Technical Note 001: How is electric vehicle performance affected?

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Overview

A common question about upgrading controllers on golf carts is how performance is affected. Just changing a controller doesn't always give the performance change you were looking for. There are a few different factors that have to be taken into consideration. Increasing performance is not that difficult if a few concepts regarding motors, controllers and electric vehicles are considered.

Getting more speed

Depending on the motor, upgrading the controller may not necessarily give an increase in speed. With Series motors, upgrading the controller does not increase the speed over the stock controller. Upgrading to a higher amperage controller will however allow the vehicle to better maintain speed under heavy load conditions.

In a Shunt/ Regen/ Separately Excited motor the field windings control the speed of the motor. With a controller that optimizes the field control, (like an Alltrax DCX controller) there can be a significant increase in speed.

There are three other ways to increase the speed on your vehicle.

- Increase the battery voltage
- Change gearing or tire size
- Install a high speed motor

Motor RPM is a function of voltage. Increasing the voltage increases the RPM of the motor. How much it increases all depends on the motor design. An increase of about 1 to 3 MPH is not unreasonable with a 6v change in the battery pack.

Changing the gearing of the vehicle is another simple way to get more speed. Gearing can be changed in two ways. First is changing the gears in the differential. The other is to change the size of the tires. Changing from 18" tires to 22" tires can add as much as 3MPH!

Putting in a high speed motor can dramatically increase the speed of a vehicle. Check with the motor manufacturer for specifics on any speed increase.

Getting more torque

This is where most of the confusion with upgrading controllers comes from. Upgrading from a stock 275A controller may not increase the speed, but it will increase torque. Torque is basically the pulling power of the motor and is a function of current, the higher the current the more torque. Going from the stock 275A controller to a 400A controller will nearly double the stall torque.

- Series motors: In a perfect world, Torque = Current Squared (I^2)
- Shunt Motor: Linear relationship to Armature current, Field current is independently variable

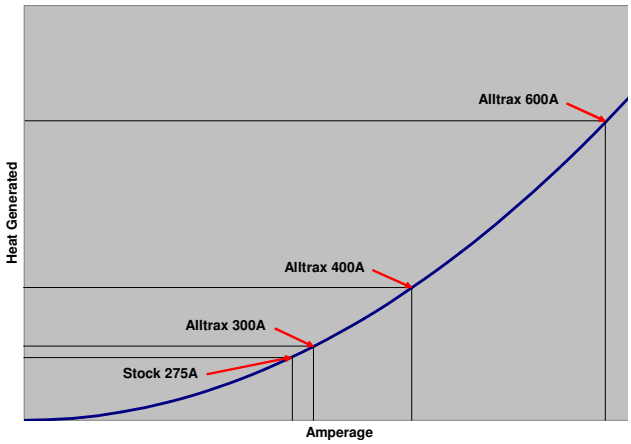
The current rating of the controller really depends on the application of the vehicle.

- Light loads: Everyday flat-land driving, carrying one or two people or just for a couple rounds of golf, use a 300A controller.
- Medium loads: Hauling, hill climbing, moving equipment or carrying more then 2 people, use a 400A controller.
- Heavy loads: Towing large or heavy vehicles or steep hill climbing, use a 500A or 600A controller.

Things to watch out for when upgrading

After upgrading to a high performance controller there are still some common pitfalls that may limit performance.

- Make sure the controller is rated for the battery voltage.
- If changing the battery voltage, make sure the charger and solenoid are rated for that voltage.
- With controllers 400A and above, the car wiring needs to be changed from #6 to #4 AWG.
- The mechanical brakes on a golf car aren't designed to handle braking speeds in excess of 15-18mph.
- When using a high current controller, be aware a stock motor may not be able to handle the heat generated. Going from a stock 275A controller to a 600A, the amount of heat generated in the motor will go up about 5 times compared to a stock controller.



Conclusion

Increasing the electric vehicles performance depends on properly choosing the system components to improve performance and meet the vehicles expectations. Some "simple changes" may end up a disappointment if other areas of improvement are not considered.

Consider the three basic areas of an electric vehicle:

- Energy storage (Batteries)
- Energy transfer (Controller, wire)
- Energy electrical to mechanical conversion (Motor, gears, tires)

To Increase Performance:

- Install an ALLTRAX High performance controller
- Install properly rated battery bus fuses
- Change to a motor rated for the application (towing or speed?)
- Increase battery capacity or voltage (Remember that cheap = low performance)
- Use correct or increased wire size
- Change in tire size (depending on application)
- Upgrade differential gear set to match motor torque and speed to the axle
- A close look at safety features of the vehicle such as brakes, seat belts, roll bars, fuses, etc.

There is not one "catch-all solution" to increasing performance. Explore your objectives and how the pieces or changes interact in the vehicle. This planned and structured approach typically results in satisfied customers with a reliable and high performance vehicle.

ALLTRAX Inc., Company History:

The company founder developed our core technology at the race track for high power electric vehicles. Throughout the 90's, the market demanded robust and high performance electronic controllers. In 2001 ALLTRAX was formed based on the E-race car developed technology.

Today, Power Conversion Engineering (PCE) is the research and development arm and ALLTRAX provides the industry a powerful and robust controller to meet all your recreational, industrial, and commercial electrical vehicle needs.

For more information please go to http://www.alltraxinc.com

"The company was founded at the track"