E-Racer
Operator’s Manual

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Senior Design II

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Important Safety Instructions

General Warnings

⚠️ TO REDUCE THE RISK OF INJURY, ADULT SUPERVISION IS REQUIRED.
NEVER USE IN ROADWAYS, NEAR MOTOR VEHICLES, ON OR NEAR
STEEP INCLINES OR STEPS, SWIMMING POOLS OR OTHER BODIES OF
WATER. ALWAYS WEAR SHOES AND NEVER ALLOW MORE THAN 1
RIDER.

⚠️ This product is meant for outdoor use and on private property only.
⚠️ Never ride the E-Racer on public streets, alleys or other public roads or
thoroughfares.
⚠️ It must never be ridden in any area that could potentially do harm to humans, animals
or property.
⚠️ Never ride around the vicinity of small children who may enter your path.
⚠️ The E-Racer is intended for riders over the age of seven and under 200 pounds. Any
rider who does not comfortably fit in the vehicle and/or cannot comfortably use the
controls should not ride the E-Racer.
⚠️ This vehicle is a serious machine and should be treated with respect when riding it,
working on it, or simply being near it.
⚠️ The decision to allow a rider to ride the E-Racer must be done with the permission of
a directly supervising adult. The directly supervising adult must read and follow all of
the contents of the owner’s manual before making this decision.
⚠️ The rider must have previous experience in riding electric powered vehicles before
attempting to ride the E-Racer. It is the responsibility of the supervising adult to
ensure the rider has the qualification, ability and training before allowing them to
attempt to ride the vehicle.
⚠️ The E-Racer is never to be ridden indoors. Indoor flooring and carpets can be
damaged from abrasive contact with the tires.
⚠️ The E-Racer is designed to run on off-road surfaces. Grass, packed dirt, and moderate
off-road terrain are ideal riding surfaces.
⚠️ The rider of the E-Racer should always wear protective footwear. Open-toed shoes
should never be allowed. Keep shoe laces and pant legs away and clear of the wheels.
⚠️ The rider must wear a safety helmet, elbow and kneepads to avoid injury if falling.
Failure to wear a standard approved helmet may result in serious personal injury or
death. It is also highly recommended to wear eye protection while riding.
⚠️ The E-Racer is not designed to pull or tow anything behind it as it may result in
serious injury or death as it may result in serious damage to the motor or internal
parts.
⚠️ The E-Racer cannot be used on wet surfaces or in wet weather. Never immerse any
party of the E-Racer in water. Moisture can damage the motor, switches and drive
components.
⚠️ The E-Racer should never be ridden in mud, water, ice or snow. It is not designed to
be ridden in streets or on paved surfaces either. Avoid riding on extreme inclines,
declines, rocky surfaces, curbs or jumps.
⚠️ The electric motor can become hot when in use. Do not touch it at anytime and
handle it carefully.
Never use the E-Racer while using personal radios or headphones.

Do not use the E-Racer for stunt riding, ramp jumping, running over curbs, acrobatics or similar activities.

Recommended tire pressure is 18 psi. Never inflate beyond 20 psi. Inflation of the tires should be performed by adults only. Use a tire pressure gauge to ensure pressure of 18 psi. Serious injury or death may result from over inflation of the tires. Avoid inflating the tires at a gas station. The greater pressure of a gas station air pump makes a blowout of the tire possible. This may result in serious injury or death.

**Electric Hazard Warnings**

⚠️ This is an electrically operated product and should be operated with care. Keep away from small children.

⚠️ Before riding, always make sure that the battery retainer is firmly in place and holding the battery securely.

⚠️ Never modify the electrical system or battery chargers. Modifications of these systems can result in fire, serious injury, and damage to the electrical components.

⚠️ Make sure the chargers are in good working condition. Do not use the chargers if they have been struck, dropped or damaged in any way. A damaged charger can harm the electrical system and be a potential fire hazard.

⚠️ Exposure to high temperatures may cause the batteries to explode. Store the vehicle in a cool, dry place.

⚠️ Keep the vehicle and battery chargers dry at all times. Never allow the battery chargers to become wet or be placed in water.

⚠️ Use only the chargers supplied with the vehicle. Use of the wrong type of battery or charger could cause a fire or explosion resulting in serious injury.

⚠️ Never use replacement parts which have not been approved by the makers of the E-Racer. Failure to do so may result in overheating, fire, or explosion.

⚠️ The batteries are to be handled by adults only. The batteries are heavy and contain a lead-acid electrolyte. Dropping the batteries can result in serious injury.

⚠️ Charging the batteries must be done by adults only. Never allow children to recharge the batteries. A child could be injured when involved in the operations of battery charging or use of electrical devices.

⚠️ Make sure that all battery contacts or connectors are free of excessive wear or damage whenever the battery is charged. If ANY damage is detected, DO NOT USE the chargers or batteries until you have replaced the worn or damaged part.

⚠️ Always push down the Emergency Power Shut-Off Button at the rear and keep the power switch off when not in use to ensure the power is off and prevent any unauthorized riders from attempting to ride the vehicle.

**Battery Charging Warnings**

⚠️ The chargers must be used only in a clean, dry indoor area.

⚠️ Only batteries of the same or equivalent type as the recommended battery are to be used.

⚠️ Batteries are to be inserted with the correct polarity.

⚠️ If the batteries will not charge, remove the old or dead batteries from the E-Racer.

⚠️ Do not short-circuit the batteries and the connectors.
⚠ The batteries must be upright when charging.
⚠ The chargers are not toys.
⚠ Do not charge the batteries on any delicate surfaces (such as a counter top).
⚠ Only use the provided chargers to charge the batteries.
⚠ Always ensure adequate ventilation. Never use the chargers in an enclosed space.
⚠ During charging, never cover the E-Racer or the charger.
⚠ Should anything abnormal happen to the E-Racer or charger, switch off the main supply immediately.
⚠ Under normal conditions, the batteries will be fully charged in 8-20 hours of charging time. The difference in time depends on the local power output in your area, the type of outlet you use, and the condition of the battery.
⚠ You should only plug the chargers directly into a standard electrical wall outlet. Do not connect the chargers to a surge protector.

Battery Care Warnings
⚠ THE LIQUID AND CONTENTS OF THE BATTERIES ARE HIGHLY ACIDIC. IF A BATTERY IS LEAKING AND THE LEAKING MATERIALS COME INTO CONTACT WITH YOU HANDS, FACE OR EYES, OR IS INGESTED, CALL A PHYSICIAN IMMEDIATELY.
⚠ Charge the batteries after each use.
⚠ Never leave the batteries in an uncharged condition. This will permanently damage them and prevent them from being able to hold any charge.
⚠ Avoid running the batteries completely flat as this will greatly shorten their usable life.
⚠ Never charge the batteries for more than 30 hours.
⚠ Unplug the batteries from the wiring if the E-Racer is to be stored for more than 2 months.
⚠ Avoid extreme temperature. Do not store the batteries in temperatures above 122°F or lower than 32°F.
⚠ Check to make sure the battery is secured in place before riding the vehicle. Tighten the battery retainer if necessary.

Riding Warnings
⚠ Never ride the E-Racer at night.
⚠ Comply with all recommendations in the General Warning section regarding where the E-Racer is to be ridden.
⚠ Do not touch the motor or wheels while they are rotating.
⚠ Keep hands, face, feet and hair away from all moving parts.
⚠ Ride on level ground. The E-Racer, like any vehicle, can reach unsafe speeds, lose traction, slide or collide with other objects.
⚠ Never ride near flammable liquids or vapors such as gasoline, acetone or paint thinner. Keep all flammable materials away from the E-Racer.
⚠ Never wear headphones or use a cell phone when operating.
⚠ Ride defensively. Remember that others around you may not see you or may be too involved in their own actions.
⚠ Learn and observe your local laws regarding use.
Pre-Ride Warnings
⚠ Look over the entire unit to ensure that there are no visible problems with the E-Racer.
⚠ Check the tires, ensuring there are no cuts or exposed cords or the tires are deflated.
⚠ Check for loose nuts, bolts and screws.
⚠ Check that all cables and wires are not frayed, cut or broken.
⚠ Make sure that the seat belt is properly secured and is low and tight across your waist.

Special Safety Warnings
⚠ The E-Racer can reach speeds up to 18 MPH on a level surface (depending on the surface terrain and the weight of the rider).
⚠ When accelerating please ensure that you start slowly and precisely. Do not push away for a quick start.
⚠ The brakes are designed to control speed as well as stop the vehicle. Practice braking for slow-down and smooth stopping.
⚠ Never operate the acceleration when the wheels are off the ground of the vehicle is in an upside down position.
⚠ Make sure the “ON/OFF” switch is “OFF” and the Emergency Power Shut-Off button is pushed down when the vehicle is not in use.

Tire Care Warnings
⚠ Tire inflation must be done by an adult only. Tires should be inflated with a standard bicycle type pump.
⚠ Before inflating any tire, make sure the ON/OFF switch is in the OFF position and the Emergency Power Shut-Off button is pushed down.
⚠ Inspect tires regularly.
⚠ When the tire tread is worn down to the point where the grooves are no longer visible, the tires are no longer safe for use.
⚠ To extend useable life of the E-Racer, the left and right wheels are interchangeable. However, the front wheels are NOT interchangeable with the rear wheels. If the wheels need to be rotated, disconnect the battery before removing the tires. Detailed steps for rotating the tires are given in the Maintenance section of this document.
Parts and Accessories

- Front grille

- Front left side pod

- Front right side pod

- Rear cover

- Chain cover

- Steering wheel assembly

- Battery clamp plate

- Roll cage
• Rear crash bumper

• Front wheel assembly

• Rear wheel assembly

• Aluminum rim

• Safety flag

• Electronic control module

• Emergency Power Cut-Off button
• DC Motor
• 36 volt battery charger
• 36 volt battery
• 36 volt battery circuit breaker
• 36 volt battery charging port
• 12 volt battery charger
• 12 volt battery
• 12 volt battery circuit breaker
• 12 volt battery charging port
• Device chain

• Seat belt

• Disc brake assembly

• Front and rear shock absorbers

• Steering assembly

• Braking assembly

• Control boxes

• Joystick

• “ACC/BRK” switch
• “ON/OFF” switch

• Mode Select switch

• “FWD/REV” switch

• “TRAINING/NORMAL” switch

• Seat assembly

• Neck brace

• Adjustable Positions for Steering Console
**Features**

- Joystick and steering wheel modes

  *Steering wheel at the center of the go-kart.*

  *Joystick on the right side of the go-kart.*

  *Mode select switch at the rear of the vehicle.*

- Variable acceleration, braking and steering
  - Not all-or-nothing controls
  - Allows for finer control of the go-kart

- Five-point restraint system
- Supportive seat

*Five-point restraint.*

*More cushioned seat used, side supports added for user’s comfort.*
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1. Introduction

1.1. General Overview

1.1.1. Steering System

The steering system is comprised of a linear actuator and linear position transducer at the front of the E-Racer. This can be seen in Fig. 1 below.

![Figure 1: Steering system. Linear actuator and linear position transducer.](image)

1.1.2. Steering Wheel

The steering wheel is used to control the E-Racer when the go-kart is in steering wheel mode. This is seen in Fig. 2 below.

![Figure 2: Steering wheel with the on/off switch, acceleration/braking control for when in steering wheel mode, training/normal switch, and forward/reverse switch.](image)

1.1.3. Steering Control Box

The steering control box contains a potentiometer which determines the angle that
the steering wheel is turned. The steering control box is mounted on the steering shaft. This can be seen in Figure 3 below.

![Figure 3: Steering control box.](image)

1.1.4. Control Box

The control boxes house the printed circuit board along with the DC motor controller circuit boards, which contains the vital electronic components of the control system. The control box is mounted at the front of the go-kart. These can be seen in Figure 4 below.

![Figure 4: Control boxes.](image)

1.1.5. Seat

The seat used in the E-Racer has cushioning and side supports. The seat is
attached to the frame of the E-Racer on both the under side of the seat and at the rear. The restraint system is also attached to the seat. This can be seen in Figure 5 below.

![Seat](image1)

Figure 5: E-Racer seat.

1.1.6. **Restraint**

The E-Racer has a five-point restraint system, which is attached to the seat and the frame of the go-kart. This can be seen in Figure 6 below.

![Side supports](image2)

Figure 6: Restraint system.

1.1.7. **Foot Straps**

Foot straps were placed near the front of the go-kart to keep the user’s feet in place while riding. This can be seen in Figure 7 below.
1.1.8. Joystick

The joystick is used to control the go-kart when it is in joystick mode. The joystick functions by pushing forward to accelerate, pulling back to brake and moving side to side to steer. The joystick features variable acceleration and braking. This can be seen in Figure 8 below.

Figure 8: Joystick mounted on right side of go-kart.

1.1.9. Brake System

The brake system is composed of several different components, including a linear actuator, a cable joiner, and several brackets. All of these components are mounted onto a plate, which is attached at the rear of the go-kart. This can be seen in Figure 9 below.
1.1.10. Motor

The motor in the E-Racer is a DC brushless motor, which is at the rear of the go-kart. This can be seen in Figure 10 below.

1.1.11. Speed Controller

The speed controller is attached to the motor, battery and control system. It receives a signal from the control system and translates this into a desired speed, which it then drives the motor at. This can be seen in Figure 11 below.
1.1.12. Batteries

The E-Racer has two rechargeable lead-acid batteries at the rear of the go-kart. One is 36 volts, which is used to power the motor, while the other is 12 volts and serves to power the auxiliary electronics for the control system. This can be seen in Figure 12 below.
1.1.13. Circuit Breakers & Charging Ports

The E-Racer has two sets of circuit breakers and charging ports with one set for each of the two batteries. This can be seen in Figure 13 below.

![Circuit breakers and charging ports](image13.jpg)

*Figure 13: Circuit breakers and charging ports: the pair on the left is for the 36 volt battery, while the pair on the right is for the 12 volt battery.*


The emergency power shut off button, located at the rear of the E-Racer, is so that someone outside of the go-kart can stop the E-Racer if needed. This can be seen in Figure 14 below.

![Emergency power shut off button](image14.jpg)

*Figure 14: Emergency power shut off button.*

1.1.15. Tires

There are four tires on the E-Racer, two located at the front, two located at the rear. This can be seen in Figure 15 below.
1.1.16. Front and Rear Shock Absorbers

There are shock absorbers at both the front and rear of the E-Racer. The front shocks are under the floor of the go-kart. The rear shock is behind the seat. This can be seen in Figure 16 below.

1.1.17. Accessories (Grille, Side Pods, Neck Brace, Rear Crash Bumper)

The grille and side pods are for aesthetic purposes. The rear crash bumper provides some protection in the case of a rear collision. The neck brace is optional and can be used if there are concerns of the user looking down while riding. This can be seen in Figure 17 below.
Figure 17: Top left: grille. Top right: front side pod. Lower left: rear side pod. Lower right: rear crash bumper. Bottom center: neck brace.

1.2. Making the E-Racer Operational

1. Connect the battery plugs at the rear of the go-kart to activate the power. This can be seen in Figure 18 below.

Figure 18: One of the battery plugs at the rear of the go-kart.

2. Charge the batteries by plugging the chargers into the ports on the rear of the go-kart. Charge the batteries until they are at full power. [Greater detail given in...
troubleshooting section in the event of difficulties.] This can be seen in Figure 19 below.

![Charging ports for the 12 volt (left) and 36 volt (right) batteries.](image)

*Figure 19: Charging ports for the 12 volt (left) and 36 volt (right) batteries.*

3. Check the tire pressure and treads on the go-kart.
   a. Pressure should be ~18 psi.
   b. The treads should be clearly visible

4. Check that all nuts, bolts and screws are tight, especially those shown below.
   a. Nuts and bolts associated with the seat attachment (on the underside of the go-kart and behind the seat). This can be seen in Figure 20 and Figure 21 below.

![Plate attaching the bottom of the seat to the frame.](image)

*Figure 20: Plate attaching the bottom of the seat to the frame.*

![Attachment of the back of the seat to the frame of the E-Racer.](image)

*Figure 21: Attachment of the back of the seat to the frame of the E-Racer.*

   b. Bolts associated with the braking mechanism. This can be seen in Figure 22 below.
c. Bolts associated with the restraint system.

d. Screws, nuts and bolts associated with the joystick attachment. This can be seen in Figure 23 below.

5. Attach the roll cage at the back of the seat, and secure with safety pins. This can be seen in Figure 24 below.

6. Put the safety flag in the hole between the charging port cover and Emergency Power Shut-Off button. This can be seen in Figure 25 below.
7. Look over the E-Racer to ensure that there are no visible problems with the go-kart.
8. Check that all cables and wires are not frayed, cut or broken.

1.3. Instructions for Use of Device
1. Complete the instructions in the section entitled “Making the E-Racer Operational”.
2. Push down the Emergency Power Shut-Off button before attempting entry into the vehicle. This will prevent accidental acceleration when loading. This can be seen in Figure 26 below.

3. Check to see the “ON/OFF” switch under the steering wheel is in the “OFF” position. This can be seen in Figure 27 below.

4. Remove the pins holding the Steering Console down to the go-kart and raise the console up and toward the front of the go-kart to provide sufficient room to enter the go-kart. This can be seen in Figure 28 below.

Figure 25: Installing the flag at the rear of the go-kart.

Figure 26: Emergency power shut-off button.

Figure 27: On/off switch under the steering wheel.
5. Step in the vehicle and carefully slide down into the seat.
6. Put on the seat belt and adjust until tight but comfortable low around the driver’s waist. This can be seen in Figure 29 below.

Figure 28: Three adjustable locations for the steering console using an easy to insert and remove locking pin on each side.

5. Step in the vehicle and carefully slide down into the seat.
6. Put on the seat belt and adjust until tight but comfortable low around the driver’s waist. This can be seen in Figure 29 below.

Figure 29: Securing the restraint system.

7. Secure the rider’s feet using the foot straps at the front of the go-kart.
8. Lower the steering console down between the driver’s legs and secure the console to the base of the go-kart frame by sliding pins through the appropriate holes on the frame.
9. Have someone outside the E-Racer release the Emergency Power Shut-Off button at the rear by turning clockwise. The button should pop up. This can be seen in Figure 30 below.

Figure 30: Releasing the emergency power shut-off button.

10. Ensure that the forward/reverse, steering wheel/joystick and training/normal switches are in the desired positions.
11. Flip the “ON/OFF” switch to “ON”.

10. Ensure that the forward/reverse, steering wheel/joystick and training/normal switches are in the desired positions.
11. Flip the “ON/OFF” switch to “ON”.

10. Ensure that the forward/reverse, steering wheel/joystick and training/normal switches are in the desired positions.
11. Flip the “ON/OFF” switch to “ON”.
12. If you have selected joystick mode, begin to accelerate the go-kart by gradually pushing the joystick forward. If you have selected steering wheel mode, begin to accelerate the go-kart by gently pushing on the “ACC/BRK” button on the steering wheel in the direction of “ACC”. This can be seen in Figure 31 below.

![Figure 31](image1.jpg)

*Figure 31: Accelerating in joystick (left) and steering wheel (right) modes.*

13. To stop in joystick mode, pull back on the joystick. The harder you pull back, the faster you will stop. To stop in steering wheel mode, push the “ACC/BRK” button in the direction of “BRK”. The harder you press, the faster you will stop. This can be seen in Figure 32 below.

![Figure 32](image2.jpg)

*Figure 32: Braking in joystick (left) and steering wheel (right) modes.*

14. To steer in joystick mode, move the joystick to the right to turn right and to the left to turn left. To steer in steering wheel mode, turn the wheel to the right (to turn right) or to the left (to turn left).

15. If you need to switch to reverse, come to a COMPLETE STOP first. Then change the “FWD/REV” switch to the “REV” position. Wait 3-5 seconds before accelerating again.

16. If you want to switch between training/normal modes, come to a complete stop, and turn the vehicle off by turning the “ON/OFF” switch to the “OFF” position. Then change the “TRAINING/NORMAL” switch to the desired setting. Then turn the “ON/OFF” switch to “ON” and begin accelerating.

17. If you want to switch between joystick/steering wheel modes, come to a complete stop and turn the vehicle off. Then change the “JOYSTICK/WHEEL” switch to the desired setting. Then turn the go-kart back on and continue driving.
2. Maintenance

2.1. Mechanical

2.1.1. Check All Nuts, Bolts and Screws

1. Nuts and bolts associated with the seat attachment (on the underside of the go-kart and behind the seat). This can be seen in Figure 33 and Figure 34 below.

![Figure 33: Plate attaching the bottom of the seat to the frame.](image)

2. Bolts associated with the braking mechanism. This can be seen in Figure 35 below.

![Figure 35: Mounting plate for the brake system at the rear of the go-kart.](image)

3. Bolts associated with the restraint system.

4. Screws, nuts and bolts associated with the joystick attachment. This can be seen in Figure 36 below.
The E-Racer is designed such that only the left and right wheels are interchangeable, while the front and rear wheels are not. Wheel rotation is done to extend the usable life of the tires. The batteries should always be disconnected before the tires are removed.

2.1.2.1. Front Wheels Rotation

1. Using a 7/8 inch adjustable wrench, loosen the nut in the center of the wheel hub on both of the front wheels by turning counterclockwise. This can be seen in Figure 37 below.

2. Carefully lift the front end of the vehicle by holding the front bumper and sliding a block, chair, or other item under the vehicle so the wheels are off the ground. This can be seen in Figure 38 below.
3. Remove the old wheel from the axle and swap the front wheels.
4. Carefully replace the vehicle back onto the ground in reverse order and make sure to tighten the wheel nuts.

### 2.1.2.2. Rear Wheels Rotation

1. Using a 7/8 inch adjustable wrench, loosen the nut in the center of the wheel hub on both the rear wheels. This is seen in Figure 39 below.

2. Use an Allen wrench to remove the six bolts on the hub of the wheel. This is seen in Figure 40 below.
3. Carefully lift the rear end of the vehicle by holding the rear bumper and sliding a block, chair, or other item under the vehicle so the wheels are off the ground. This is seen in Figure 41 below.

4. Remove the old wheel from the axle and place it aside.

5. Swap the left and right wheel and tighten the center nut and six bolts on the hub.

If any of the four tires should become so worn that the tread is no longer visible, or if there are any defects in any of the tires, stop using the E-Racer immediately and replace the tire.

2.1.3. Chain Adjustment

If the chain becomes loose, or pops off, this can lead to the motor not running correctly or the E-Racer making odd noises. This can be fixed by the instructions given in the trouble shooting section of this document. This is seen in Figure 42 below.
2.1.4. Brake Adjustment

If the brake is too tight or too loose, this can lead to problems in controlling the E-Racer. Also, if the E-Racer suddenly stops or runs sluggishly, this can be indicative of the brake cables being too tight or too loose. The brakes can be adjusted by following the instructions given in the trouble shooting section of this document. This is seen in Figure 43 below.
2.2. Environmental

2.2.1. 36V Battery Replacement

The batteries are only designed to last 1 to 2 years, even under perfect conditions. If the user wishes to use the E-Racer after the batteries can no longer hold charge, they will have to purchase replacement batteries. The user should only use replacement batteries of the same type as those in the E-Racer.

1. Check to make sure that the ON/OFF switch under the steering wheel is in the OFF position. This is seen in Figure 44 below.

![Figure 44: On/off switch](image)

2. Push down the Emergency Power Shut-Off button at the rear of the E-Racer. This is seen in Figure 45 below.

![Figure 45: Emergency power shut-off button.](image)

3. Remove the battery cover. This is seen in Figure 46 below.
4. Disconnect the battery connector. This is seen in figure 47 below.

5. Carefully lift the battery out of the rear of the vehicle. NOTE: The battery is very heavy. Use caution to avoid injury.

6. Remove the battery and replace it with the new battery.

7. Reconnect the plug and position the wires inside properly.

8. Replace the battery cover and tighten it.

9. Charge the new battery a minimum of 12 hours the first time before attempting to ride again.
2.2.2. Battery Disposal

- Always return your unwanted batteries to the local federal or state approved lead-acid recycling center or an authorized automobile battery seller.
- Always recycle unwanted or used batters in a safe and environmentally friendly manner.
- Do not throw the batteries into your regular household trash.

*Do not throw batteries away with normal trash.*

- Law prohibits the disposal of lead-acid batteries by incineration, placing them in a landfill, or mixing them with other rubbish.
- Never expose the batteries to fire. The batteries may leak or explode.

*Do not incinerate batteries.*

2.3. Electrical

The electrical system should be periodically inspected to ensure the integrity of all exposed electrical components. Wires running under the kart are protected by a black plastic cover. The wires should always remain in this split loom tubing at all times. If a tear ever occurs, or if wires begin to fall out of the tubing, replace the tubing immediately. This tubing can be found at Radio Shack or any other electronics store. While replacing the tubing, be sure to inspect the wires. Make sure all wire insulation is intact and no wires are broken. If there is any damage to any wires, email Kevin Arpin at Kevin.arpin@gmail.com.
Similarly, the user should regularly inspect the wires in the back of the go kart. To inspect these wires, remove the back plastic cover. Once the cover is off, inspect all wires going to and from the silver speed controller and the batteries. This is seen below in Figure 48. If any problems exist, email Kevin Arpin.

![Figure 48: Motor Controller and battery connections.](image)

There are two boxes containing electrical equipment in the front of the go kart. These boxes are sealed to be water tight. If any damage occurs to these boxes, contact Kevin Arpin for a replacement.

If after a year of use, you are noticing that the batteries can not hold a decent charge for regular operations, they may need to be replaced. Consult with Kevin Arpin to identify which battery needs to be replaced. New batteries can be found on monsterscooterparts.com.
3. Technical Description

3.1. Switches

3.1.1. On/Off

The on/off switch, located below the steering wheel, is a simple electronic switch which completes a circuit when in the “on” position. There is a cover over the switch which can easily be pushed down to turn off the E-Racer. This is seen in Figure 49 below.

![Figure 49: On/Off switch.](image)

3.1.2. Wheel/Joystick

The steering wheel/joystick mode select switch is located at the rear of the E-Racer and allows for the user to decide (before turning on the E-Racer) whether they want to use steering wheel or joystick mode. This switch, depending on its position, will complete one of two circuits, either that applying to the steering wheel, or that applying to the joystick. This is seen in Figure 50 below.

![Figure 50: Wheel/joystick select switch.](image)

3.1.3. Training/Normal

The training/normal switch, located on the steering wheel, allows the user to switch between training mode, in which the E-Racer travels a bit slower, and normal mode. Similar to the mode select switch above, the
training/normal switch completes one of two circuits, depending on which way it is pressed. This is seen in Figure 51 below.

![Training/normal switch](image)

*Figure 51: Training/normal switch.*

### 3.1.4. Forward/Reverse

The forward/reverse switch, also located on the steering wheel, allows the user to go in either forward or reverse. Again, the forward/reverse switch completes one of two circuits, depending on its position. This is seen in Figure 52 below.

![Forward/Reverse switch](image)

*Figure 52: Forward/Reverse switch.*

### 3.1.5. Acceleration/Braking

The acceleration/braking switch is mounted on a metal plate on the right hand side of the steering wheel and is responsible for the control of the braking and acceleration systems while the vehicle is in steering wheel mode. This switch was purchased from a boating parts vendor and was manufactured to be water and dust resistant. Pressing and holding the top of the switch activates the acceleration of the vehicle while pressing and holding the bottom of the switch activates the braking of the vehicle. When either portion of the switch is released the switch will return to the center position where neither braking nor acceleration are activated. This switch eliminates the possibility of activating the acceleration system while the brakes on the vehicle are depressed. This is seen in Figure 53 below.
3.2. Steering System

3.2.1. Actuator

The steering system is mechanical, but due to the fact that the signals from both the steering wheel and the joystick are electrical, a linear actuator is used to move the steering rack from left to right depending on the voltage that is sent to it. Linear actuators function by converting rotational motion to linear motion, which pushes the moving end of the actuator in and out. The rotational motion comes from a small motor on the actuator. This is seen in Figure 54 below.

![Steering Actuator](image)

3.2.2. Position Transducer

The linear position transducer is connected to the actuator and determines how far the actuator is moving, thus, how far the wheels are turning. This information is important in determining when the wheels should stop moving and when more wheel movement is required. The linear position transducer used in the E-Racer is manufactured by Novotechnik of Southborough, MA. This device is able to move through a range of 75 mm and functions electrically in the same manner as a rotary potentiometer. This is seen in Figure 55 below.
When the linear position transducer moves through its range of motion, the output voltage varies accordingly. The image below in Figure 56 shows the electrical schematic of this component, where movement of the device yields a change of voltage at pin 4.

The linear position transducer is mounted parallel to the stroke of the linear actuator. This mounting location allows the linear position transducer to track the location of the linear actuator for control purposes.

3.2.3. Steering Wheel

The steering wheel controls the location of the front wheels when the E-Racer is in steering wheel mode by turning it to either side from the center position. The steering wheel has several switches on it, including acceleration/braking for steering mode, forward/reverse and training/normal. This is seen below in Figure 57.
3.2.4. Potentiometer Box

This box houses the potentiometer and a connector between the potentiometer shaft and the steering column. This potentiometer monitors how much the steering wheel is turned and converts this measurement to a voltage which is then sent to the control box and finally to the steering actuator to turn the wheels a desired direction. This is seen below in Figure 58.

3.2.5. Control Boxes

The control boxes house the printed circuit board and two speed controllers. They are mounted on the floor of the E-Racer, near the very front. This is seen below in Figure 59.
3.3. Braking System

3.3.1. Actuator
The braking actuator works like the steering actuator. It receives a signal from the control box and responds by moving linearly. This is seen below in Figure 60.

3.3.2. Cables
The brake cables start at the left and right disc brakes and end in the cable joiner on the actuator. In between the brakes and the actuator, they are bundled at the rear of the go-kart. This is seen below in Figure 61.
3.3.3. Brackets

Several brackets were used to secure the actuator to the plate and secure the brake cables to the actuator. One was used to secure the fixed end of the bracket, shown in the first picture below. In the middle picture is a piece that is used to join the two cables and attach them to the moving end of the actuator. This is done to ensure that the same amount of force is applied to each of the brake wires and thus each of the left and right brakes are equally depressed. In the lower picture is the total brake set-up, which includes a bracket to secure the shaft of the actuator, and shows how the brake cables are attached to the actuator. This image also shows the bracket used to secure the sheathing to the plate. It is important that only the brake wires move when the actuator pulls; the sheathing must remain stationary for the brakes to be depressed. These are seen below in Figures 62, 63 and 64.

Figure 62: Bracket for the fixed end of the actuator.
3.3.4. Disc Brakes

The cables shown in the actuator above are attached to the disc brakes as shown in the Figure 65 below. When the actuator retracts, the cables are pulled, which depresses the brake pads against the rotor as shown in Figure 66 below.
3.4 Acceleration System

3.4.1. Motor

The motor on the E-Racer is an 800 Watt DC brushless motor. This can be seen in Figure 67 below.

A DC brushless motor works by having a large magnet around a coil. When electric current passes through the coil, which is in the magnetic field, the magnetic force produces a torque, which turns the motor. The four images below (Figure 68, 69, 70 and 71) explain the physics behind a DC motor.
Figure 68: Force in DC motor.

Figure 69: Magnetic field in DC motor.
3.4.2. Speed Controller

In Figure 72 below, the speed controller on the go-kart is shown. The speed controller has several outputs, which connect to the motor, the battery, the emergency stop, as well as other things. The speed controller takes a signal representing the demanded speed, and drives the motor at that speed. Figure 73 below shows a schematic of the motor controller. Figure 74 below shows a block diagram of the motor controller.
Figure 72: Speed controller on the go-kart.

Figure 73: Speed controller connections.
3.5. Power Delivery System

3.5.1. Batteries and Chargers

Below are the batteries on the E-Racer and the chargers associated with each battery. The top battery is the 12 volt battery which powers the auxiliary electronics on the go-kart. The bottom battery is the 36 volt battery powering the DC brushless motor. Both batteries are rechargeable lead-acid batteries. This can be seen in Figures 75 and 76 below.
The 12 volt battery, circuit breaker, and charging plug are all shown on the image below. Each of these components was purchased and installed with the goal to mimic the existing 36 volt battery, circuit breaker, and charging plug that came with the go-kart to power the electric motor. This helps to prevent user error, damage to electrical components, excessive steps for the user, and unnecessary training to charge both batteries on the go-kart.

The 12 volt battery is mounted in a similar manner to the 36 volt battery below it. A ¼ inch thick aluminum base plate rests between the two batteries. This serves as a base to mount pieces on each side of the 12 volt battery to keep it from sliding in any direction, a replacement for the metal bar that ran across the top of the 36 volt battery and bolted in on either side to hold the battery down, and also as a way to actually secure the 12 volt battery and all the components used to keep it from moving to the go-kart. The base plate has two identically positioned holes as the metal bar that previously ran across the 36 volt battery, that line up with threaded holes on the frame of the go-kart. The same bolts used to mount the metal bar will be used to hold the base plate securely to the go-kart frame. Two 1.5 inch long pieces of L-shaped (1” x 1”) aluminum are screwed into the base plate on opposite sides of the 12 volt battery to prevent movement in two different directions. The charging plug, circuit breaker, and Steering Wheel vs. Joystick mode switch are all mounted on a piece of ½ inch thick Lexan. The piece of Lexan also acts as a cover over the 12 volt battery to hold it down on the go-kart and two 4.5 inch long by 3/8 inch diameter bolts with a 24 thread count are used to secure the piece of Lexan to the base plate and also are positioned on the two remaining sides of the battery without the L-shaped aluminum to prevent the battery from moving in either of those directions.

The small black plastic box, shown in the image below under the clear Lexan 12 volt battery cover, contains all the wiring for the 12 volt charger, 12 volt battery, the circuit breaker, and also acts as a protective casing around the wiring connected to the Steering Wheel vs. Joystick mode switch. A 12V DPDT relay is used to separate the 12 volt battery wiring to the electronics on the go-kart and connect the wiring between the charging plug and the battery once the 12 volt charger has been plugged into the wall and the charging plug on the go-kart. A diagram describing the wiring to the relay is shown.
The 12 volt charger outputs 12 volts and .4 amps, which is wired to the normally open side of the relay and also to the center position where the electromagnet is located. When the 12 volt and .4 amp signal is sent to the electromagnet, a magnetic field is produced inside the relay. This causes metal armatures to move between a normally closed position to a normally open position and basically switch the relay wiring from its normally closed position, where current flows from the battery to the electrical components on the go-kart to the normally open position, where current flows from the charger to the battery. Once the charger is disconnected from the go-kart, the magnetic field is gone and the armatures return to their normally closed position. A diode and relay were added in series to the positive wire coming from the charging plug, after the wires were split to send a signal to the electromagnet and also one to the normally closed portion of the relay, and before the relay. The diode prevents current from back flowing from the battery along the wiring to the charging plug, which would keep the relay in a normally open position even after the charger is removed, because the battery would then power the electromagnet. The 27KΩ resistor is used to prevent the diode from overheating.

The circuit breaker is wired in series with the positive wire traveling from the battery to the relay. With the circuit breaker located directly after the battery before the relay, all the electronics on the go-kart and the 12 volt wall charging unit are all protected from any problems that could ever occur that would pull or send more than 15 amps from the battery or to the battery. This can be seen in Figure 77 below. A diagram of a lead acid battery is seen in Figure 78 below.

Figure 77: The batteries located at the rear of the go-kart.
3.5.2 Circuit Breaker

There are two circuit breakers at the rear of the go-kart, one corresponding to each of the two batteries. The circuit breaker on the left in Figure 79 below is for the 12 volt battery, while that on the right is for the 36 volt battery.

The circuit breakers will shut down the electrical power if it detects too much electrical current is being drawn from the components in series with it and the battery. This protects the electrical components from extreme abuse. The circuit breakers will disconnect the power if the vehicle is going up a steep hill, has too heavy a load, or the wheels are blocked.
The circuit breaker acts as a safety device in the same way as a fuse. It disconnects the supply if too large a current flows. When the live wire carries the usual operating current the electromagnet is not strong enough to separate the contacts. If something goes wrong with the appliance and a large current flows the electromagnet will pull hard enough to separate the contacts and break the circuit. The spring then keeps the contacts apart. After the fault is repaired, the contacts can then be pushed back together by pressing a button on the outside of the circuit breaker box. Figure 80 below shows a schematic of a circuit breaker.

![Figure 80: Schematic showing a circuit breaker.](image)

### 3.5.3 Charging Port

There are two charging ports at the rear of the go-kart. In the port is a small ridge (more easily seen on the charging port for the 12 volt battery). This ridge matches up with a ridge on the battery charger cable. To charge the battery, these ridges must be matched up. Figure 81 shows both charging ports.

![Figure 81: Charging ports for the 12 volt battery (left) and 36 volt battery (right).](image)
3.5.4. Emergency Power Shut Off Button

The emergency power shut off button at the rear of the E-Racer, used to stop the E-Racer by someone outside of the go-kart in case of emergency, works by either breaking a circuit (when depressed) or completing a circuit (when not depressed). When this circuit is broken, the go-kart stops. This can be seen in Figure 82 below.

![Emergency power shut off button](image)

*Figure 82: Emergency power shut off button.*

3.6. Joystick

The joystick is used to control the go-kart when the E-Racer is in joystick mode. The joystick receives a signal between +5 and -5 volts. The joystick works by accelerating when it is pushed forward, braking when it is pulled back, and steering when it is pushed to the left or right. Since the joystick can receive a signal between +5 volts and -5 volts, it offers variable acceleration and braking so the rider can control how fast he accelerates or brakes. This can be seen in Figure 83 below.

![Joystick on the right side of the go-kart](image)

*Figure 83: Joystick on the right side of the go-kart.*
3.7. Seating and Restraint System

3.7.1. Seat

The seat on the E-Racer has ample cushioning and also has side supports on it to increase lateral support. The seat is also the point of connection for the restraint system. This can be seen in Figure 84 below.

![E-Racer seat and side supports.](image)

*Figure 84: E-Racer seat and side supports.*

3.7.2. Restraint

Most go-karts have safety belts similar to those in cars, with three points of attachment. However, the E-Racer has a restraint system with five points of attachment for added safety. The five attachment points are: over the left shoulder, over the right shoulder, at the right hip, at the left hip, and between the legs. This can be seen in Figure 85 below.
3.7.3. Foot Straps

The E-Racer has two foot straps near the front of the vehicle. These straps are used to ensure that the driver’s feet remain stationary during riding. Since the user does not need his feet to control the go-kart, it is important that they not get in the way of his driving. This can be seen in Figure 86 below.

3.7.4. Neck Brace

The neck brace prevents excessive forward flexion of the neck. It is optional and is easily removed. The neck brace will help prevent the rider’s head from dropping too far when he is driving. This neck brace is the same type that dirt bike, four-wheeler, etc. riders wear to help stabilize their neck from constantly bending in all different directions. This is a result of driving on rugged, uneven terrain and having a helmet on their head that makes their head top heavy and more likely to bounce around. Comparing the maximum shocks that the E-Racer will experience to the shocks that off road vehicles encounter, we feel confident that this brace will provide sufficient support for the client. The neck brace is shown in Figure 87 below.
3.8. Miscellaneous Mechanical Components

3.8.1. Tires

The E-Racer has four tires, each of which has a bolt in the center and six bolts around the hubcap. The tires should have a pressure of 18 psi. This can be seen in Figure 88 below.

3.8.2. Front and Rear Shock Absorbers

The E-Racer has shock absorbers at the front and the rear of the vehicle. The shock absorbers serve to improve the rider’s comfort by absorbing some of the shock when the E-Racer goes over large bumps, and also serve to extend the life of the go-kart by protecting some parts from shocks. This can be seen in Figure 89 below.
Shock absorbers work by having a moving piston rod which reacts to shock by moving up and down in an oil filled cylinder shaped cavity. Therefore, the piston absorbs much of the shock, thereby preventing the E-Racer from experiencing as much shock from driving over bumpy and uneven surfaces. The black spring surrounding the piston assembly that is shown on the rear shock in the image above also is on the front pistons. The black rubber casing surrounding the springs on the front shock absorbers acts as a barrier to protect the piston assembly and spring from rocks, dust, water, and other objects that could come in contact with these shock absorbers. The rear shock absorber is mounted above the base frame and behind the seat, so it is protected from foreign objects.

The spring adds more rigidity, strength, and reactive forces to return the shock absorber to its original position following compression. This model of a shock absorber is identical to the shock absorbers on most cars and the front of trucks. The piston assembly along with the spring compress and return back to original positions very smoothly along with providing a relatively smooth ride to the driver. Figure 90 shows a schematic of shock absorbers.

Note: Having the least amount of vibrations to the go-kart during travel is optimal to increase the life and prevent damage to all the added electrical components.
3.8.3. Front Grille

The front grille is primarily for aesthetic purposes. It serves to cover up part of the front of the E-Racer, and look more like a “rugged” vehicle. This can be seen in Figure 91 below.

Figure 91: E-Racer front grille.

3.8.4. Side Pods

There are four side pods: two front and two rear. Like the front grille, they are primarily for aesthetic purposes, but can also serve to protect the rider from dirt and mud that may be kicked up by the tires. This can be seen in Figure 92 below.
Figure 92: Front (left) and rear (right) side pods.
4. **Trouble Shooting**

4.1. **Table of Possible Problems and Solutions**

<table>
<thead>
<tr>
<th>Problem</th>
<th>Probable Cause</th>
<th>Solution</th>
</tr>
</thead>
<tbody>
<tr>
<td>The E-Racer does not run.</td>
<td>1. The ON/OFF switch is in the OFF position. 2. One or both of the circuit breakers “POPS-UP”. 3. The batteries are low. 4. The batteries are dead. 5. The charger is not working. 6. The wires are loose.</td>
<td>1. The ON/OFF switch is in the OFF position. 2. Wait 10 seconds for the circuit breaker to cool down and reset the switch. (Further instructions below) 3. Charge the batteries. 4. If the batteries are old or have been abused, they will need to be replaced. 5. Check to see if the wall socket is in the “ON” position and the red light illuminates on the charger. 6. Check all connectors.</td>
</tr>
<tr>
<td>The E-Racer was running but it suddenly stopped.</td>
<td>1. Low battery voltage. 2. Circuit breaker has “popped up”. 3. Loose connectors. 4. The brake is not properly adjusted.</td>
<td>1. The electronic circuit will automatically detect when the voltage is too low for the vehicle to run. Recharge the batteries. 2. Wait 10 seconds for circuit breaker to cool down and reset the breaker. 3. Check all electrical connections. 4. Adjust the brake as described below.</td>
</tr>
<tr>
<td>The E-Racer is in the “ON” mode but when I press the throttle, the back wheel won’t turn.</td>
<td>1. The charger is still connected. 2. The brake is too tight. 3. The batteries are low.</td>
<td>1. Disconnect the charger. 2. Adjust the brake as described below to loosen the brake. 3. Charge the batteries for at least 1 hour and check again.</td>
</tr>
<tr>
<td>The brake is too tight or too loose.</td>
<td>The brake cable is out of adjustment.</td>
<td>Adjust the brake cable to the proper tension as described below.</td>
</tr>
<tr>
<td>Motor will run but the vehicle does not move.</td>
<td>The chain has come off.</td>
<td>Replace the chain onto the gears (see below).</td>
</tr>
<tr>
<td>The E-Racer is noisy or makes a “popping” sound</td>
<td>The drive chain is too loose.</td>
<td>Adjust the drive chain at the back wheel (see below).</td>
</tr>
<tr>
<td>Issue</td>
<td>Possible Solutions</td>
<td>Notes</td>
</tr>
<tr>
<td>----------------------------------------------------------------------</td>
<td>-------------------------------------------------------------------------------------</td>
<td>----------------------------------------------------------------------</td>
</tr>
<tr>
<td>The charger gets warm when I recharge the battery.</td>
<td>This is normal.</td>
<td>No action required.</td>
</tr>
<tr>
<td>The batteries only last about 40 minutes when I ride the vehicle.</td>
<td>This is normal.</td>
<td>No action required. Recharge the batteries normally. Note: Heavy use of the batteries will result in even less operating time.</td>
</tr>
<tr>
<td>The batteries make a slight sizzling or gurgling sound when they recharge.</td>
<td>This is normal.</td>
<td>No action required.</td>
</tr>
<tr>
<td>When I try to recharge the battery, the LED does not light up.</td>
<td>Electricity is not going to the charger.</td>
<td>There is no problem with the battery. Try another outlet.</td>
</tr>
<tr>
<td>The vehicle runs for less than 30 minutes when I ride.</td>
<td>1. The batteries are undercharged.</td>
<td>1. The first time you charge the batteries, make sure they were charged for 12 hours. Check to see that the green light is on before attempting a run.</td>
</tr>
<tr>
<td></td>
<td>2. The batteries are old.</td>
<td>2. If the batteries are old, it may need replacing. Note: Battery life will vary depending on the terrain, battery condition, driving style, and weight of the rider.</td>
</tr>
<tr>
<td>The RED LED light never goes off.</td>
<td>1. The batteries are not being properly charged.</td>
<td>1. Make sure all connectors are clean. Repair if necessary and ensure the plug is properly placed in the vehicle’s receptacle.</td>
</tr>
<tr>
<td></td>
<td>2. The battery is too old or has been abused.</td>
<td>2. Replace the batteries.</td>
</tr>
<tr>
<td>The E-Racer runs sluggishly.</td>
<td>1. The batteries are undercharged.</td>
<td>1. Charge the batteries.</td>
</tr>
<tr>
<td></td>
<td>2. The batteries are old.</td>
<td>2. Even under perfect conditions, the batteries will only last about 1-2 years. If your batteries are old or have been abused or left uncharged for a long period of time, they may need replacing.</td>
</tr>
<tr>
<td></td>
<td>3. The conditions and surface you are on are too extreme.</td>
<td>3. Try to run on smooth, flat surfaces only.</td>
</tr>
<tr>
<td></td>
<td>4. The vehicle is overloaded.</td>
<td>4. Make sure the rider does not exceed the 200 lbs</td>
</tr>
<tr>
<td></td>
<td>5. Brake is dragging.</td>
<td></td>
</tr>
</tbody>
</table>
The red LED light over the ON/OFF switch is on. The battery is low or there is an overloading current. Follow instructions below called “Low Battery and Override Protection LED”

The E-Racer is slower or does not handle as well. The tires may be low on air. 1. Inspect the tires for defects. 2. If there seem to be no defects, follow the instructions below for tire inflation.

4.2. Instructions for Replacing the Chain on the Gears

1. Whenever removing the protective chain cover, you must disconnect the batteries first. This will ensure no possibility of the motor or chain running accidentally while working in this area. This can be seen in Figure 93 below.

*Figure 93: One of the battery connections at the rear of the E-Racer.*
2. Remove the rear side pods using a Philips head screwdriver prior to removing the rear body cover. This can be seen in Figure 94 below.

![Figure 94: Rear side pod.](image1)

3. Remove the four bolts holding down the rear cover.
4. Lift up the rear cover.
5. Remove the 4 supporting nuts attached between the chain cover and the frame. The chain cover can be seen in Figure 95 below.

![Figure 95: Rear right chain.](image2)

6. Use a Philips head screwdriver to remove the screws and separate the upper and lower chain cover pieces.
7. Push and release the clips on the chain cover and remove the chain cover from the vehicle.
8. Place the chain over the MOTOR gear first. Use your fingers to keep some tension on it.
9. Place the chain on the top of the rear wheel gear about half way around. The chain and gear can be seen in Figure 96 below.
10. Carefully rotate the wheel so that the entire chain pops into gear.
11. Replace the chain covers in reverse order.
12. Replace the supporting screws holding the chain cover to the frame in reverse order.
13. Reconnect the battery cable.
14. Replace the rear cover, battery cover and side pods in reverse order and ride as normal.

4.3. Instructions for Adjusting the Drive Chain

1. Disconnect the batteries. This can be seen in Figure 97 below.

2. Remove the rear side pods prior to removing the rear body cover. This can be seen in Figure 98 below.
3. Remove the four bolts holding down the rear cover. This can be seen in Figure 99 below.

4. Loosen the nuts holding the motor in place.
5. Loosen the two side nuts in front of the motor.
6. Tighten the two center nuts to raise the motor and increase the tension in the chain.
7. When the exact tension is located, retighten the motor and increase the tension in the chain.
8. Replace the rear body cover and side pods by reversing the removal procedures.
9. Reconnect the battery.
4.4. Instructions for Rear Disc Brake Adjustment

1. Disconnect the batteries.
2. Remove the side pods prior to removing the rear body cover. This can be seen in Figure 100 below.

![Figure 100: Rear side pod.](image)

3. Carefully lift the side of the vehicle by holding the side framework and make sure another person is helping to hold the vehicle still and steady.
4. Locate the brake caliper beside the inner hub of the rear wheels. This can be seen in Figure 101 below.

![Figure 101: Brake caliper.](image)

5. Loosen the nut while holding onto the end of the brake cable.
6. When the nut is loosened, squeeze the caliper with the brake cable going through and remove any slack in the brake cable. While removing any slack retighten the loosened nut. This can be seen in Figure 102 below.
7. Place the vehicle on the ground carefully.
8. Check that the brakes are functional.
9. If the brakes are working as desired, replace the side pods in reverse order and ride as normal.

4.5. **Instructions for Charging 36V Battery**

1. Loosen the screw on the protective cover. Lift up the protective cover and expose the charging port.
2. Note that the charging port has a “ridge” inside. Orient the charging plug so that the groove lines up with the ridge. (This is shown below on the 12 V battery charging port, but it is the same on the 36 V battery charging port.) This can be seen in Figure 103 below.
3. Plug the other end into a standard electrical outlet and the RED indicator light will be ON.
4. When properly charging, the ORANGE LED indicator light on the charger will be ON.
5. The GREEN LED indicator light will come on when the battery is fully charged. This can be seen in Figure 104 below.

Figure 104: Battery charger display showing the different LED colors.

6. Unplug from the wall outlet then remove the charging plug and close the protective cover after charging the battery.
Note: It is recommended that you always recharge the battery for a period of 8 hours. However, 80% of the power will be charged into the battery in 4 hours. It is possible to use the E-Racer after this period but the total running time will be reduced.

4.6. Instructions Related to Low Battery and Override Protection LED

1. When the battery is low and almost completely drained of power, the LED indicator will light up and the vehicle will noticeably slow down. This will help you conserve power and prepare to return to your charging location. If you continue to run the vehicle too long, without recharging the battery, your vehicle will automatically shut down. At this point, you MUST recharge your vehicle to get it to run again.

2. If an overloading current in the electronics occurs, the sensor will shut the vehicle down and the LED will flash on the front panel above the “ON/OFF” switch. If this happens, you must wait for the sensor to detect a lower current. This may take at least 5-10 minutes, depending on the electronics. The LED indicator light should be off when the current has resumed normal. To reset, release the accelerator, switch OFF the power “ON/OFF” switch. After the LED has stopped flashing, switch ON the vehicle and resume your ride as normal. When an overloading current occurs causing the vehicle to stop operating and NO LED is lit, refer to the circuit breaker section below.

4.7. Instructions for Tire Inflation

1. NEVER inflate the tires above 20 psi. Recommended tire pressure is 18 psi.
2. Tire inflation should be done by an adult only and tires should be inflated with a standard bicycle pump.
3. Tires must be at the proper pressure to achieve good handling characteristics and control.
4. Over inflation will cause the tires to “bulge” outward. This will cause premature wear.
5. Under inflation will cause the tire to look flat on the ground which will result in poor running speeds and handling.
6. Before inflating any tire, make sure the ON/OFF switch is in the OFF position and the Emergency Power Shut-Off button is pushed down.

4.8. Instructions for the Circuit Breaker

1. THE E-RACER WILL COMPLETELY SHUT DOWN WHEN THE POWER OVERLOADS.
2. First, switch the ON/OFF switch to the OFF position and check to see if the black button in the center of the breaker has “popped up”. To reset the circuit breaker, you must wait about 10 seconds to let it cool down.
3. Press the black button down. If the button stays down, the circuit breaker is reset. If not, wait longer until it has cooled down enough.
4. Once the circuit breaker has been reset, put the switch to the ON position and ride as normal.

4.9. Troubleshooting Electrical System

The electrical system on the go kart has been extensively modified to fit the client’s needs. If the kart stops working, follow these steps:

1. Recharge both batteries
2. If problem occurs after a year of use, the batteries may need to be replaced (consult with Kevin Arpin)
3. Check all wire connections to ensure that no wires have been split or exposed.
4. Consult with Kevin Arpin for more detailed trouble shooting. Have a digital multi meter, the technical diagrams section, and all replacement parts provided by UConn BME ready for trouble shooting.

4.9.1. Technical Diagrams (all required for troubleshooting)

Figure 105: Box layout.
Figure 106: Schematic for the electronics enclosed in Box #1 (see Figure 104 for box identification).
Figure 107: Circuit board layout for the electronics in Box #1.
Figure 108: Schematic for the electronics enclosed in Box #2.
Figure 109: Circuit board layout for the components found in Box #2