10.15	33.292	11	1.5
21	0.0285	0.7239	12.8	41.984	9	1.2
22	0.0254	0.64516	16.14	52.9392	7	0.92
23	0.0226	0.57404	20.36	66.7808	4.7	0.729
24	0.0201	0.51054	25.67	84.1976	3.5	0.577
25	0.0179	0.45466	32.37	106.1736	2.7	0.457
26	0.0159	0.40386	40.81	133.8568	2.2	0.361
27	0.0142	0.36068	51.47	168.8216	1.7	0.288
28	0.0126	0.32004	64.9	212.872	1.4	0.226
29	0.0113	0.28702	81.83	268.4024	1.2	0.182
30	0.01	0.254	103.2	338.496	0.86	0.142
31	0.0089	0.22606	130.1	426.728	0.7	0.113
32	0.008	0.2032	164.1	538.248	0.53	0.091

Figure 48: Wire Guage Table

24 Connection of PWMs to the SuperDroid Robots RC Interface Board

For complete assembly of the SuperDroid Robots RC interface board and or SuperDroid Robots PWMs see the website www.superdroidrobots.com and look at the descriptions for each item TE-062-000 and TE-058-000 and download the assembly and operation manuals for the items.

This controller is intended to be attached to our PWM motor drivers (TE-058-000), but can be hooked up to any motor controller that has a PWM input and a direction and brake input. The Connection to the PWMs is best done using our PWM to RC interface board hook up kits (TE-060-000). With the larger IG42 motors we recommend our motor per PWM, for the smaller IG32 gear motors one PWM motor controller can be used to drive two motors.
This section applies to the attaching a Magnevation Controller(s) to an OOPic II/II+

Tips:

- Keep all electrical leads as short as possible to minimize them acting like antenna and receiving or transmitting electrical noise.

Caution:

- Be careful of polarities to ensure you do not damage any of the components. Double-check all your work before powering up.

The boards are labeled. B = brake, D = Direction, P = PWM, G = Ground. You do not need to hookup the brake, its up to you. The gear motors will generally stop right away with or without the brakes connected.

1. Attach B1, D1, P1, and G to the respective PWM controllers. If you are using two PWM controllers (recommended for the IG42 motors) just parallel the lines from the RC controller board (ie two lines on B1, D1, P1, and G) and go to each PWM.

2. Attach B2, D2, P2, and G to the respective PWM controllers. If you are using two PWM controllers (recommended for the IG42 motors) just parallel the lines from the RC controller board and go to each PWM.

3. Attach the motors and motor power supply to the PWMs. P1, is generally the right, and P2 is the left, but with channel reversing it does not make much difference. If it turns when it should go straight switch channels 1 and 2. See Operation section below. If you are putting two motors to the same PWM, make sure they are wired the same, if one turns the opposite of the other, change the leads of one of the motors.

4. See the Figure , Figure , Figure , and Figure for two examples of wiring the controller.

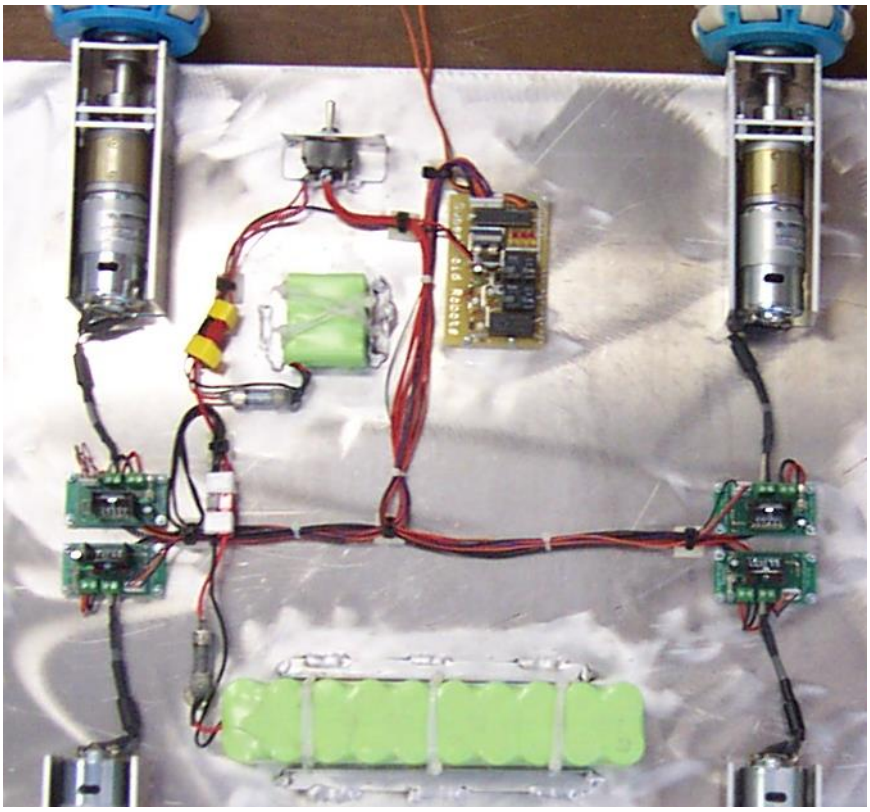


Figure 49: Four PWMs to RC Interface Board Typical Layout

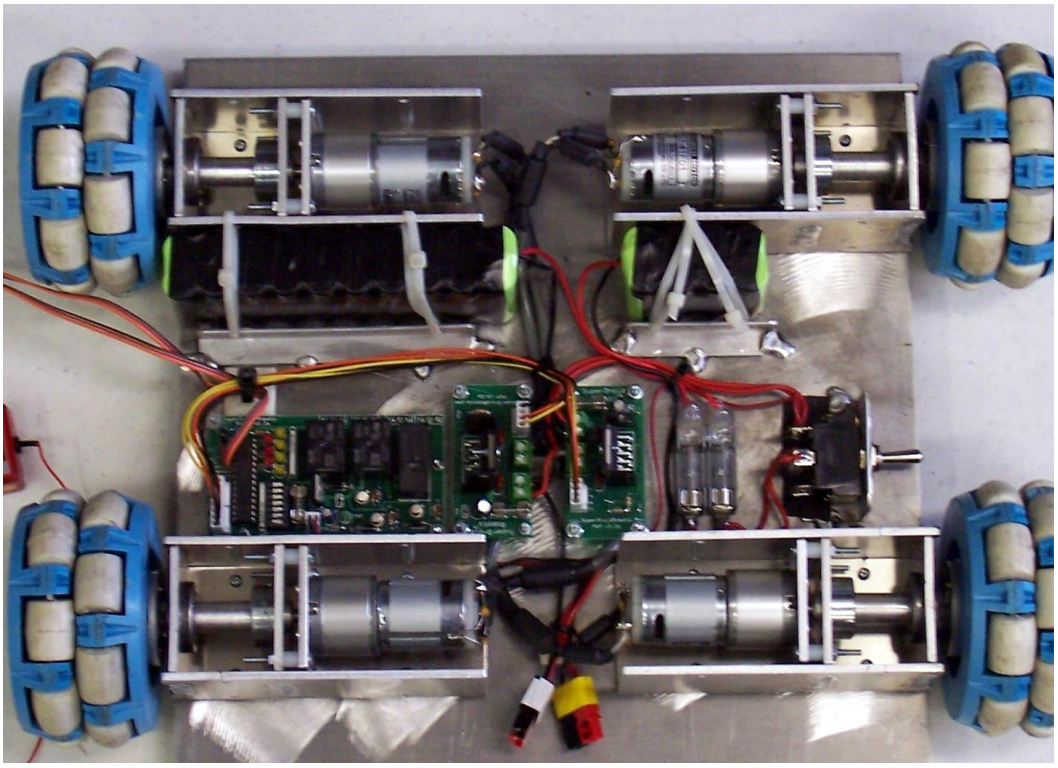


Figure 50: Two PWMs to RC Interface Board Typical Layout

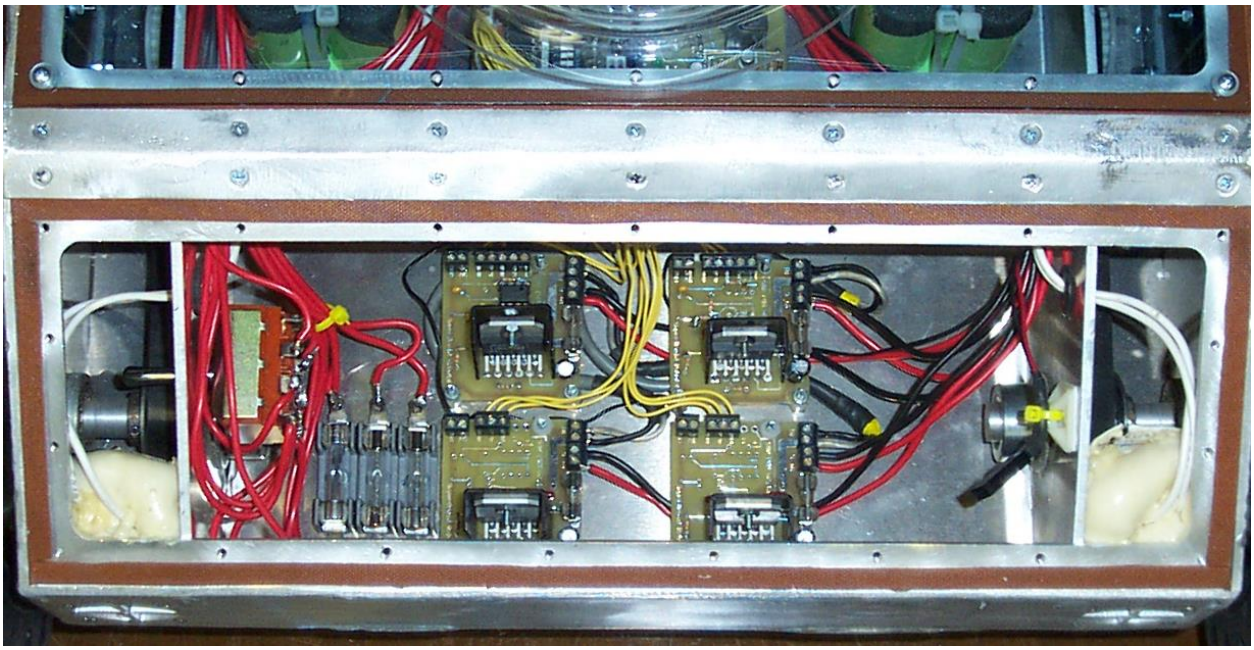


Figure 51: Deluxe ATR PWM mounting

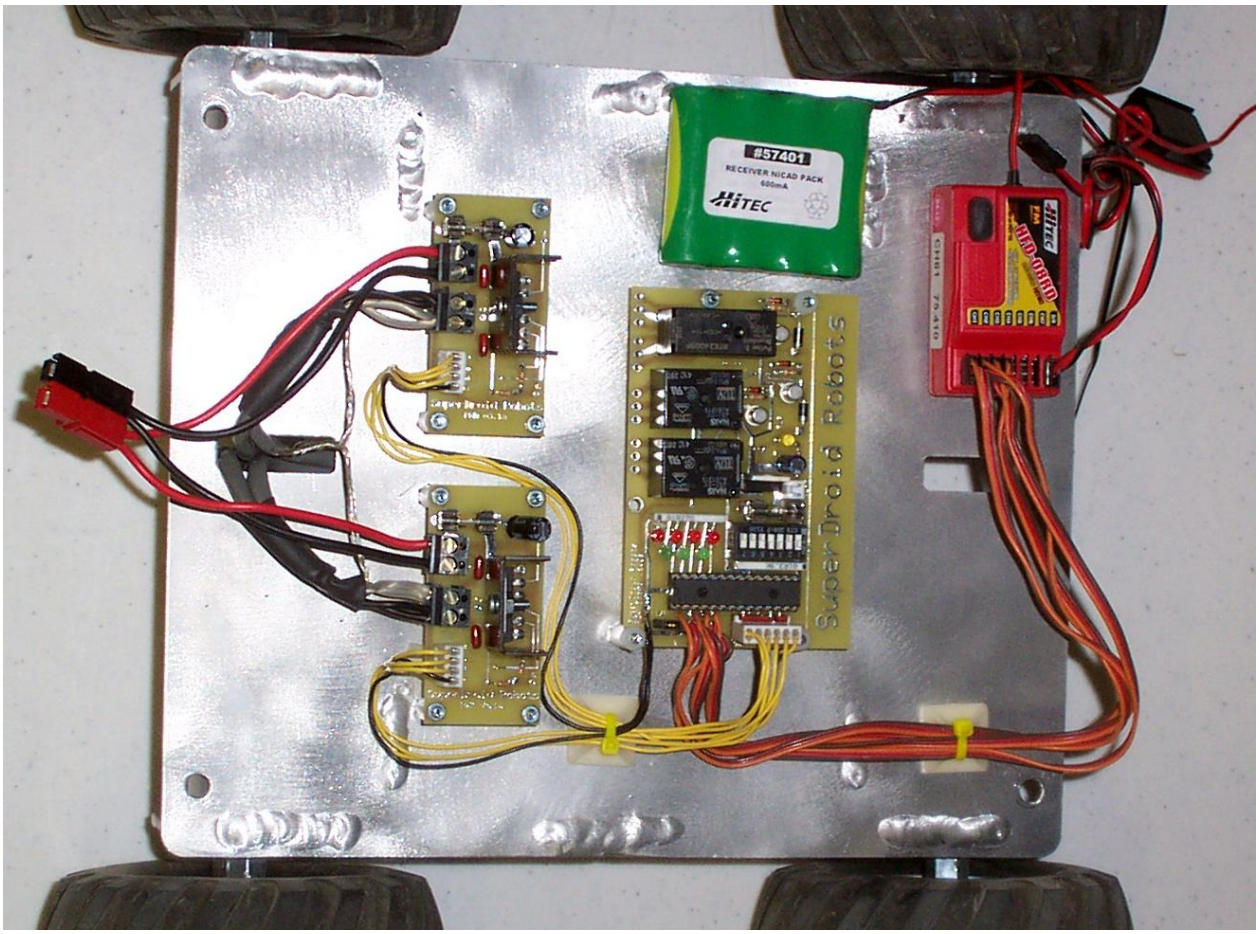


Figure 52: Mini ATR PWM mounting with RC interface board

25 Hooking Up a microcontroller to- the MD22

This section applies to the attaching a MD22 to a microcontroller.

Tips:

- Keep all electrical leads as short as possible to minimize them acting like antenna and receiving or transmitting electrical noise.
- Refer to Figure for reference of hooking up the MD22.
- For more information on the Ultrasonic sensor see: http://www.superdroidrobots.com/product_info/MD22_info.htm

Caution:

- Be careful of polarities to ensure you do not damage any of the components. Double-check all your work before powering up.

1. Attach fused (5A) power to the MD22 (12-50VDC, the SuperDroid VRs and ATRs use 24VDC).

2. The control fused (1A) power to the microcontroller. 5V from the microcontroller board or a separate voltage regulator is required.

3. Attach the motor leads of each motor to the MD22. If you are driving 2 motors per side, the motors on each side should be paralleled. If you are using shielded cable (such as supplied with our electric motor hookup kit), the ground wire/shielding should be attached to the metal base of the robot (best place is the mounting screw for the MD22).

4. The MD22 control can be hooked up to a microcontroller to the terminal block of the MD22. Set the mode selector switches to correspond to the mode of operation you are using. Refer to Figure .

Figure 53: MD22

Mode	Switch 1	Switch 2	Switch 3	Switch 4
I2C Bus - address 0xB0	On	On	On	On
I2C Bus - address 0xB2	Off	On	On	On

I2C Bus - address 0xB4	On	Off	On	On
I2C Bus - address 0xB6	Off	Off	On	On
I2C Bus - address 0xB8	On	On	Off	On
I2C Bus - address 0xBA	Off	On	Off	On
I2C Bus - address 0xBC	On	Off	Off	On
I2C Bus - address 0xBE	Off	Off	Off	On
0v - 2.5v - 5v Analog	On	On	On	Off
0v - 2.5v - 5v Analog + Turn	Off	On	On	Off
RC Servo	On	Off	On	Off
RC Servo + Turn	Off	Off	On	Off

Figure 54: MD22 Operation Mode Selection

26 Hooking up the MD22 to a standard RC system

This section applies to the attaching a MD22 to a RC System.

Tips:

- Keep all electrical leads as short as possible to minimize them acting like antenna and receiving or transmitting electrical noise.
- For more information on RC control see: http://www.superdroidrobots.com/product_info/RC.htm
- For more information on motor controllers see: http://www.superdroidrobots.com/product_info/motor_controllers.htm

Caution:

- Be careful of polarities to ensure you do not damage any of the components. Double-check all your work before powering up.

1. Attach the fused (5A) power to the MD22 (12-50VDC, the SuperDroid VRs and ATRs use 24VDC).

2. Attach the fused (1A) control power to the RC Receiver.

3. Attach the motor leads of each motor to the MD22. If you are driving 2 motors per side, the motors on each side should be paralleled. If you are using shielded cable (such as supplied with our electric motor hookup kit), the ground wire/shielding should be attached to the metal base of the robot (best place is the mounting screw for the MD22).

4. The MD22 can be easily hooked up to RC Receiver using standard wire from one terminal block to the 3 pin headers of an RC Receiver. You will want some 3-ping crimp receptacles to attach the wire to the header.

5. Set the mode selector switches to correspond to the mode of operation you are using. Refer to Figure .

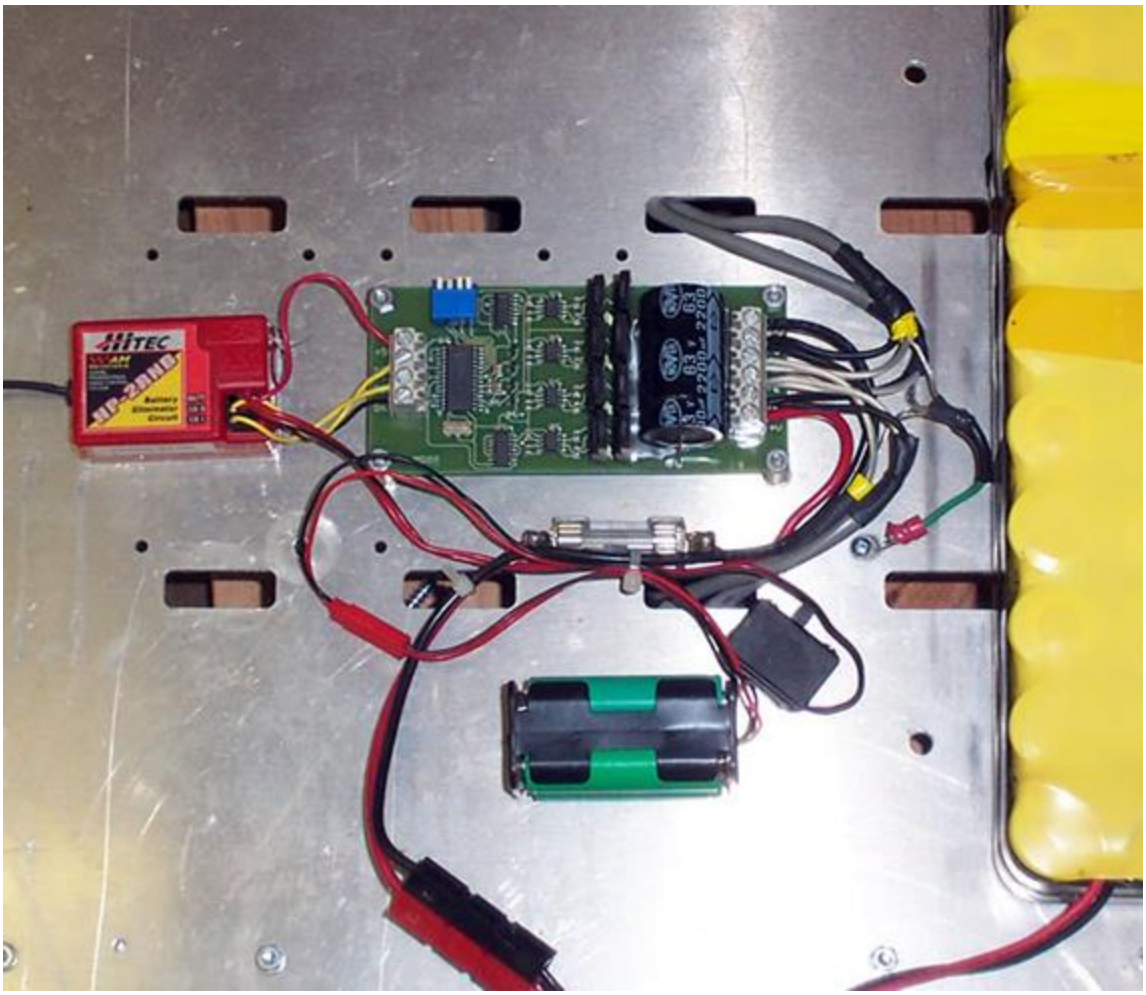


Figure 55: RC and MD22 Hookup

27 Hooking up a Sabertooth to a RC system

This section applies to the attaching a Sabertooth 2x10 or 2x25 to RC receiver.

Tips:

- Keep all electrical leads as short as possible to minimize them acting like antenna and receiving or transmitting electrical noise.
- With the new Spektrum RC systems we found some minor issues using them. The RC signal was not as high a range for ms output and the receiver needs a little more power than 72/75 MHz radios. It is also common to add a couple servos to the receiver and the standard Sabertooth RC does not have a large enough regulator for that. So we have had these custom Sabertooths made with larger 5V switching supplies and reprogrammed to work with spektrum RC systems
- For more information on RC control see: http://www.superdroidrobots.com/product_info/RC.htm
- For more information on motor controllers see: http://www.superdroidrobots.com/product_info/motor_controllers.htm
- For a schematic for the spectrum RC system see: http://www.superdroidrobots.com/product_info/Spektrum+Sabertooth_schem.pdf

Caution:

- Be careful of polarities to ensure you do not damage any of the components. Double-check all your work before powering up.

1. Attach the Sabertooth to the switched and fused battery (power).

2. The receiver will then be powered from the Sabertooth. A standard sabertooth may have trouble powering the spectrum receiver especially when binding, so its best to use our custom saberooths with a 1A switching 5V regulator.

3. Attach the motor leads of each motor to the Saberooth. If you are driving 2 motors per side, the motors on each side should be paralleled.

4. The Saberooth can be easily hooked up to RC Receiver using standard servo pigtail wire from the Sabertooth terminal block to the 3 pin headers of an RC Receiver. S1 and S2 are the two receiver signals. Refer to our Sabertooth schematic for details. Also go to dimension engineering's website to download their manual.

5. Set the mode selector switches to correspond to the mode of operation you are using. Refer to the Sabertooth manual for settings.

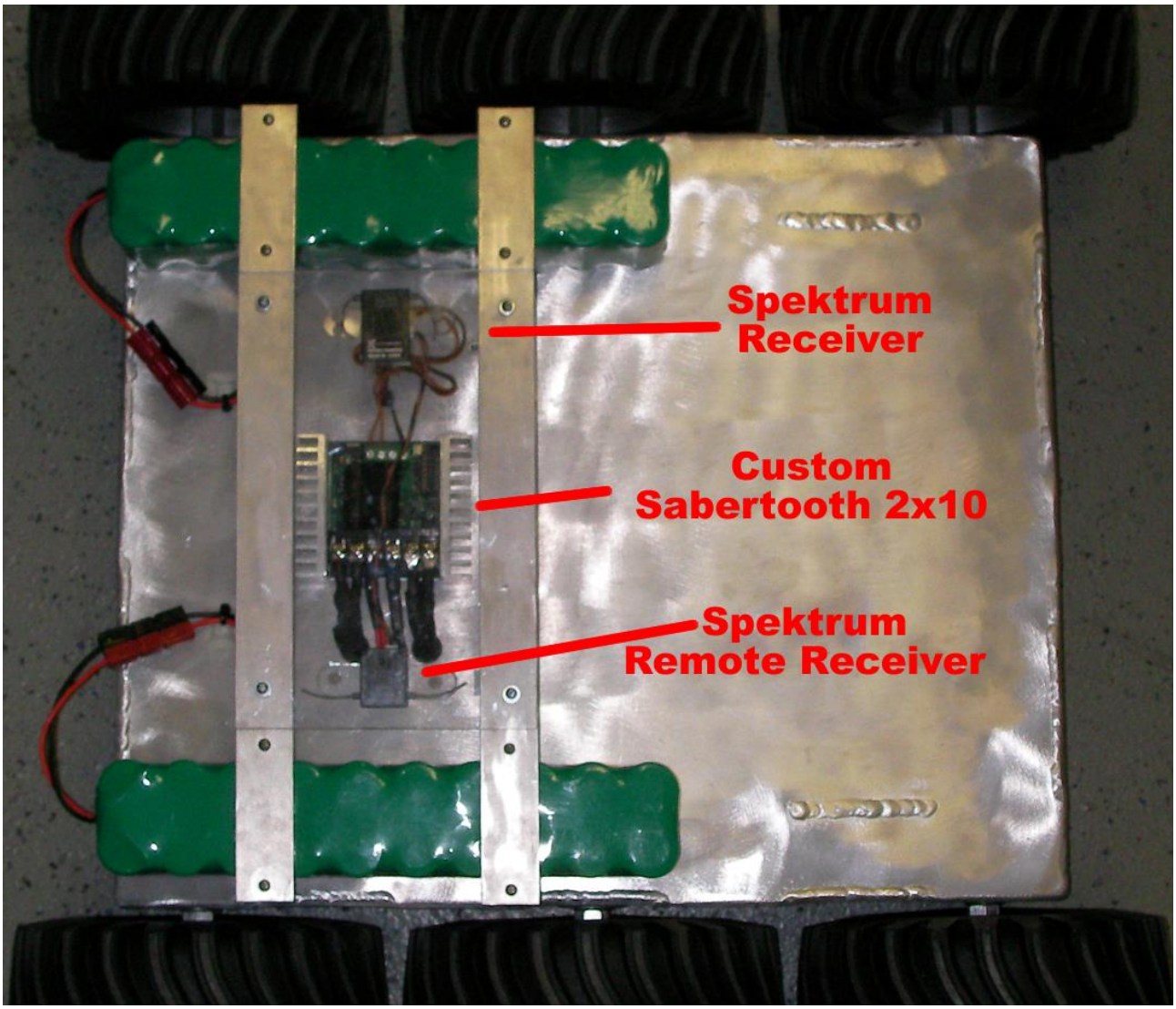


Figure 56: Spektrum RC and Sabertooth 2x10 Hookup

28 Hooking up a to Quad Wheel VR with Microcontroller

This section applies to the attaching a quad wheel VR with 4 PWMs to a microcontroller. The microcontroller is commanded wirelessly through an xBee.

Tips:

- Keep all electrical leads as short as possible to minimize them acting like antenna and receiving or transmitting electrical noise.
- There is a lot of subtleties involved with hooking up a RF system to run with a microcontroller, this is just a brief overview.

Caution:

- Be careful of polarities to ensure you do not damage any of the components. Double-check all your work before powering up.

1. Attach a control battery fused (1A) power to microcontroller (the microcontroller shown has a regulator, if you are not using a regulated microcontroller it will need to be added to your circuit).

2. Attach the fused 24V to 4 PWM motor controllers. One to each motor. The microcontroller chosen must be capable of outputting 4 PWM signals so each motor can be controlled independently.

3. Attach the motor leads of each motor to the PWM motor controllers.

4. The microcontroller is attached to a xBee to receive wireless commands via the microcontroller's TTL RS232 port.

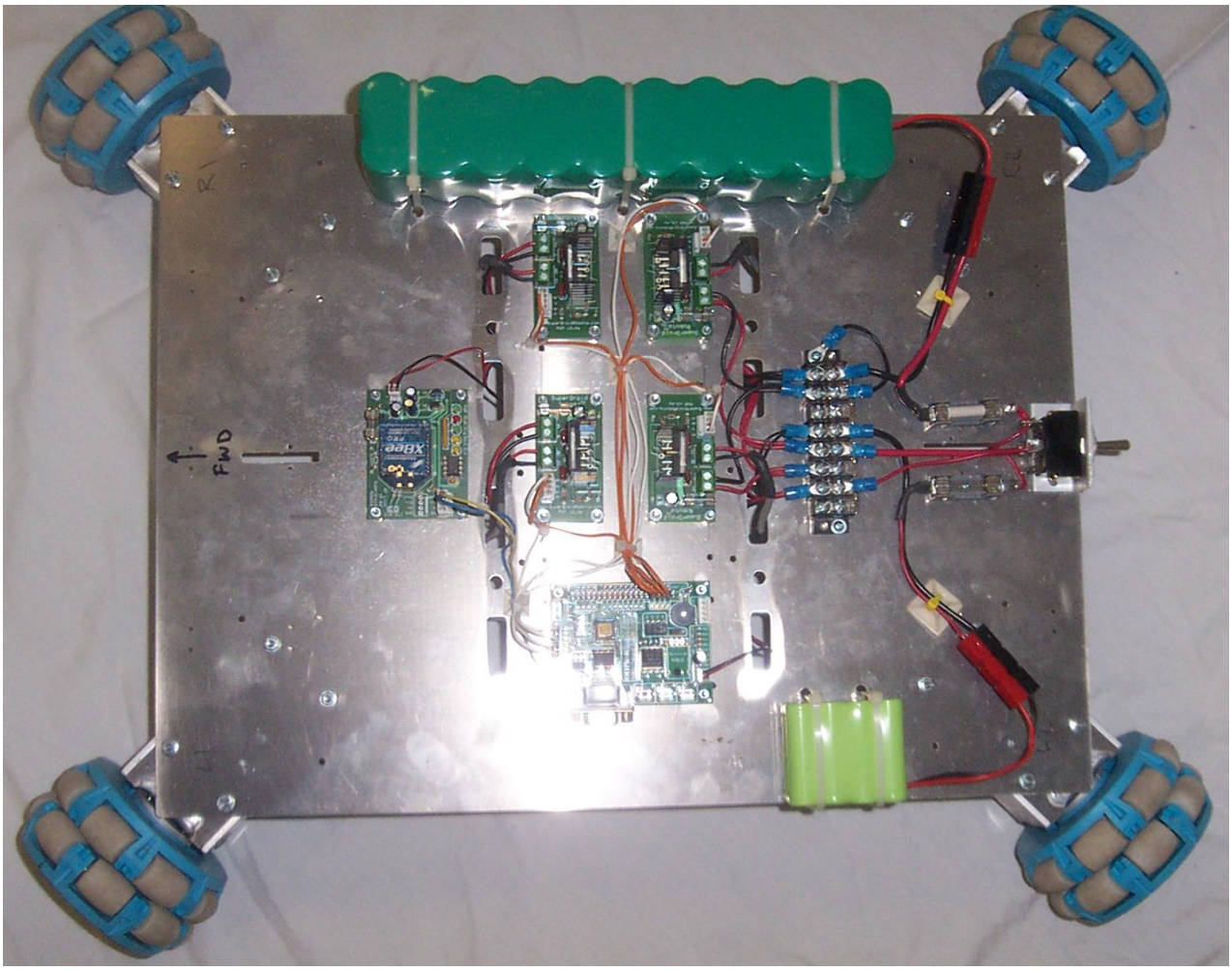


Figure 57: RF to Quad Wheel VR with Microcontroller Hookup

29 Mounting a servo to an ATR or VR platform

This section applies to the attaching a servo to the base of the ATRs and VRs. There are many locations on all the platforms that accept a standard servo hole pattern. With the Servo spacer mounting hardware package the servo can be bolted to the frame.

1. Insert he rubber grommets and brass inserts into the servos. These parts come with a standard servo.

2. The servo mounting hardware package comes with 4 # bolts and spacers. Use the bolts to mount the servo to the base. Use the spacers between the servos and the base plate. Refer to

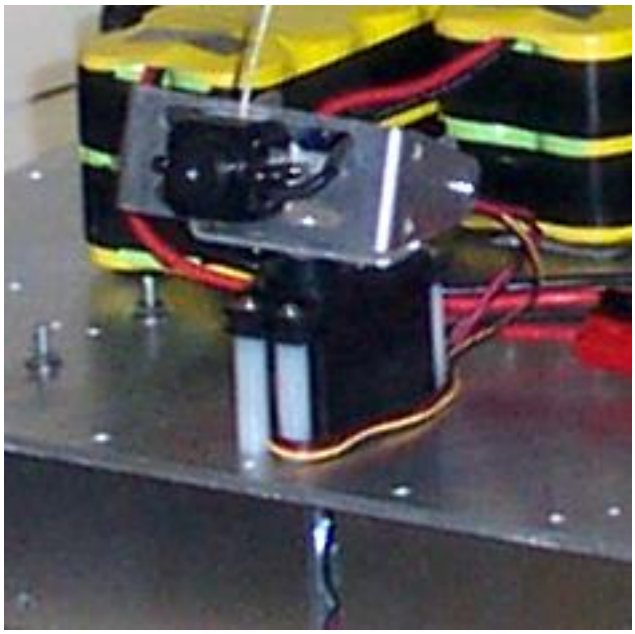


Figure 58: Servo Mounting

30 Assembly of a Sweeping Scanner Servo Arm Bracket

1. Insert a #2 x 5/16" long screw through the top of the bracket. Fasten the servo arm on with a washer, lock washer and nut as shown in Figure 59.

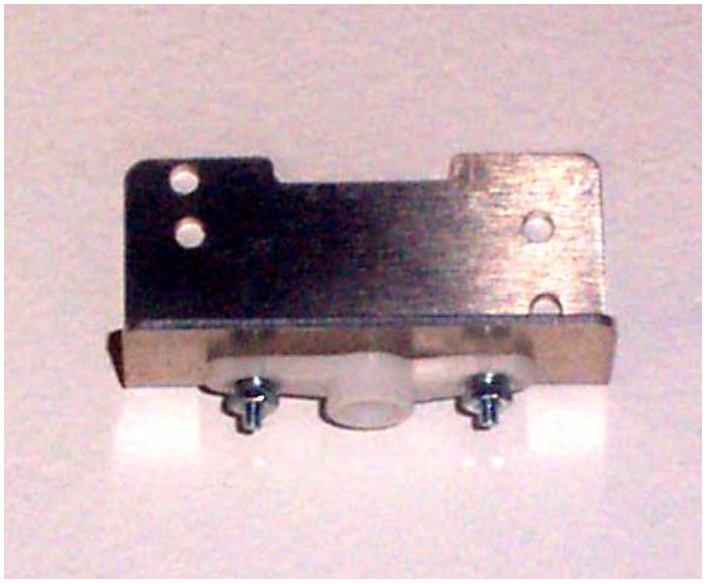


Figure 59: Sweeping Scanner Servo Bracket

31 Wiring an IR Detector

This section applies to wiring a Sharp GP2D12 IR Ranger to interface with the Trekker Expansion Board.

Tips:

- For more information on the Sharp IR detector see: http://www.superdroidrobots.com/product_info/SharpGP2D12-15.pdf

Caution:

- The electronics are sensitive to static electricity. Use proper precautions to ensure you do not statically discharge to the electronic boards.

1. Strip back about 1/4" of insulation on each wire (the end without preinstalled small crimps).

2. Crimp terminals onto the wire using the technique discussed above.

3. Insert the small crimps into the small white IR plug so when it plugs into the IR sensor it will look as shown in Figure 60

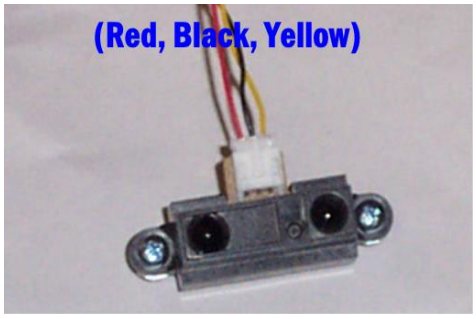


Figure 60: IR Sensor Wiring

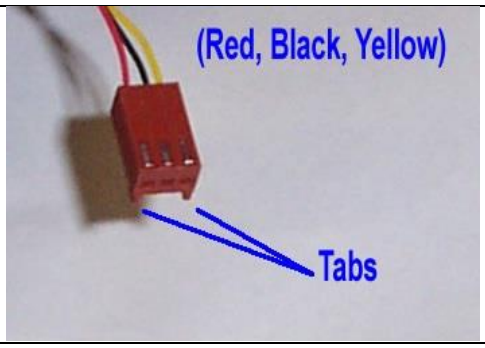


Figure 61: IR Sensor Connector

4. Twist the black strand of the wire around the other two many times to form a twisted pair of wires.

5. Insert the larger crimps into the 0.1" spaced friction lock receptacle as shown in Figure 61. Refer back to

   Figure 39 for inserting the crimps.

32 Wiring an SRF04 Ultrasonic Sensor

This section applies to wiring a SRF04 Ultrasonic Ranger to interface with the Trekker Expansion Board.

Tips:

- Note: The Deventech sensor has 5 holes for receiving wires. Only 4 of the wires are used.
- For more information on the Ultrasonic sensor see: http://www.superdroidrobots.com/product_info/SRF04.htm

Caution:

- The electronics are sensitive to static electricity. Use proper precautions to ensure you do not statically discharge to the electronic boards.

1. Strip back the outer insulation/sheath of the cable to expose the 4 internal wires. About 2" of insulation/sheath should be removed.

2. Strip about 1/4" of insulation off each wire

3. Heat each wire with the soldering iron to allow the insulation to melt back (this makes the final soldering easier)

4. Place the wires in the holes as shown in Figure 62 and solder them. The insulation of the wires needs to come up to the board to avoid shorts when assembled with the Trekker.

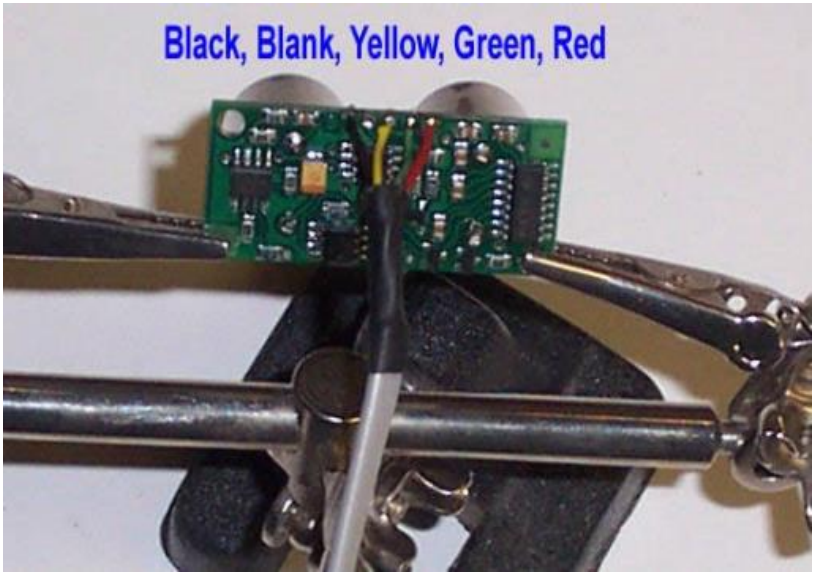


Figure 62: Devantech SRF04 Wire Arrangement

5. Slide a piece of heat shrink onto the wire and shrink it as shown in Figure 62.

6. Slide another piece of heat shrink onto the wire, do not heat it at this point.

7. If desired cut extra wire to length. Be careful not to cut too much, especially if the scanner is going to rotate on a sweeping servo or if you plan on relocating the scanner later.

8. Strip back the other side of the wire. About 2" of insulation should be removed. Strip about 1/4" of insulation off each wire.

9. Crimp terminals onto the wire using the technique discussed Section 9.

10. Slide the heat shrink back onto the end of the wire and shrink it as shown in Figure 63.

11. IMPORTANT: Do not perform the next step until the Ultrasonic sensor is mounted, the wire receptacle will not go through the openings with the connector installed. Mounting of the ultrasonic sensor are covered in later sections of this chapter.

12. Install the 4 crimps into the connector as show in Figure 63.

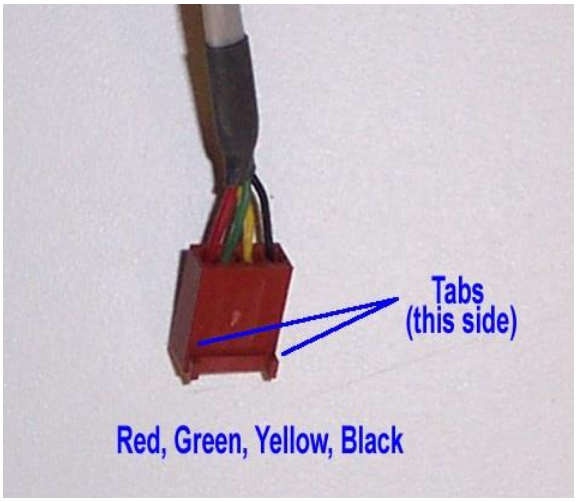


Figure 63: SRF04 Ultrasonic Header Hookup

13. Note: The crimp ends can be removed from the connector by pushing the metal bur exposed through the side of the connector housing while pulling lightly on the wire. Do this only if you need to remove the connector to feed the wire though the mounting hole location. The crimp should be inspected afterwards and gently bent back into shape if deformed while performing this step. It is important that the crimp is not flattened out or it may not reseat into the connector causing erratic behavior.

33 Wiring an SRF08 Ultrasonic Sensor

This section applies to wiring a SRF04 Ultrasonic Ranger to interface with the Trekker Expansion Board.

Tips:

- Note: The Deventech sensor has 5 holes for receiving wires. Only 4 of the wires are used.
- For more information on the Ultrasonic sensor see: http://www.superdroidrobots.com/product_info/SRF08.htm

Caution:

- The electronics are sensitive to static electricity. Use proper precautions to ensure you do not statically discharge to the electronic boards.

1. Strip back the outer insulation/sheath of the cable to expose the 4 internal wires. About 2" of insulation/sheath should be removed.

2. Strip about 1/4" of insulation off each wire

3. Heat each wire with the soldering iron to allow the insulation to melt back (this makes the final soldering easier)

4. Place the wires in the holes as shown in Figure 62 and solder them. The insulation of the wires needs to come up to the board to avoid shorts when assembled with the Trekker.

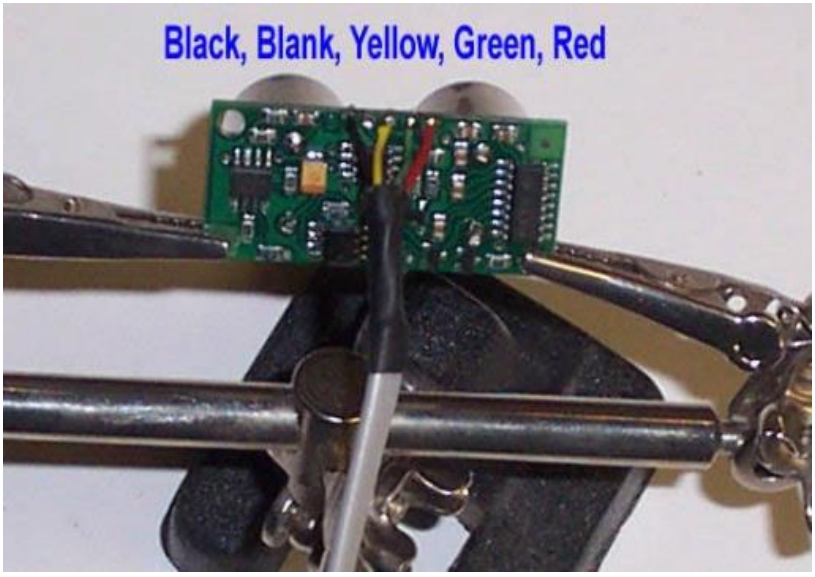


Figure 64: Devantech SRF08 Wire Arrangement

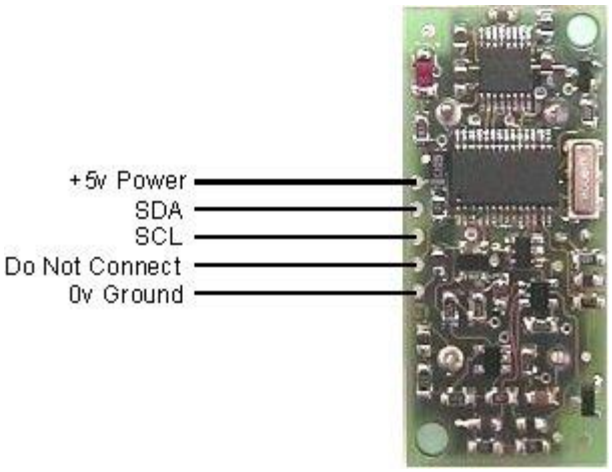


Figure 65: SRF08 Hookup

5. Slide a piece of heat shrink onto the wire and shrink it as shown in Figure 64.

6. Slide another piece of heat shrink onto the wire, do not heat it at this point.

7. If desired cut extra wire to length. Be careful not to cut too much, especially if the scanner is going to rotate on a sweeping servo or if you plan on relocating the scanner later.

8. Strip back the other side of the wire. About 2" of insulation should be removed. Strip about 1/4" of insulation off each wire.

9. Crimp terminals onto the wire using the technique discussed in Section 9.

10. Slide the heat shrink back onto the end of the wire and shrink it as shown in Figure 66.

11. IMPORTANT: Do not perform the next step until the Ultrasonic sensor is mounted, the wire receptacle will not go through the openings with the connector installed. Mounting of the ultrasonic sensor are covered in later sections of this chapter.

12. Install the crimps into the 4 pin connector as show in Figure 66if connecting to the Trekker Expansion board. Install the 5-pin connectors as shown in Figure 67 if connecting to a OOPic II/II+ or OOPic-R parallel programming port..

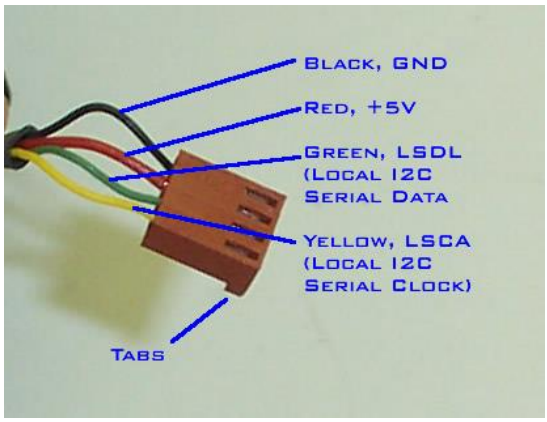


Figure 66: SRF08 Receptacle wiring: 4-position receptacle

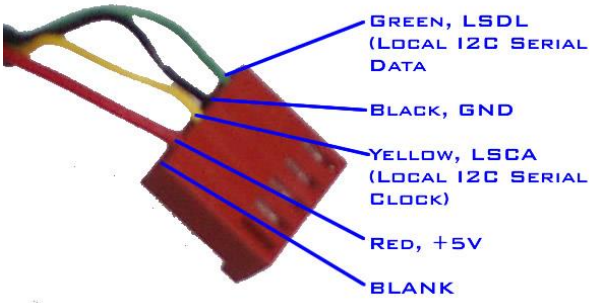


Figure 67: SRF08 Receptacle wiring: 5-position receptacle

13. Note: The crimp ends can be removed from the connector by pushing the metal bur exposed through the side of the connector housing while pulling lightly on the wire. Do this only if you need to remove the connector to feed the wire though the mounting hole location. The crimp should be inspected afterwards and gently bent back into shape if deformed while performing this step. It is important that the crimp is not flattened out or it may not reseat into the connector causing erratic behavior.

Chapter 3

Chapter 3: Testing and Operating the ATR and VR

1 Powering Up your VR or ATR

Caution:

- The electronics are sensitive to static electricity. Use proper precautions to ensure you do not statically discharge to the electronic boards.

1. Now its time for the first power test. Ensure all solder joints are clean and do not cross onto other traces or connections.
2. Ensure all splices are taped properly so no exposed wires are present.
3. Remember the base of the robot it grounded if wired per Figure 40 (which is highly recommended)
4. Lift the robot up on blocks so the wheels do not contact the ground.
5. Make sure all electronics are disconnected before the first power test
6. Connect the charged batteries.
7. Turn on the power make sure you have proper power to all the wires.
8. Turn off the power and attach components, then repower. Keep Repeating this until all components are added.

2 Putting it all Together

With the above many aspects of the ATRs and VRs they can be made to perform very complicated tasks.

Combining the ATRs and VRs with a microcontroller or PC the robot can be tasked to do multiple functions. Writing the programs takes a lot of trial and error, but when it all comes together the result is very satisfying.

ENJOY!