Greenpower Rotary Racer Team

BatEm

Greenpower Electric Car Lead Acid Battery Emulator

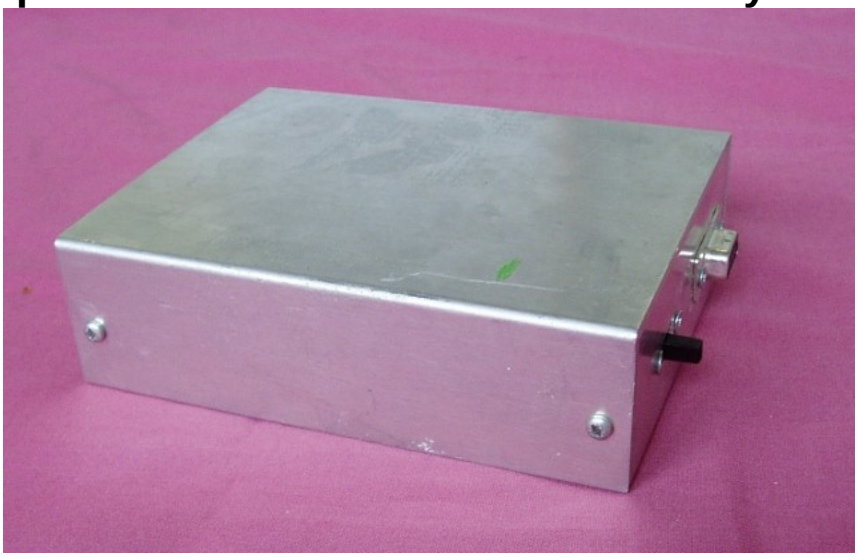

Illustration 1: Example picture

This is a first pass idea of a unit to help in the Greenpower racing challenge to regulate cars speeds and protect the batteries for much longer life.

The BatEm unit is designed to emulate one or more Lead Acid batteries of particular capacity. The small unit is wired in-line from the batteries to the cars electrical system. It meters out the energy from the batteries in a manner that emulates a battery of smaller, programmable, capacity.

Benefits

- Allows the average speed of an electric car to be managed.
- Can limit the maximum cars speed if required.
- Any desired "battery" capacity can be programmed in.
- One, Two or more battery sets can be simulated to allow the use of multiple battery packs during the race.
- The real batteries will not be anywhere near fully discharged. They would thus have a much longer life. This saves money for the teams and is much better for the environment.
- The unit can be programmed to have a minimum output voltage, of say 8 Volts, to allow the car to complete the race, no matter how badly the team got the gearing wrong (good for start up teams).
- Any battery differences between cars, including battery temperature and age, would be eliminated.
- Cars would race just as if they had smaller lead acid batteries, with similar "energy" handling issues, like how much current to take at what part in the race. Also cars would slow down near the end of the race, especially in cars that got their energy management wrong.
- If required some cars could be easily handicapped for a handicapped race.
- Any battery type could be used including the current Yuasa batteries.
- No modifications to the current Greenpower cars, other than installing the box.
- No changes to the current Greenpower race format.
- Password protected with data logging built in.

Design and Operation

The unit is housed in a small metal box. It has connectors for the two input battery wires and for the two output wires. It also has a USB connector for Laptop or PC connection, three LED's and a shielded “Start”

button.

The unit is pre-programmed by the race organisers for the racing season, or can be programmed at the race during scruitineering using a simple Laptop computer if required. The Laptop is is used to set the battery capacity and number of batteries for the race format.

Just before the start of the race the shielded “start” button is pressed to indicate that the emulated batteries are fully charged. The green LED lights to show the system is ready and operating, this is checked by race marshals. Once some energy has been used, the orange light comes on to indicate race conditions. If the “start” button is further pressed, the RED LED comes on and flashes to indicate race tampering. This can only be reset by the race organisers through the USB connection or by waiting 6 hours.

To handle practice laps and testing, the unit returns to full power 6 hours after the start of a race. It stays in this mode until the “Start” button is pressed.

During the race the unit would recognise battery changes and would switch to emulating the other battery automatically. A flashing yellow light could be used to indicate that the real batteries are starting to fail.

Perhaps having a “test” button would be useful.

The log of current usage would be available for download by the race organisers and perhaps the teams themselves.

Optional Functionality

These are questionable. I think it would be better to leave teams to implement this functionality themselves. But it would be easy to add if required.

1. Could have a speed input connection to provide: Time, Voltage, Current, Speed data logging for teams and/or speed limit.
2. Could have a display socket to allow an LED or LCD module to be attached for driver information.
3. Teams could access the data logging functions.
4. Could provide motor over-heat protection by limiting the power when the unit detects that an excessive amount of power has been used for more than a set time.
5. Could limit maximum power available versus time to limit a cars maximum lap speed.
6. Could implement the Lap Counting transponder to save having to install this for each race.

Operation

The unit would use a PWM switching unit to reduce the battery voltage to the output terminals. The systems algorithms would provide a current limit of 60 Amps (programmable ?). It would then emulate a lead acid batteries discharge curve. This would effectively simulate a batteries internal resistance and the state of charge. The unit would produce the appropriate voltage based on current draw and the emulated batteries state of charge.

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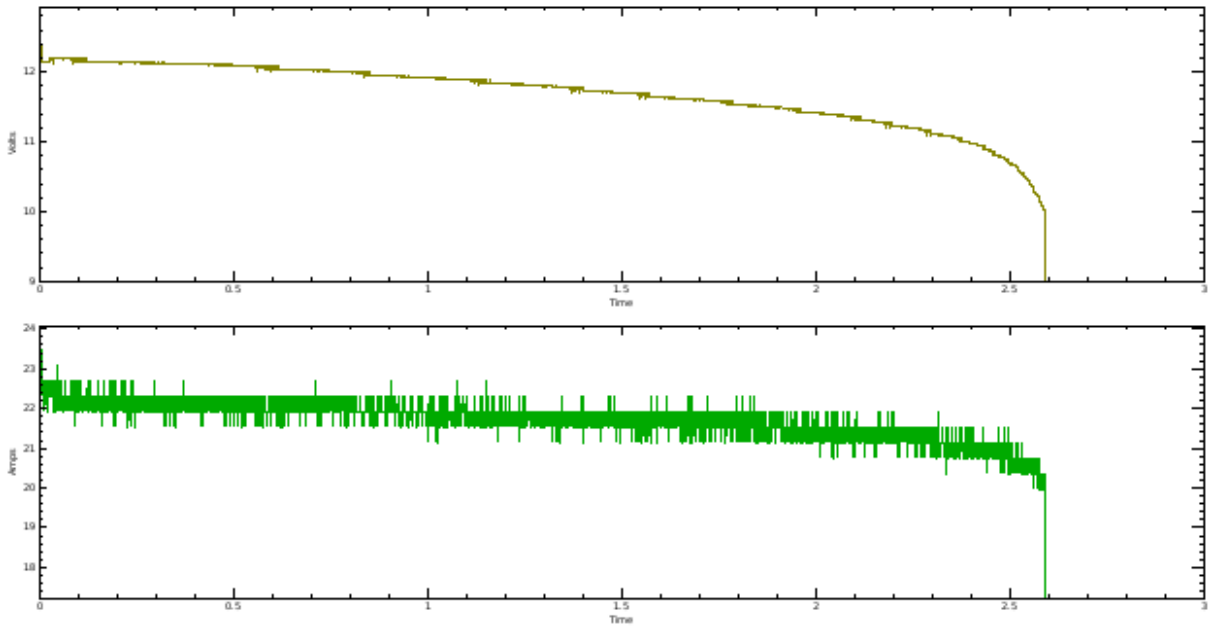

Illustration 2: Typical Yuasa battery discharge curve