TEXAS STATE
INGRAM SCHOOL OF ENGINEERING

2.5 Solar Car Smart Charger

American Solar Challenge

BACKGROUND INFORMATION

American Solar Challenge:

- ➢1500-2000 mile race spanning over several states.
- ➢Schools must design and implement a fully functional and street legal solar car.
- ➢Competing teams must overcome obstacles associated with solar panels such as weather conditions, time of day, and other limitations.

Texas States Progression:

- ➢Prototype solar car by June 2018.
  - D2 current projects are 3 phase motor control and wiring system for chassis with previous projects.
  - Previous teams completed work on solar car were integrated power system and monitoring system.
- ➢Working solar car project by June 2019.

Use:

➢The smart charger will be used to detect faulty batteries within the pack.

Before the Race:

➢The battery charger will be used as the solar car is being tested and prior to the start of the American Solar Challenge.

During the Race:

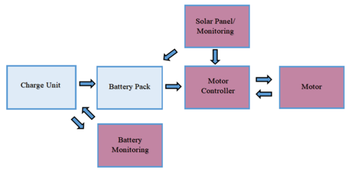
➢ If the solar panels are unable to sufficiently charge the batteries during the race the team may be allowed by the tour officials to charge the battery.

PROJECT DESCRIPTION

The goal for this project is to design a **smart battery charger,** which is mainly a switch mode power supply (also known as high frequency charger), that has the ability to communicate with a smart battery pack's battery management system (BMS) in order to control and monitor the charging process.

The **project scope** is to develop a switching voltage and current power supply with our current (pun intended) knowledge of electronics and micro devices to adjust the charging level for the American Solar challenge.

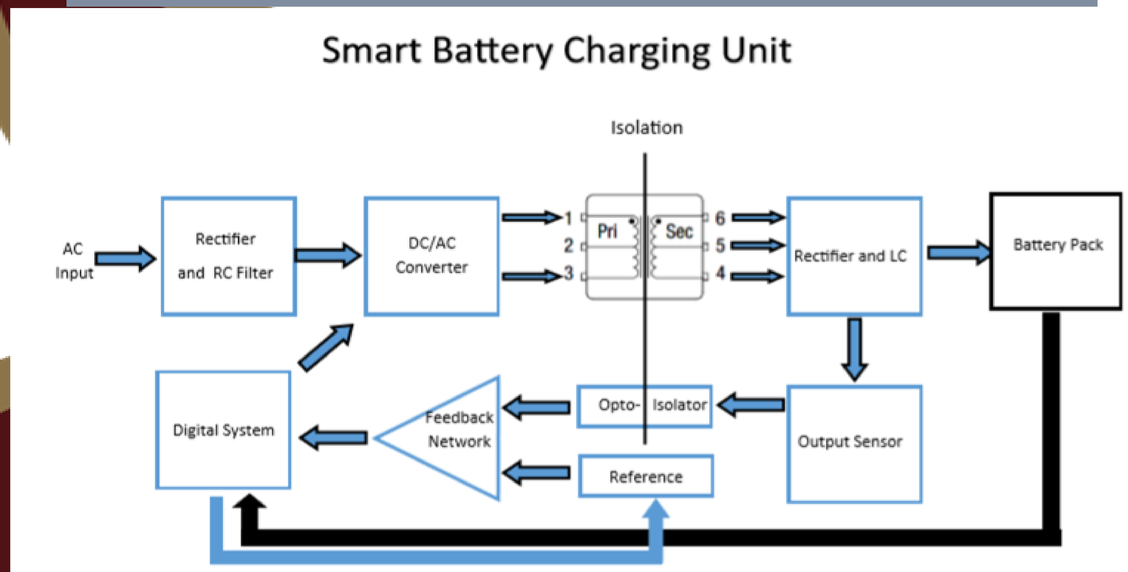
- ➢The project will be configured to lead acid configuration but with the stretch goal of making it for Li+ batteries since the ASC is moving towards the Li+ battery configurations
- ➢The battery pack will not be able to exceed 125Kg in accordance with the ASC 2017 rule set



SPONSOR REQUIREMENTS

To build a smart charging supply unit for the solar car, in compliance with the guidelines and parameters defined by the American Solar Car Challenge (ASC) 2018.

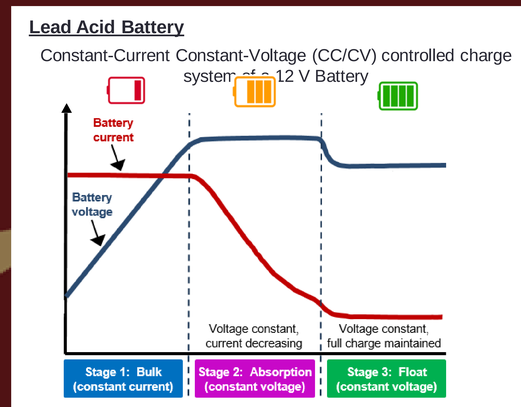
VOLTAGE AND CURRENT CONTROLLED SYSTEM



PERFORMANCE

Hardware Performance Parameters					
Parameter	***Test Conditions***	***Min***	***Max***	***Units***	***Testing Method***
Battery Temp (for unit)	*25 C*		*>25*	*C*	Temperature gauges/thermistor -Tested using thermistor connected to controller unit to monitor inside unit for spike in temperature to protect against runway and damage
Battery Unit	*V = ± 138.0V*	*111*	*138.0*	*V*	DMM
Pulse Width Modulation for Current	*A= 9-10 A*	*0*	*10*	*A*	Using a oscilloscope and the reason to test the current at zero is due to the type of IC's we are using should allow the tool to have full range of current control
AC to DC converter (system linearity)	*Vin=120V AC 15-20A*	*110*	*130*	*V*	DMM and Oscilloscope- Used to measure AC voltage into converter and DC voltage out. Should be a linear system
Pulse Width Modulation for voltage	*V=13.5 V*	*0*	*32 (p*	*V*	Oscilliscope- This will be from 0 to 32 due to the type of IC's purchased and we may possibly be able to drive for more
Controller with monitoring	*1-138 volts*	*1*	*138*	*V*	DMM, DC power supply- will be used to supply range of currents to confirm accuracy in voltage current monitoring.

CHARGING PROFILE



- Stage 1: Bulk
  - Maximum Battery Current limit: 10 A
  - Battery Voltage rises to peak at 13.8 V
- Stage 2: Absorption
  - Battery Charge Voltage: 13.8 V
  - Battery Current starts to fall
- Stage 3: Float
  - Float Battery Charge Voltage: 13.5 V ±.03
  - Battery Current close to 0mA

TEAM MEMBERS

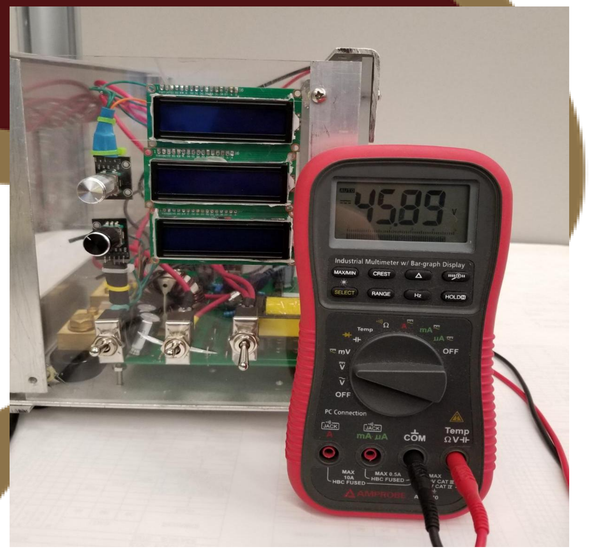
Anthony Sherrow, Preston Iloka, Rosa Espinosa, Steven Bradley

FEATURES

Feature	Description
Voltage Control	This was done through the use of a comparator lead into a BJT to set a voltage limit. Buck/boost converter
Current Control	This was done with the use of a comparator driven by the PWM in order to control the BJT.
Digital Display	This was done through the use of our processing board which will allow the users to be able to see all set parameters.
Status LCD	Will indicate several different functions such as a line is live or different color variations will show a error
Feedback monitoring	Using a rheostat between the comparator and controller to monitor feedback.

RESULTS

- DC/DC converter produces a modified sine wave
- Functioning 3 LCD display monitoring system
- .2V incremental encoder rotation
- Isolation circuitry produces accuracy of 90% or higher
- High voltage system



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