

COMPETITION RULES

Revision: H



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2 Enquiries

For any enquiries about this document or technical queries about your vehicle build, please use the enquiry form on the website, which can be found [here](#), or by emailing admin@evolocity.co.nz

Frequently Asked Questions (FAQs) can be found on the website [here](#).

General questions about EVelocity, event dates and support can be sent to the local regional coordinator, whose contact details can be found on the website [here](#).

3 Acronyms

DQ	Disqualification	<i>Vehicle is not allowed to start/finish the event.</i>
DNF	Did Not Finish	<i>Vehicle didn't finish the event.</i>
ECU	EVolocitY Control Unit	<i>The competition power limiter and Efficiency event energy monitor.</i>
BMS	Battery Management System	<i>An electrical system that monitors the health of the vehicle's batteries.</i>
RAMS	Risk Analysis Management System	<i>Health and safety documentation used by NZ schools to manage risks.</i>
STEM	Science, Technology, Engineering, and Math	<i>Term used to group together the distinct but related technical disciplines of science</i>
WOF	Warrant of Fitness	<i>The checklist that all vehicles must pass in order to race at an EVolocitY competition.</i>

4 Rules

4.1 General Rules

GR.1.0 EVelocity concept

EVelocity is a New Zealand school based engineering education programme that facilitates students to design, build, and race single seat electric go-karts and bikes. It exists to provide a platform for students to gain hands-on engineering experience whilst promoting STEM in a supportive, exciting and competitive environment.

GR.2.0 EVelocity competition

EVelocity hosts several regional competitions at the end of each year. This is a celebration of the years' hard work and is the place where teams can put their vehicle to the test, competing against other teams.

On the track, the EVelocity competition tests the vehicles' speed, agility, reliability and energy efficiency in a series of events on a race track. Off the track, the students' understanding of the design, build and testing process are tested in the static events.

GR.3.0 Student eligibility

GR.3.1 Teams must be made up of one to six students.

GR.3.2 Participants must be aged between 10 and 18 years old and residing in New Zealand.

Exemptions can be requested by emailing the local regional coordinator.

GR.4.0 Team teacher

GR.4.1 Each team must assign one teacher, parent, or adult representative. One teacher, parent, or adult may represent multiple teams.

GR.4.2 The teacher/parent/adult is responsible for the RAMS documents for EVelocity events (where required).

GR.5.0 Code of conduct

GR.5.1 All participants must act in accordance with good sporting principles in the spirit of fair competition.

GR.5.2 All participants must follow instructions from EVelocity Officials.

GR.5.3 All officials, participants, parents, mentors, and spectators are expected to treat each other with kindness and respect.

Rules authority

- GR.5.4 EVelocity reserves the right to change the rules as necessary. All rules enquiries will be published for teams to view. EVelocity will make faithful and reasonable attempts to ensure this information is readily available to all teams. Rules enquiries or disputes can be submitted to EVelocity, see Section 2 for details.

GR.6.0 Restriction on vehicle use

- GR.6.1 Vehicles made for the EVelocity competitions must not be used on public roads, cycleways or footpaths.
- GR.6.2 Schools, teams, and participants who are found to have operated their vehicles in an irresponsible manner may be banned from participating in EVelocity events.

4.2 Vehicle Rules

VR.1.0 General Vehicle Rules

- VR.1.1 All vehicles, regardless of class, must comply with all vehicle rules.
- VR.1.2 The majority of a vehicle's design and construction must be done by the team. Commercially available vehicles without significant modifications are not allowed.
- VR.1.3 Vehicles that have competed in previous EVelocity competitions must have undergone substantial changes to be eligible to win points and awards in EVelocity competition. A substantial change would typically constitute a complete redesign and remanufacture of a major subsystem. Please contact Evoloccity if you are intending to enter a vehicle that has previously competed in EVelocity competitions.
- VR.1.4 Vehicles with three or more wheels are considered to be a "Kart". The Kart Class rules therefore apply.
- VR.1.5 Vehicles with two or less wheels are considered to be a "Bike". The Bike Class rules therefore apply.
- VR.1.6 Vehicles must have at least one wheel.
- VR.1.7 Vehicles must be completely powered by electrical power. Solar power and wind power are acceptable. Other options can be considered. Please contact the EVelocity team if this is the case. Pedalling/pushing or combustion engines are not allowed.

VR.2.0 Construction and build quality

- VR.2.1 The chassis must be robust and be constructed using materials and joining techniques which are suitable for racing purposes. This means that the chassis should be strong enough to withstand a crash without harming the driver or others.
- VR.2.2 The entire vehicle should be free of sharp edges and protrusions. Teams may be requested to round or pad edges and protrusions during scrutineering, and should bring the required material with them.
- VR.2.3 All tubing must have the ends plugged.

VR.3.0 Chassis

- VR.3.1 Load bearing joints must be sufficiently strong for racing purposes. Load bearing joints should not pose a risk of coming apart during the EVelocity competition. Load bearing joints should not pose a risk of harm to the driver or others in a crash.
- VR.3.2 Appropriate barriers must be in place to prevent feet or lower limbs escaping and coming into contact with wheels, or going under the vehicle.

- VR.3.3 The vehicle must have a seat that is firmly fixed to the chassis. The seat must be designed such that the driver will remain in contact with it whilst driving.

VR.4.0 Safety cell (kart only)

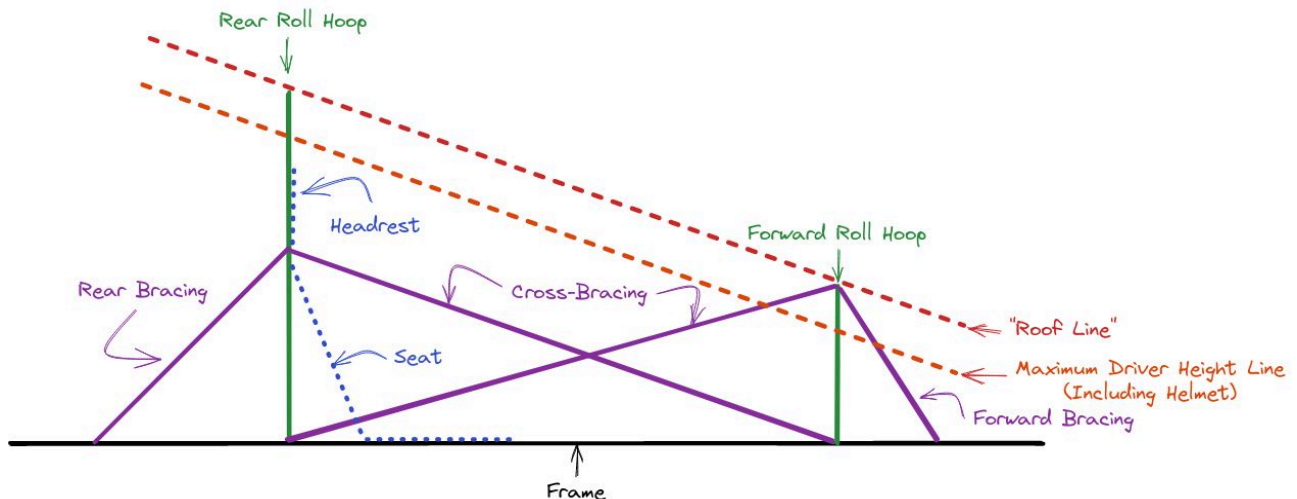


Figure 1: Example vehicle safety cell, including appropriate bracing.

- VR.4.1 A roll hoop, or similar protection (see VR.4.2), must be installed to protect the driver in a roll-over situation. An example of a well-designed safety cell including roll hoops is shown in Figure 1.
- VR.4.2 Approval must be obtained from the EVelocity technical team before the construction and installation of any form of roll-over protection that replaces the roll hoop ("or similar protection" in VR.4.1).
- VR.4.3 The roll hoop must be sufficiently sturdy to withstand impacts and roll-overs while protecting the driver.
- 4.3.1. Materials used should be strong enough to allow the roll hoop to retain its shape in a collision. An example would be a roll hoop made from one piece of metal tubing that is of sufficient size, thickness and material strength. Please contact the EVelocity technical team if teams are unsure on material suitability or roll hoop design
 - 4.3.2. The roll hoop must be attached with sufficient materials and techniques to hold it in place during a collision.
 - 4.3.3. Bracing and triangulation must be used to reinforce the roll hoop from force in every direction. See Figure 1 for an example that shows bracing and triangulation.
- VR.4.4 The roll hoop must be taller than the drivers helmet, such that there is 50 mm of space between the top of the drivers helmet and the ground in a rollover event. See "Roof Line" and "Maximum Driver Height Line" in Figure 1.

Note: Teams are encouraged to design the rollhoop with more than 50 mm space to account for driver growth spurts.

- VR.4.5 A head restraint must be placed behind the driver's helmet to prevent whiplash during impact and support the driver's head during a collision.

VR.5.0 Wheels and tyres

- VR.5.1 All wheel bearings must be smooth and free running.
- VR.5.2 Tyres must not be excessively worn (no canvas showing) and be inflated to an adequate pressure to maintain vehicle control.
- VR.5.3 Wheels/rims must be in good condition (no cracks or bends) and strong enough for the task.

VR.6.0 Steering

- VR.6.1 Fasteners used in critical parts of the steering system must use Nyloc nuts, standard lock nuts, or an equivalent anti-loosening nut.
- VR.6.2 Steering systems must provide adequate stability and control of the vehicle at racing speeds.
- VR.6.3 Steering systems must be safe for the task, and have minimal play in joints.

VR.7.0 Brakes

- VR.7.1 The vehicles must show they have an effective braking system that can achieve one of the below:
- 1) A scrutineer cannot push the vehicle with a driver fully applying the brakes.
 - 2) A scrutineer pushing the vehicle with a driver fully applying the brakes results in the brake system fully locking and transferring sufficient force to the ground.
- VR.7.2 The brakes must be operable without compromising vehicle control. For example, brakes that require the driver to take their hands off the vehicle steering are not allowed.

VR.8.0 Drivetrain

- VR.8.1 A chain guard must be used. The chain guard must **completely** cover all moving parts of the drivetrain including any chains, gears, etc. Wheels, tires, bearings, and smooth axles do not need to be covered. Please contact the EVoloccity technical team if unsure.
- VR.8.2 The drivetrain must be adequately guarded to prevent fingers, hair and clothing of the driver, or anyone working on the vehicle, from becoming trapped.

Cover (completely
cover drivetrain)



Cover (completely
cover drivetrain)



VR.9.0 Stability

- VR.9.1 Vehicles must demonstrate sufficient stability to ensure the vehicle does not tip over during the competition. Vehicle stability is affected by the karts centre of mass, wheel track, wheelbase and steering.

Note: Scrutineers may test stability by attempting to tip the vehicle by pushing on the roll hoop. The scrutineer will observe the force required to lift a wheel, and the angle at which the vehicle is no longer self righting. The test may be repeated at different steering angles. Vehicles should be carefully designed to resist rolling over, as this is a serious safety concern, and vehicles which are determined to be unsafe will not be allowed to race.

- VR.9.2 Vehicles may be disqualified after passing scrutineering if they are found to be unstable or inherently unsafe on track (see Black Flag rules in RE.7.3).

VR.10.0 Electrical and Wiring

- VR.10.1 The fuse must be the first item after the battery system and be located along the positive lead no further than 200 mm from the battery. The fuse must also be easily inspectable.

Standard class vehicles with lead acid batteries should be fused per CR.2.4.

- VR.10.2 The fuse must be sized 2-3 times of the karts nominal current. An example using a sizing factor of 2 is provided below. Teams should be prepared to show their fuse size calculation at pre-scrutineering and competition.

The fuse size should be calculated by:

$$Fuse\ size = 2 \times \left(\frac{Controller\ power\ rating}{Battery\ nominal\ voltage} \right)$$

Example (Standard class, 2x sizing factor used):

$$\begin{aligned} Fuse\ size &= 2 \times \left(\frac{350\ W}{24\ V} \right) \\ &= 29.2\ A \Rightarrow 30\ A\ fuse \end{aligned}$$

The fuse size can be rounded up to the nearest integer fuse size that can be purchased. An example fuse/holder for Standard Class is shown in Figure 2.



Figure 2: Example fuse and holder suitable for the EVoloccity Standard Class.

- VR.10.3 A kill switch must be placed after the fuse. Kill switches must have a DC rating that is greater than or equal to the fuse size. The DC voltage and current rating must be clearly printed on the switch, and must be appropriate for the continuous DC voltage and current of the vehicle. The kill switch must be inspectable by scrutineers on race day. Figure 3 shows an example of a suitable kill switch for the standard class. Teams using a non-standard killswitch must provide a datasheet at scrutineering. Kill switches which only possess an AC rating are not permitted regardless of the AC voltage or current rating. For example, a 1000V 1000A AC rated kill switch with no DC rating will not be allowed.



Figure 3: An example of the type of kill switch recommended by EVoloccity for the standard class.

- VR.10.4 All cables and connectors must be sized such that they can handle a DC current that is greater than or equal to the fuse size. Table 1 can be used for reference - if the desired fuse size is not stated here and it is unclear what size cable to use, EVoloccity can help.

The wires that are attached to the standard class motors provided by EVoloccity are acceptable.

Table 1: Minimum cable sizes that should be used for a given fuse size.

Fuse Size	Minimum Cable Size
25A	14 AWG (2.5mm ²)
35A	12 AWG (4mm ²)
60A	10 AWG (6mm ²)

- VR.10.5 Cables must be routed away from moving parts and be secured to the chassis with cable/zip ties, tape or similar.
- VR.10.6 Batteries must be secured such that it is not possible for them to fall out if the vehicle is flipped.
- VR.10.7 Energy monitor: the required connectors to install the competition energy monitor must be installed - see Section RE.5.2 Energy Monitors for details.
- VR.10.8 A basic single line diagram of the electrical system, showing the minimum required components is shown in Figure 4. The connectors for the energy monitor may have positive and negative leads in the same connector; they are shown separately in the diagram for simplicity.

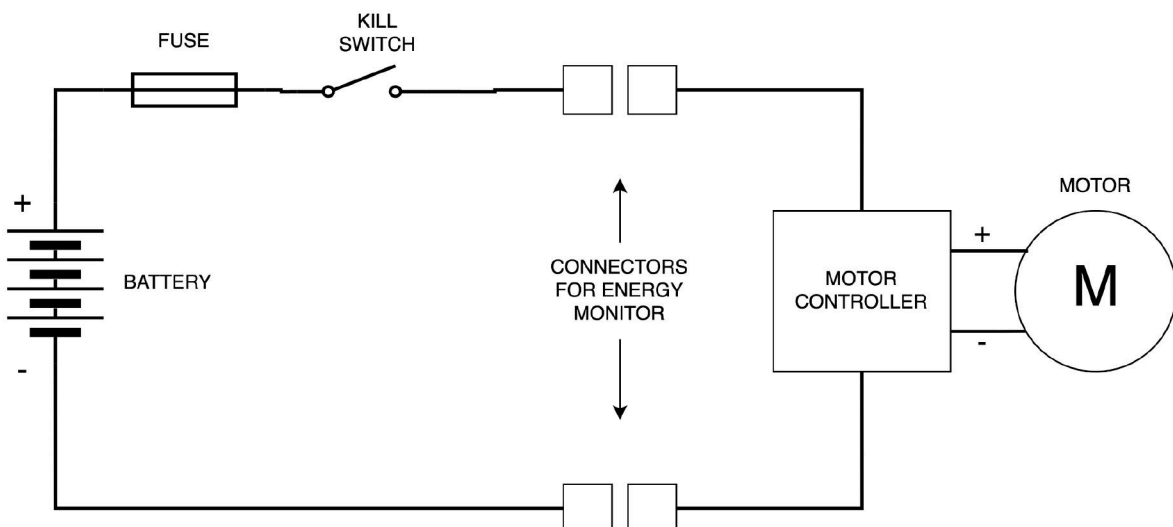


Figure 4: Basic circuit diagram highlighting the minimum required components in an EVelocity vehicle electrical system (not including throttle wiring).

VR.11.0 Lead-Acid Batteries

- VR.11.1 Lead-acid batteries can be used. This battery type is recommended for teams that are new to EVelocity.

VR.12.0 Lithium Batteries

The complexity associated with using lithium batteries is a considerable step-up compared to lead-acid. This is because lithium batteries are at an increased risk of causing a fire and must be handled appropriately.

- VR.12.1 Vehicles containing lithium batteries must comply with all of these rules - others may skip this section.

More than one battery pack is allowed as long as all battery packs are connected to the same bus before the main kill switch and EVelocity Control Unit connector. Each battery must be sufficiently fused, and a main bus fuse must be fitted as required by the fusing requirements. Contact the EVelocity technical team if you are unsure.

- VR.12.2 Regenerative braking

Charging current from regenerative braking must be limited to the rated charging current of the battery.

Regenerative braking must not cause any individual cell to be over-charged or enter an over voltage condition.

Teams using regenerative braking must notify the EVelocity team, as recording regenerative braking data for the efficiency event requires additional hardware.

- VR.12.3 Battery Enclosures

Batteries must be contained in an enclosure to help protect the driver from catastrophic battery failure. The battery enclosure must provide ventilation to prevent pressure build-up, and adequate cooling to keep the battery within the temperature limits.

EVelocity highly recommends that the battery enclosure be made of non-conductive and fire resistant material.

- VR.12.4 Firewall

All vehicles fitted with lithium batteries must have a firewall installed. The firewall is to provide sufficient shielding from a battery fire to allow the driver to exit the vehicle safely. The firewall is to be made from a fire-resistant material such as sheet metal.

- VR.12.5 Chemistry

Acceptable chemistries are: Lithium-ion (Li-ion), Lithium Polymer (LiPo) and Lithium Iron Phosphate (LiFePo4). EVelocity strongly recommends LiFePo4 over the other chemistries as it is the safest (lowest fire risk) to work with.

- VR.12.6 BMS and Voltage Monitoring

- a. The maximum voltage difference between the highest and lowest voltage cells in a pack must not exceed 100 mV (0.1 V) after charging/balancing. This is referred to as the balance threshold.

- b. Either a Battery Management System (BMS) or balance charger must be used. It must be possible to prove to competition scrutineers that the battery cells can be balanced within the required balance threshold with a manufacturer datasheet.
- c. It must not be possible to over-discharge the cells. Vehicles must have either an indicator light to tell the driver that the batteries are low, or have the BMS cut power automatically. If there is only an indicator light, the driver must stop the vehicle immediately if it turns on.

VR.12.7 Voltage Levels

Table 2 shows the per-cell voltage restrictions for lithium batteries. Teams must be able to demonstrate that these levels will not be exceeded.

Table 2: Minimum and maximum allowable lithium cell voltages.

Chemistry	Per Cell Min. Voltage	Per Cell Max.Voltage
Li-ion	3.0 V	4.2 V
LiPo	3.2 V	4.2 V
LiFePo4	2.5 V	3.7 V

VR.12.8 Temperature Monitoring.

- a. Cells must not exceed 60°C.
- b. Vehicles must be able to monitor the temperature of the cells during use.
- c. For teams with a BMS: The BMS must automatically cut power to the motor should cell temperatures exceed 60.
- d. For teams with a balance charger: An indicator light must be installed such that it illuminates should any cell exceed a temperature of 60 C. Drivers must stop and power off the vehicle if they see the indicator light turn on.

VR.13.0 Race number

VR.13.1 Race numbers are required on the front and sides of the vehicle.

VR.13.2 Race numbers must be at least 200 x 150 mm in size, clear and legible from 15 m away.

VR.14.0 Driver

VR.14.1 The driver must wear a full face helmet, sturdy footwear and gloves. They must also wear either a helmet visor, goggles, or safety glasses. Long sleeved clothing or overalls must also be worn; there can be no bare skin exposed.

VR.14.2 Long hair is to be tied up.

4.3 Class Rules

CR.1.0 General Class Rules

- CR.1.1 Vehicles are placed in a class according to the maximum continuous power draw of the motor controller as shown in Table 3. Vehicles must also comply with the class voltage limits.

Table 3: Power and voltage limits allowed for each vehicle class.

Class	Power limit	Maximum Battery Voltage
Standard	350 W	30 V
Open	2000 W	60 V

- CR.1.2 Power drawn from the battery must not exceed the class power limit as defined in 4.3.1 Energy Monitors and Power Limiting.
- CR.1.3 All wiring, components, kill switch and fuse must be appropriately rated for the continuous voltage and currents.
- CR.1.4 The maximum battery voltage refers to the fully charged voltage of the pack.
- CR.1.5 All vehicles must have an energy monitor installed to race at the competitions.

CR.2.0 Standard Class

- CR.2.1 The battery, motor, and motor controller must all be supplied by EVelocity.
- CR.2.2 Modification to the components described in CR.2.1 is not allowed.
- CR.2.3 Teams that received Standard Class kits not supplied with a battery (i.e. the in-hub Standard Class kits, pre-2022) are allowed to supply their own lead-acid battery.
- CR.2.4 The wiring diagram for the Standard Class kits is shown in Figure 5. The connectors for the energy monitor may have positive and negative leads in the same connector; they are shown separately in the diagram for simplicity.

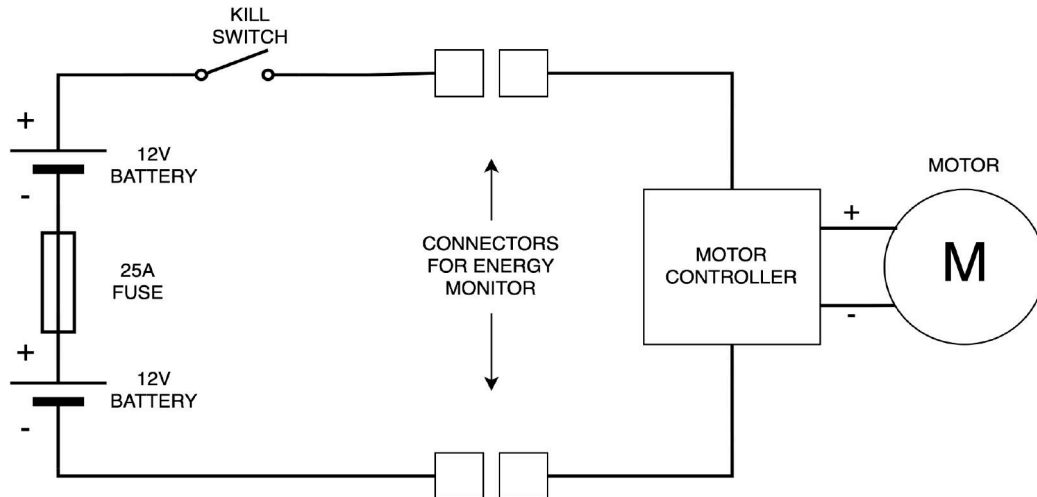


Figure 5: Wiring diagram for the Standard Class kits (not showing signal wiring).

CR.3.0 Open Class

- CR.3.1 Teams must supply their own battery, motor, and motor controller.
- CR.3.2 The location of the fuse, kill switch and energy monitor connectors shall be as shown in Figure 6.

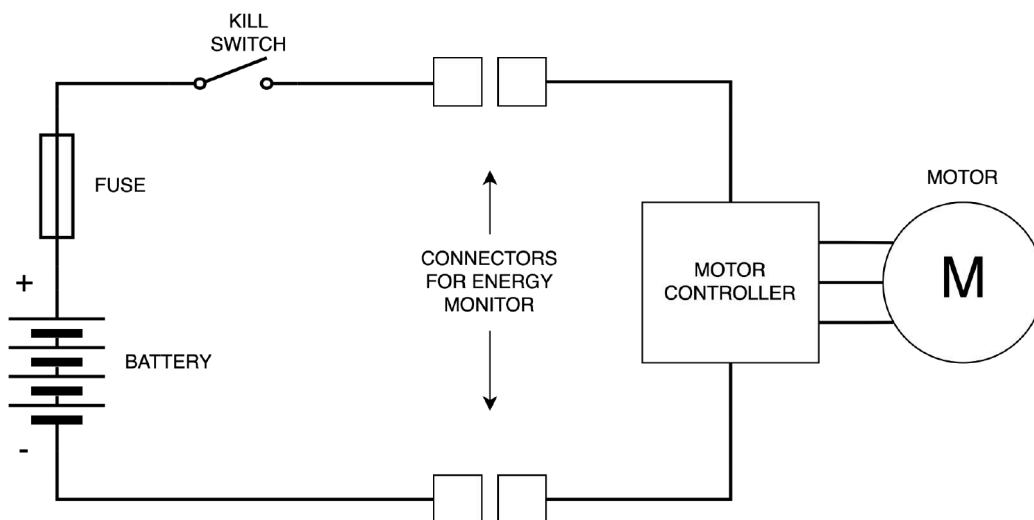


Figure 6: Example wiring diagram for the Open Class (not showing signal wiring).

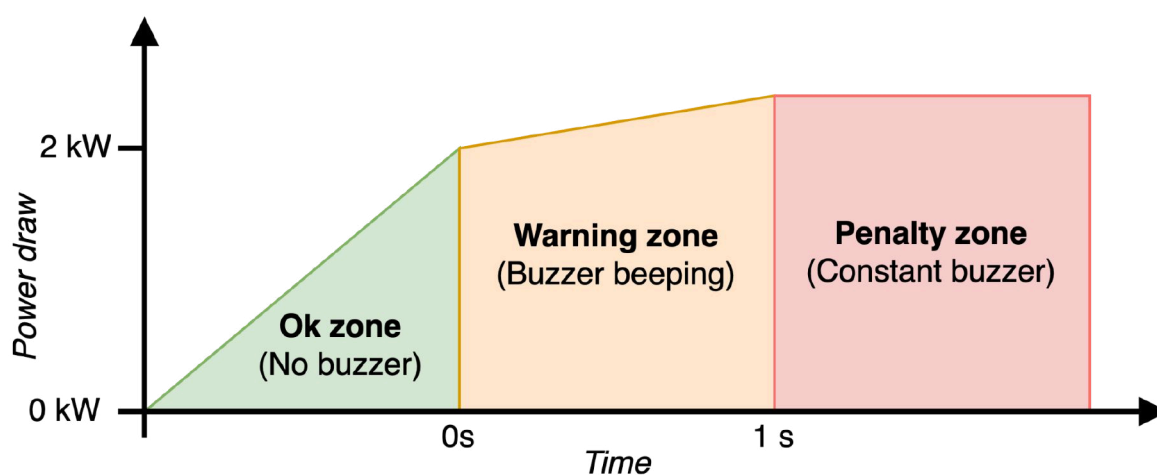
4.3.1 Energy Monitors and Power Limiting

- CR.3.3 Power draw of Open Class vehicles shall be regulated by the EVolocity energy monitor as shown in Table 4.

Each energy monitor has a buzzer to let the driver know that they are exceeding the power limit for their class.

Table 4: Power limit zones, penalty and buzzer description.

Zone	Power draw	Duration	Penalty	Buzzer description
Ok	$0 < \text{Power} < 2 \text{ kW}$	No limit	No	No buzzer if power is less than the class limit.
Warning	$\text{Power} > 2 \text{ kW}$	$< 1 \text{ second}$	No	Buzzer will beep as soon as the power draw is more than the class limit.
Penalty	$\text{Power} > 2 \text{ kW}$	$> 1 \text{ second}$	Yes	Buzzer will sound constantly if power is greater than the class limit for more than 1 second.



CR.3.4 Power limit may be exceeded for less than 1 second.

CR.3.5 If the buzzer is ignored, a time penalty shall be applied to the Endurance score.

5 Race Day and Inspection

IN.1.0 Applicability

- IN.1.1 All vehicles must be inspected for rules compliance before being allowed to power on or compete at EVolocity events.
- IN.1.2 Inspections will be according to the most recent version of the rules that have been issued.
- IN.1.3 Inspections must be performed on the day of the competition or event the vehicle is entered in.

IN.2.0 Inspection checklist

- IN.2.1 Vehicles will be inspected to ensure compliance with the vehicle and class rules.
- IN.2.2 A vehicle is considered to be compliant once it passes all applicable fields in the EVolocity Vehicle Inspection Warrant of Fitness (WOF).

IN.3.0 Re-inspections

- IN.3.1 A vehicle that does not pass the inspection initially will go into a workshop area students will have opportunity to fix failed WOF and be re-inspected as required on the day, subject to the availability of scrutineers.
- IN.3.2 Inspections outside the booked time-slot on the event day will be at the discretion of the Chief Scrutineer when there is a scrutineer available.

IN.4.0 Previous inspections

- IN.4.1 Previous inspection results have no influence on the present competition vehicle inspection. This includes having been allowed to participate in previous competitions.

IN.5.0 Assessment authority

- IN.5.1 EVolocity Officials have the authority to make the final decision on any rule interpretation or judgement on the safety of a vehicle. Teams should send enquiries to EVolocity prior to the race day if unsure about meeting any rules.

IN.6.0 Charging

- IN.6.1 Batteries are not allowed to be charged at EVolocity competition events unless under circumstances deemed fair and necessary by an EVolocity Official on the competition day.

IN.7.0 Pit Etiquette

- IN.7.1 On race day, vehicles are not to be powered or driven while in the pits.
- IN.7.2 Running in the pits is not permitted.

6 Competition Events

The end-of-year competition consists of both racing (dynamic) and non-racing (static) events. These events allow teams to earn points that contribute to their overall competition placing. Table 5 shows the maximum total points that can be awarded at a competition. Winning an event will result in maximum points being awarded.

Table 5: The maximum number of points that can be awarded in the racing and static competition events.

Class	Racing Events	Static Events	TOTAL
Standard Bike	400	300	700
Standard Kart	400	300	700
Open Bike	400	300	700
Open Kart	400	300	700

The following sections describe the rules and procedures for the racing and static competition events.

6.1 Racing Events

RE.1.0 Maximum Point Allocations

The maximum amount of points for a given racing event is received by achieving first place. Table 6 shows the maximum points that can be awarded for each of the competition racing events.

Table 6: The maximum number of points that can be awarded in each racing event.

Class	Drag	Gymkhana	Endurance	Efficiency	TOTAL
Standard Bike	100	100	100	100	400
Standard Kart	100	100	100	100	400
Open Bike	100	100	100	100	400
Open Kart	100	100	100	100	400

The following sections detail each of the racing events.

RE.2.0 Drag Race

The Drag Race is a straight line test of the vehicle's acceleration and deceleration.

RE.2.1 Course Description

The acceleration course is 50m in length, followed by a 14m deceleration (braking) zone as shown in Figure 7.

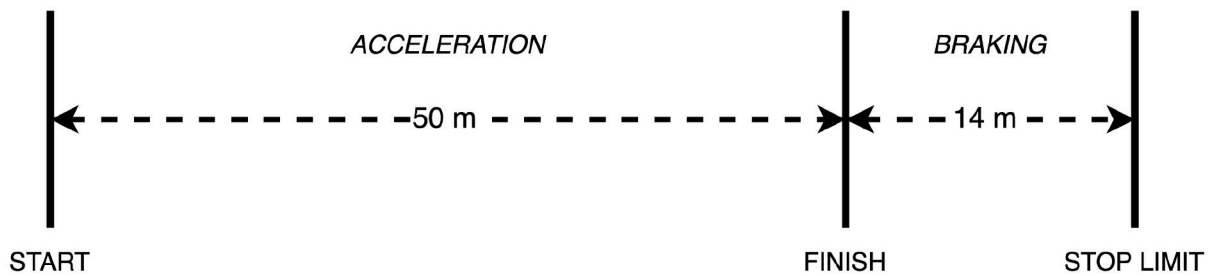


Figure 7: Layout of the Drag Race event.

RE.2.2 Scoring

- Score is based on time to complete the acceleration zone.
- The timer starts on the "go" signal/sound and stops when the vehicle's front axle crosses the finish line.
- The vehicle must come to a complete stop before the end of the deceleration zone (stop limit).
- Failure to stop in the deceleration zone results in a six second penalty.
- False starts result in a DQ for that run.
- Teams are allowed at least two attempts, up to a maximum of five.
- The fastest attempt will be used for scoring.
- If the event location has enough space, some events may allow two karts to race at once. However, only the time recorded for the run impacts the score.

RE.2.3 Time Limit

Attempts must be completed within one minute of the start signal. Teams exceeding this time will receive a DNF result and no points.

RE.3.0 Gymkhana

The gymkhana is a test of the vehicle's agility and manoeuvrability through a slalom course.

RE.3.1 Course/Event Description

- Drivers must follow the path and direction shown in Figure 8.
- From the start position, complete the slalom and circle the 40m cone, then slalom back to the 0m cone.
- Repeat the course three times.

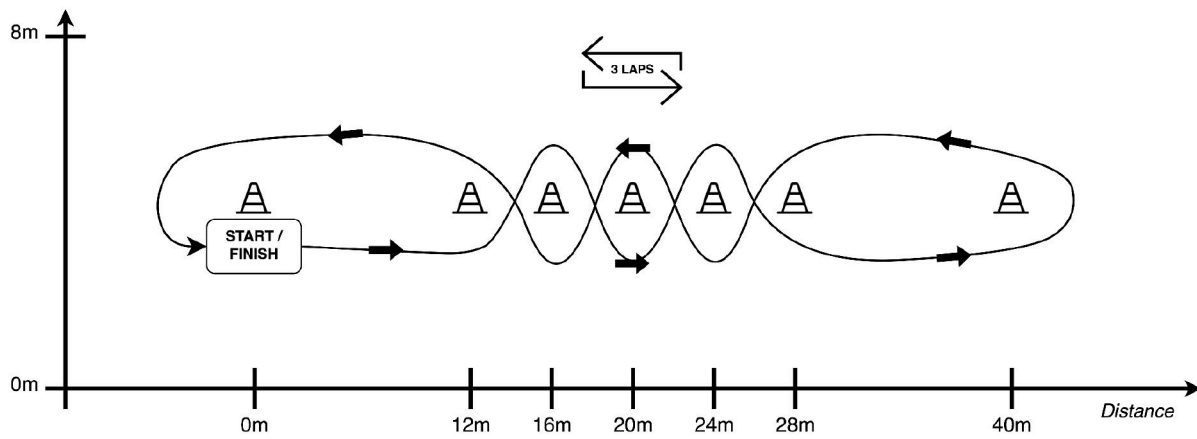


Figure 8: Layout and driving path of the Gymkhana event.

RE.3.2 Scoring

- Total time to complete the course is measured.
- Five second penalty added to the total time for each cone hit.
- False starts result in DQ for that run.
- Maximum of two attempts allowed.
- The best score out of the two runs will be used.

RE.3.3 Time Limit

Vehicles must complete the attempt within five minutes of the start signal. Teams that exceed this time will receive a DNF result and no points.

RE.4.0 Endurance

The Endurance event tests the overall speed, agility and reliability of the vehicle over a circuit course. Other than a driver change, there are no special tasks in this race.

RE.4.1 Course Description

- a. The race will consist of laps around a circuit course similar to the one shown in Figure 9.
- b. Vehicles will start in a grid formation if possible (venue dependant). The grid should order faster vehicles at the front to slower vehicles at the rear. The ordering is to the satisfaction of the Race Coordinator.
- c. The race will take place over a fixed time period of 25 minutes, subject to variation by the Race Coordinator where required. The image below is an example only, tracks will vary from region to region.

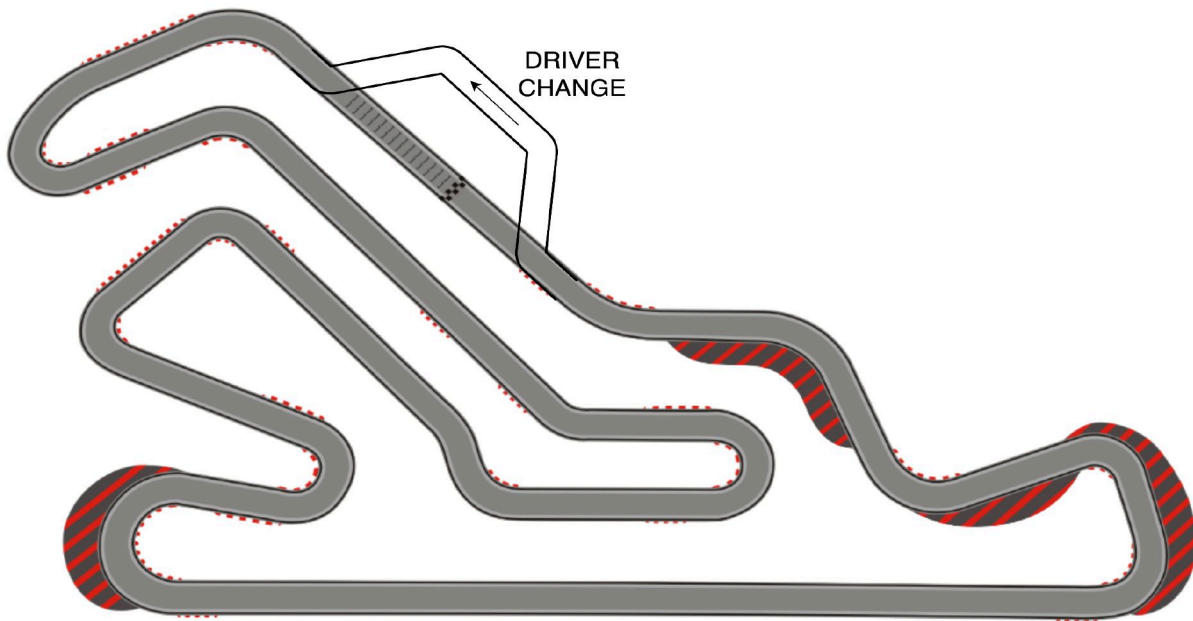


Figure 9: Example Endurance event track.

RE.4.2 Driving Etiquette

- a. Wheel-to-wheel racing should be avoided. Passing is allowed if it can be done safely, with at least 1.5m being kept between the passing and passed vehicles. Dangerous driving will result in a DQ.
- b. Marshalls will be present and the flag system detailed in RE.7.0 applies.

RE.4.3 Driver Swap

- a. At least one driver swap must take place during the race.

For teams with a single member, a fake driver swap must be held by the driver stopping, getting out of the vehicle, waiting five seconds and then

getting back in.

- b. Driver swaps must occur in the designated area.
- c. The speed limit in the driver swap area is walking pace.

RE.4.4 Scoring

- a. The team that completes the most laps within the allocated time will score maximum points in Endurance.
- b. The team that completes the fewest laps within the allocated time will score minimum points in endurance.
- c. Teams that complete an equal number of laps within the allocated time will be considered to have "tied" and receive equal points, regardless of the order of finishing.
- d. Only complete laps will be counted.
- e. Teams which do not complete a lap will receive a DNF classification along with zero points.
- f. Teams which do not start the event will receive a DNS classification along with zero points.
- g. False starts will result in a penalty of 10 points.
- h. Excessive or intentional cone hits, or course cutting, will result in a DQ.

RE.5.0 Efficiency

The Efficiency event tests the energy efficiency of a vehicle. The event is run in parallel with the Endurance event by installing an energy monitor on the vehicle and measuring the amount of energy each vehicle uses to complete Endurance.

RE.5.1 Scoring

- Maximum points for this event is awarded to the vehicle that consumes the least amount of energy during the Endurance event.
- Entering the 'Penalty Zone' of the power limiter (see Section 4.3.1 Energy Monitors and Power Limiting) incurs a 5-second penalty, with an additional 5-second penalty for each second in the Power Limiter's Penalty Zone.

RE.5.2 Energy Monitors

- Energy is measured by the EVolocity Control Unit (ECU), provided by EVolocity at the competition.
- Teams that race without an energy monitor, either by choice or otherwise, will receive zero points for Efficiency.
- An example of the data that the energy monitor will record is shown in Figure 10 (recorded at the 2022 Taranaki Regional Finals). In this example, the final energy value was 24.97Wh.

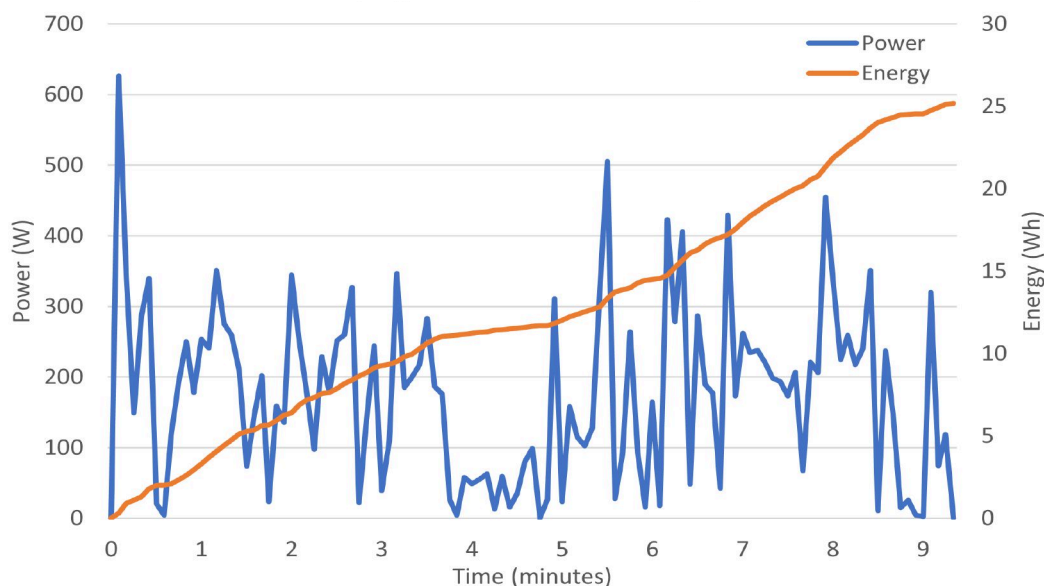


Figure 10: Example data recorded on a Standard Class vehicle during the Endurance event.

RE.6.0 Flag system

- RE.6.1 Circuit driving events (Endurance and Free Drive) will use a flag system to give signals to drivers. All drivers must remember the meaning of each flag.
- RE.6.2 Flags will be carried by marshalls that are spread out over the course.
- RE.6.3 There are five flag types, shown in Figure 11;
- Blue:** tells a driver that there is a faster vehicle behind that should be let through. The front vehicle must pull over and slow down to allow faster vehicles to pass.
 - Yellow:** there is a hazard on or near the track (for example when a vehicle has stopped, or a minor collision). Vehicles must slow to a walking speed.
 - Red:** the entire race has been stopped (in the case of a serious incident).
 - Black:** the vehicle being pointed to must retire from the race and go to the pits ASAP. This may be due to disqualification or a mechanical issue.
 - Chequered:** signals that the vehicle has successfully finished the race.

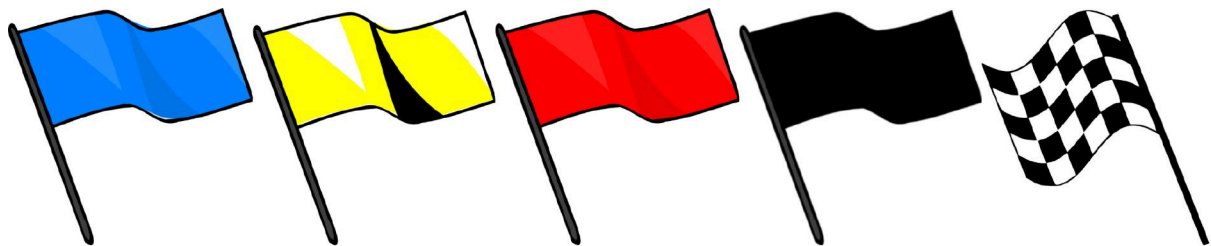


Figure 11: Flags used during EVelocity Racing Events.

7 Appendix 1: ECU installation guide

This section describes how to prepare for the installation of the EVelocity Energy Monitor (AKA the ECU) prior to arriving at the event.

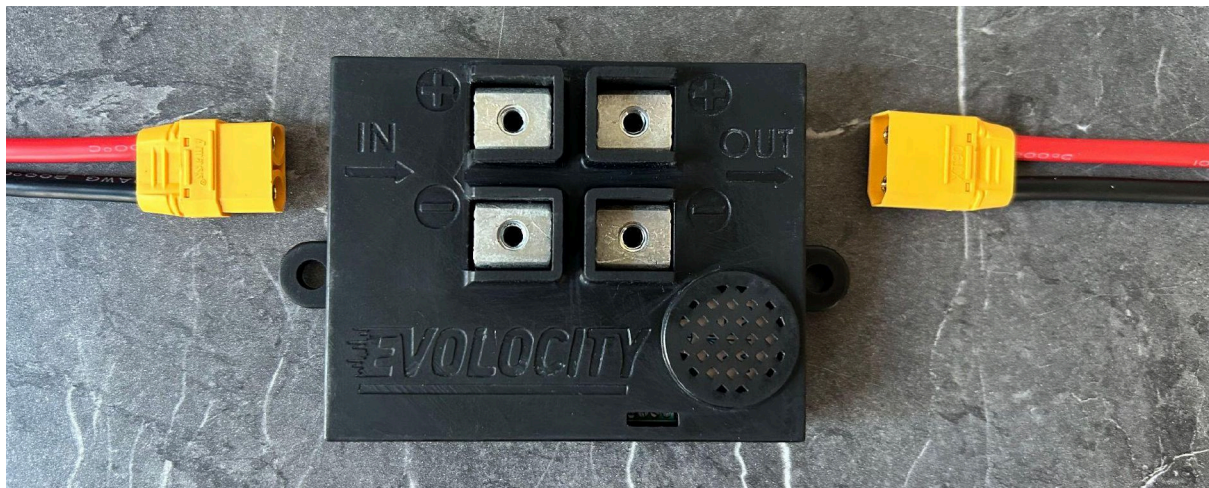
Size and Mounting

3D models and 1:1 scale dimensioned drawings can be **downloaded** from the [EVelocity website](#).

Electrical Connections

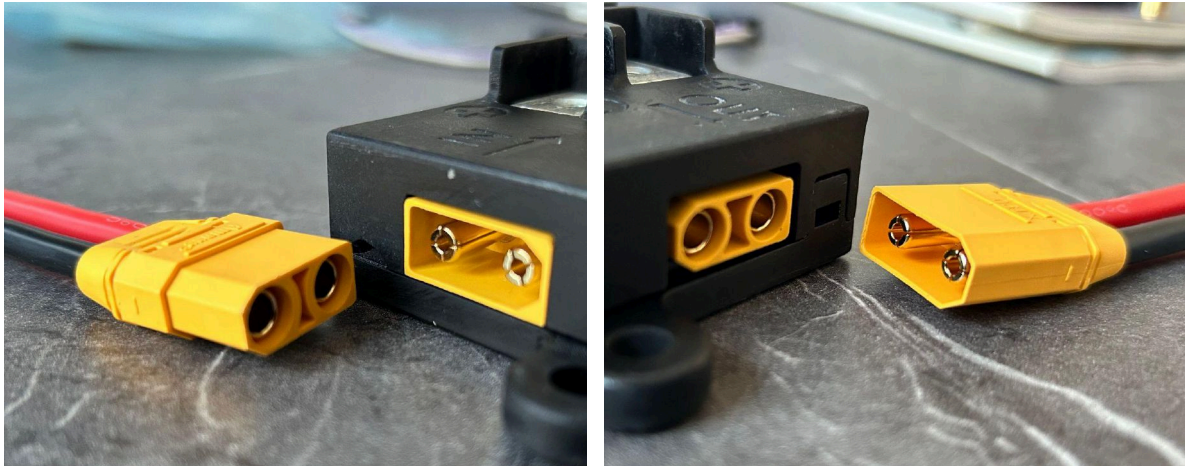
The ECU uses XT90 connectors. The genders of the input and output connectors are different so it is important to ensure the correct gender is installed. There are threaded M5 terminal blocks on the ECU which can be connected to M5 ring terminals if using XT90 connectors is not possible.

Interface	ECU Gender	Mating Gender	Mating part number
Input	Male	Female	XT90-H-F
Output	Female	Male	XT90-H-M
M5 ring terminals	NA	NA	M5 ring terminal



Input (from battery)

Output (to motor controller)

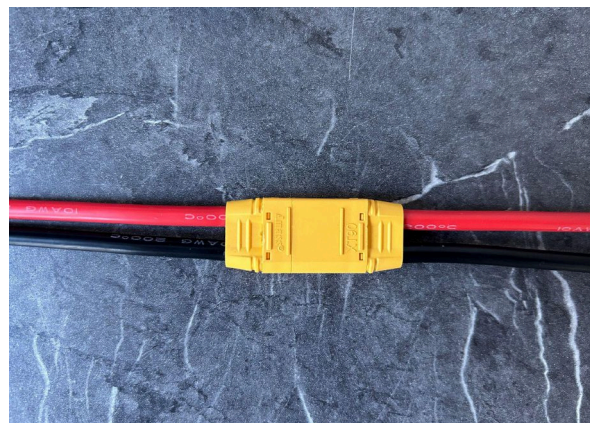


When the ECU is not installed, the two connectors installed on the vehicle can be connected together as shown below.

ECU installed:



ECU not installed:



The pre-terminated leads can be connected to your existing wiring with the yellow crimp splices. This is just an example, other crimps/connection methods are acceptable as long as they are suitable for the motor currents.



Standard M5 ring terminals may be used if the XT90s are not. Size the ring terminal appropriately for the wire gauge used.



Purchasing

XT90s

EVolocity has had good success purchasing the following **Male and Female pair** connectors: <https://www.aliexpress.com/item/1005001863187817.html>

It is highly recommended to purchase the pre-terminated leads instead of soldering them yourself. If purchasing pre-soldered leads, choose **10 AWG** wire.

Delivery using the link above usually takes 2-3 weeks.

XT90H-F & M (Female & Male)



10/20/30/40/50CM UAV Wire Harness Accessories Amass XT90 Male and Female Plug With 12AWG/10AWG Silicone Flexible Cord Connector

★★★★★ 4.9 94 Reviews 397 Sold

NZ\$4.46 ~~NZ\$7.21~~ 38% off

NZ\$13.73 off
On orders over NZ\$137...

Color: Male and Female



Package: 1pcs

1pcs

Pins: 20CM

10CM

20CM

30CM

40CM

50CM

Insert Type: 10AWG

12AWG

10AWG

Yellow Splices

These can be purchased locally in NZ at Repco, Supercheap Auto and JayCar. These splices are required in order to use the XT90 connectors.

Example: [link](#).

Advice for avoiding power limit penalties:

Your vehicle will draw the greatest power when accelerating from low speeds, or standstill. Being “smooth on the throttle” at the start line and accelerating out of corners can help you increase your efficiency, and avoid penalties.

Remember that a single 5s penalty can ruin your entire drag run, so don't be afraid to be gentle with the throttle!

Keep an ear out for your buzzer - once you hear a beeping tone you have 1 second to reduce your power draw, but this doesn't happen instantaneously. As soon as you hear the beeping tone, you should smoothly reduce your throttle to zero. If 0.5s has passed, and the beeping tone hasn't disappeared, you should use your brakes, as this will reduce power draw quicker than coasting.

9 Revision History

Revision	Date	Changes
A	10/04/2023	Initial release.
B	13/04/2023	Updated Section 2 Enquiries.
C	31/01/2024	Increased Open Class power limits, modified energy monitor requirements, modified power limiting scheme, removed water and baton from Gymkhana, removed the Competition Class, removed Make Your Marque, and added ECU installation guide.
D	18/02/2024	Minor formatting adjustments.
E	19/06/2024	Removed Electronic Innovation Award (merged with Engineering Design Award), removed final mention of Make Your Marque.
F	02/07/2024	Added “kart only” to section VR.4.0 Safety cell, minor formatting adjustments.
G	16/08/2024	Moved rule CR.3.2 from Open Class to General, improved wording on VR.10.3, updated links in Section 2 Enquiries, minor formatting adjustments.
H	14/09/2026	Corrected error in Table 4 indicating penalties for power consumption <i>less than</i> 2kW. VR 8.2 Added diagrams for drive train cover. Removed 6.2Static Events section and 7 National Awards Section(No nationals)