Solar Vehicle Testbed Design & Analysis

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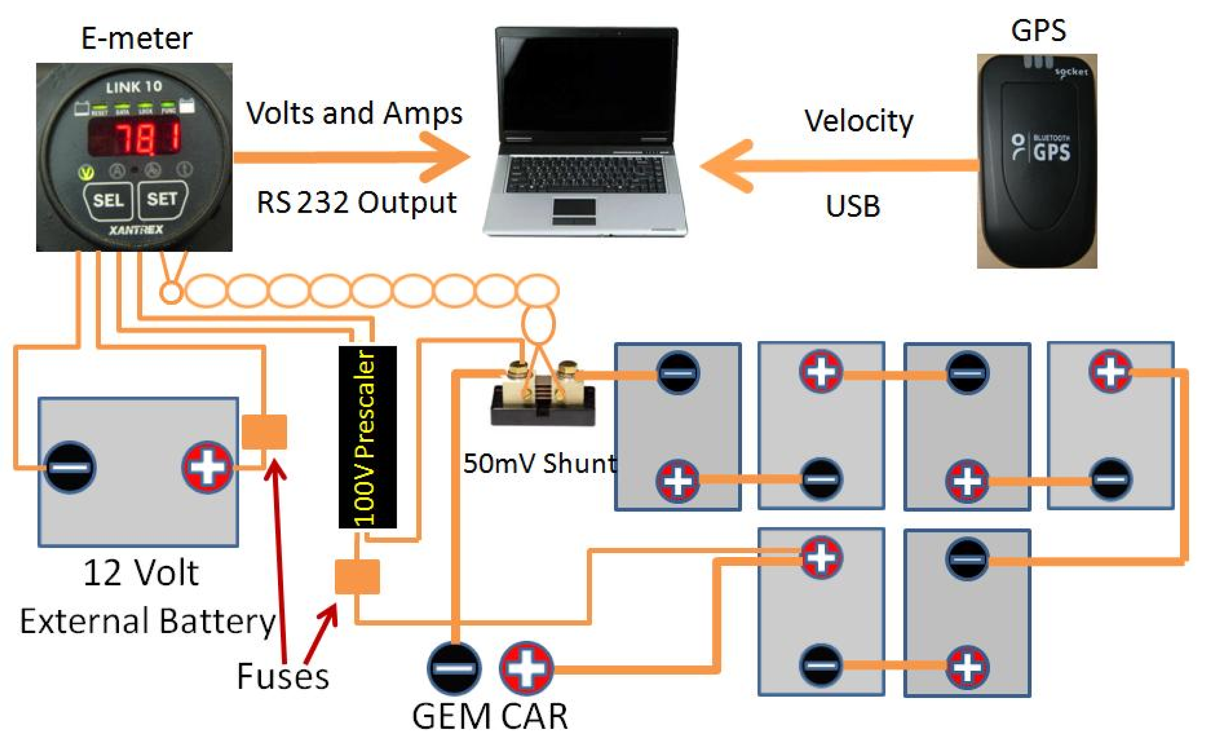
Abstract

One of the major contributors to global climate change around the world is the carbon dioxide that internal combustion engine (ICE) vehicles produce. This issue deserves significant attention, leading to alternative energy sources and powertrains for transportation other than ICE vehicles. The purpose of this research project is to integrate solar electric power into a Neighborhood Electric Vehicle (NEV) car to demonstrate the possibilities that solar-electric vehicles can be a legitimate alternative transportation mode in the future. Eight solar panels have been installed on the roof and bed of the NEV in order to convert solar radiation into electric power. The electric power is used to power the vehicle during the day and to also recharge the batteries for later use. During the night the NEV uses the energy saved in the six batteries that the vehicle uses. The goal of this project is to power the vehicle by at least 50% from solar power, the remaining power coming from the electric grid. Solar-electric vehicles can potentially be an efficient and clean source of energy for short trips in a community, producing zero exhaust emissions.

Characterizing GEM



The block diagram above shows how the e-meter was The laptop recorded all the data from the e-meter and GPS using matlab.

E-meter measures:

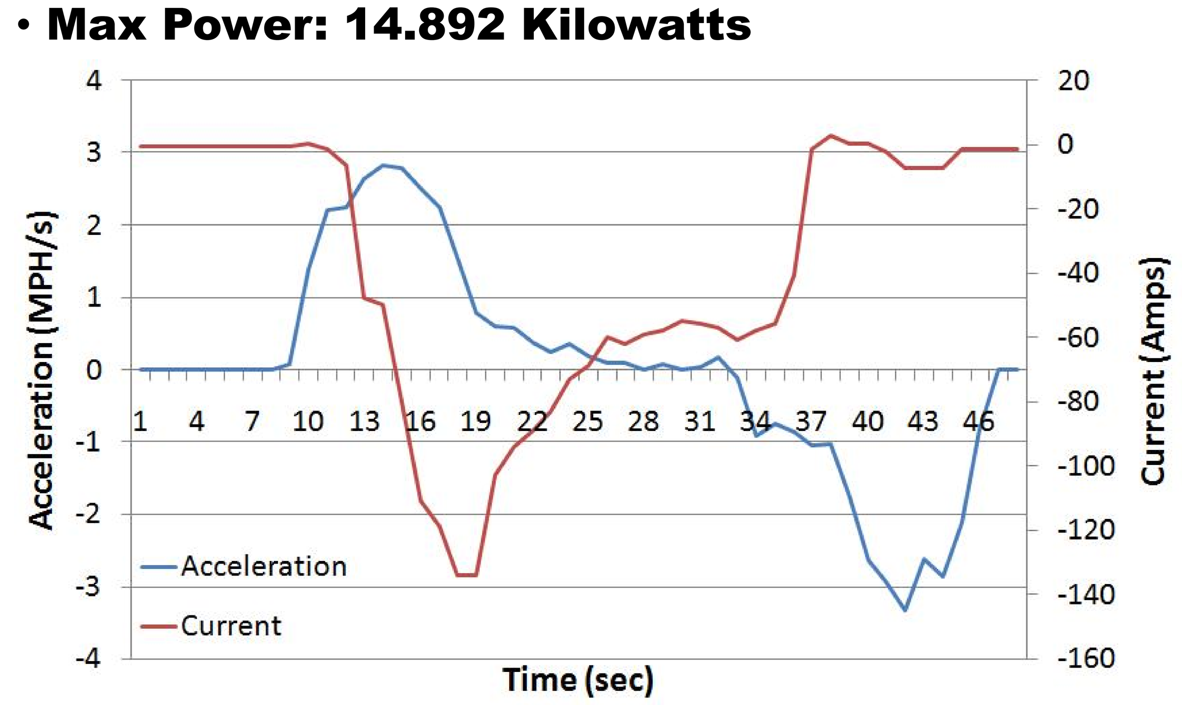
- **Volts**
- **Current**
- **Power = Voltage * Amperage**
- **Kilowatt Hours: Voltage * Current * Time**

Global Position System (GPS) measures:

- **Velocity**
- **Acceleration = ∆V/ ∆t**

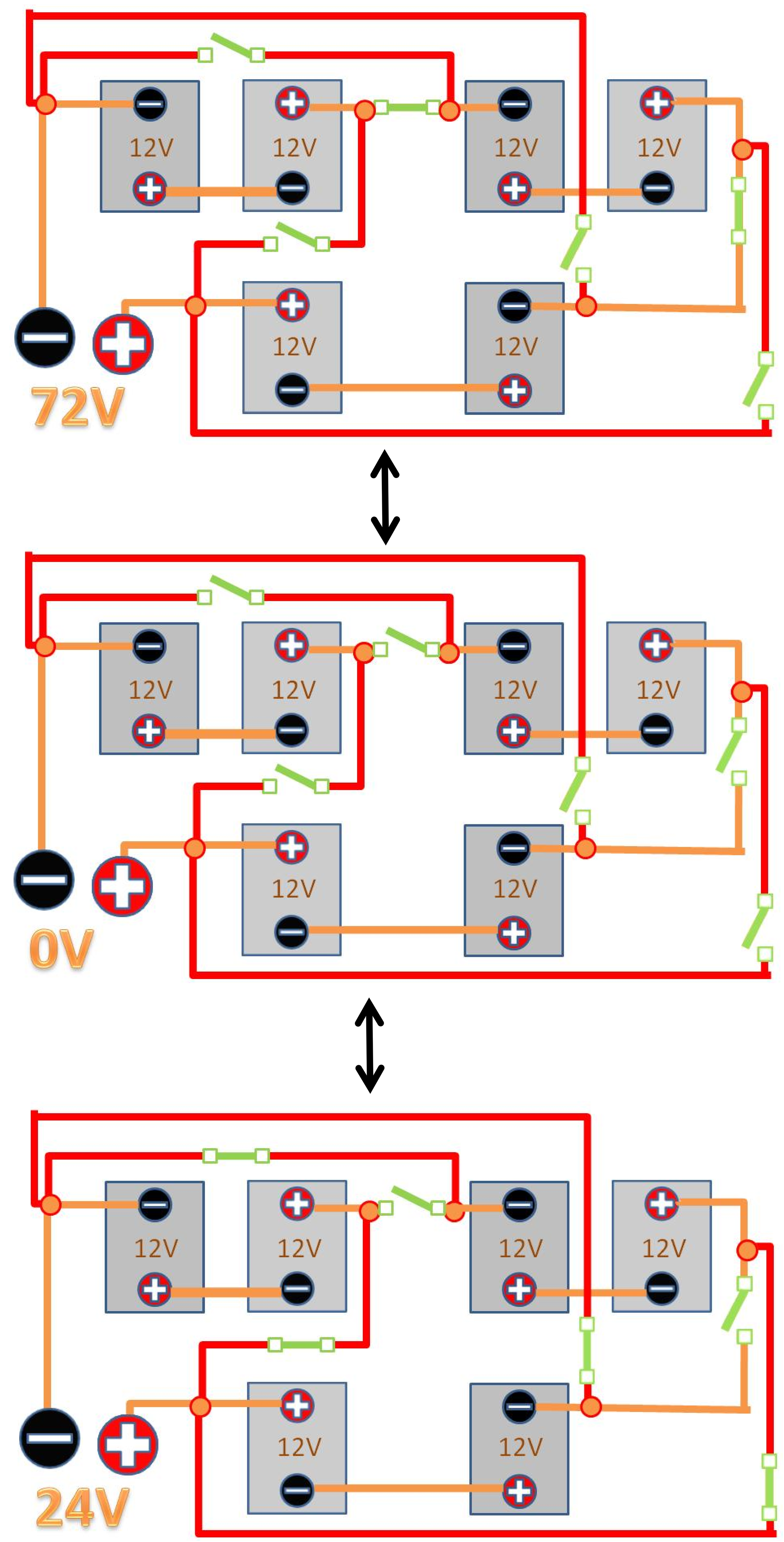
GEM Characterization

- **Battery Life: 1.75 Hours**
- **Total Energy Used: 3.36 Kwh**
- **Average Velocity: 10.429 MPH**
- **Max Acceleration: 6.72 MPH/s**
- **Max Current: 225 Amps**
- **Max Power: 14.892 Kilowatts**



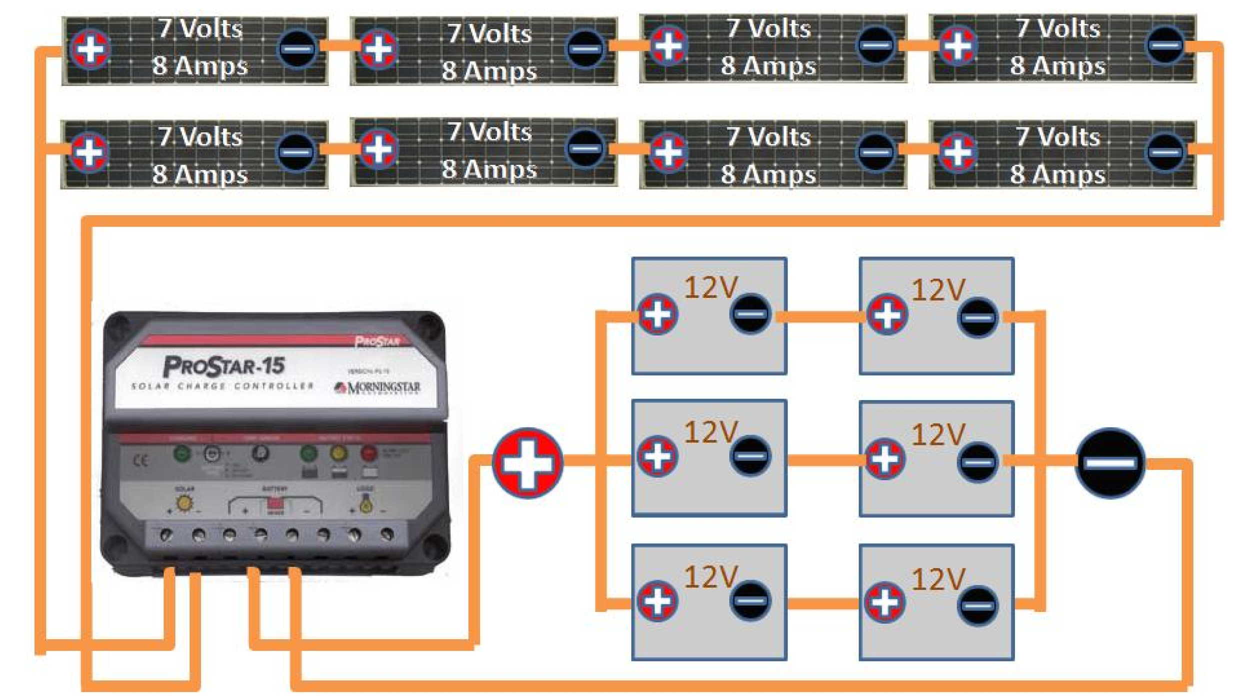
The graph above shows the relationship between the acceleration and the current drawn from the vehicle. The reason why the current is negative is because it current coming out of the batteries. As acceleration increases the current drawn also increases. As acceleration decreases the current drawn also decreases.

Circuit Conversion from 72V to 24V



The diagrams above shows the transition of the circuit conversion from 72V to 24V using solenoids. The voltage drop is necessary because the solar panels do not produce enough voltage to charge at 72V, therefore the batteries will charge at 24V.

Solar 24V Circuit



The block diagram above illustrates the complete circuit when the vehicle is in charge mode.

Expected Results

Due to the voltage drop on the battery circuit, the vehicle can only be charged when it is parked. The solar panels produce 28V * 16A = 448 watts each hour, giving us .448 Kwh. The GEM car consumed 3.36 Kwh in the 1.75 hours driven, therefore it would take around 8 hours (8 * 448Kwh = 3.584Kwh) parked in direct sunlight in order to recharge the entire battery pack. A scenario for this case is to leave it charging all the day use it during the night. This could apply to a factory worker that works at night and needs a GEM car. Another scenario is to use GEM throughout the day and charge it when it is parked, this would increase the driving range during the day. Once the experiment is complete and tested, we will look for different ways to optimize our charging efficiency.