# Motorvators

AZTEC | ELECTRIC | RACING

SAN DIEGO STATE UNIVERSITY | FORMULA ELECTRIC

SDSU | San Diego State University

## GROUNDED LOW VOLTAGE BATTERY POWER SUPPLY

## PROJECT OVERVIEW

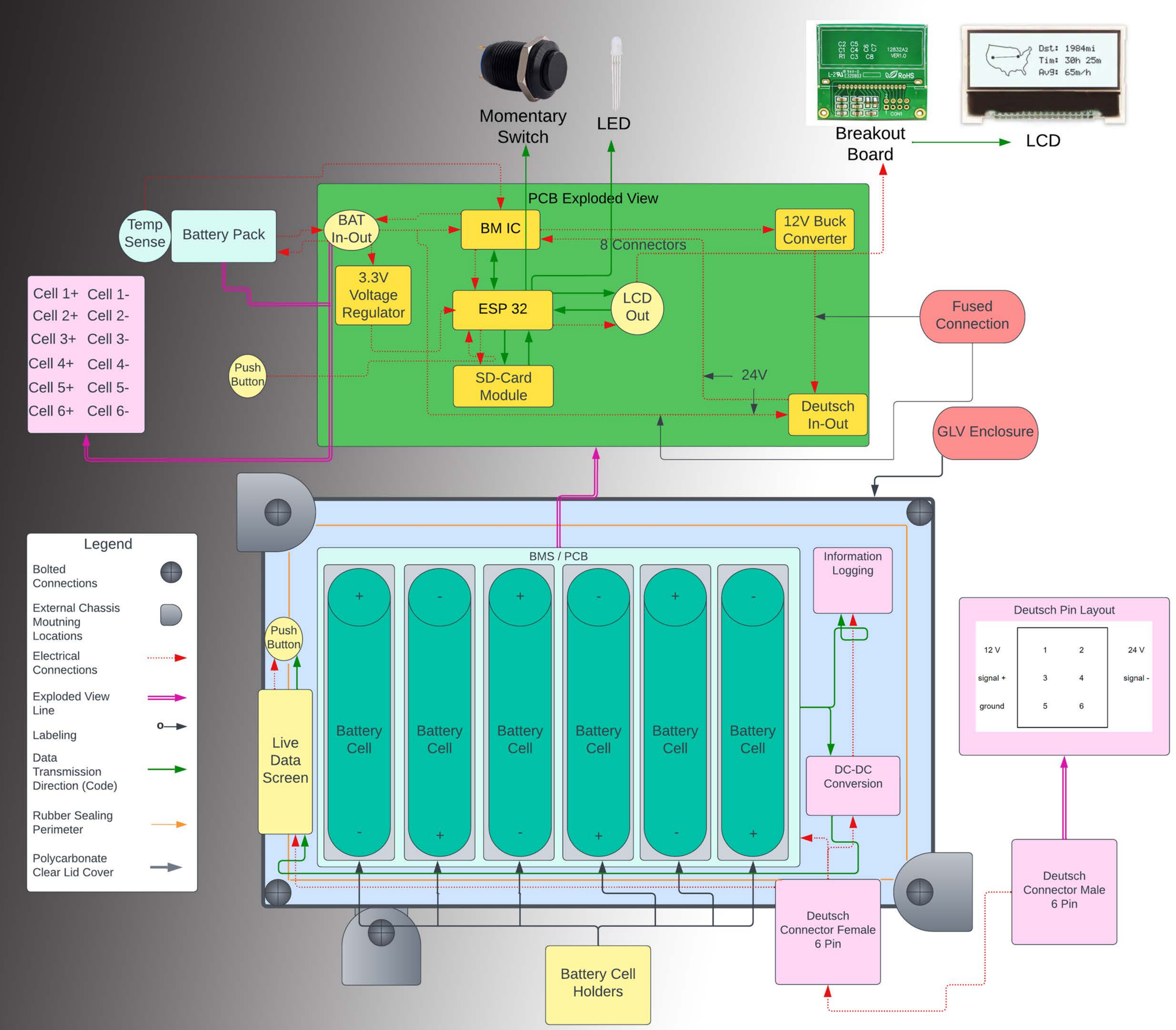
The Aztec Electric Racing team (AER) is a competitor in the Formula Society of Automotive Engineers (FSAE) Collegiate Design Series, in which their electric racing vehicle is subjected to extensive testing. The vehicle requires a Grounded Low Voltage (GLV) System which supplies power to the electrical components not included in the main tractive system. AER sought to make improvements to their GLV in terms of its design for serviceability and overall reliability by introducing additional features and capabilities. This was accomplished by using a thermally resistive PC-ABS 3D printed enclosure which houses a modular cell holder system, live data recording system and data screen, and a custom printed circuit board with an integrated battery management system. This project was completed through extensive research, electrical and mechanical system design, analysis, and prototyping; the team designed and manufactured an effective GLV system for AER that meets all of their requirements so that it may perform effectively at competition.

## TEAM MEMBERS

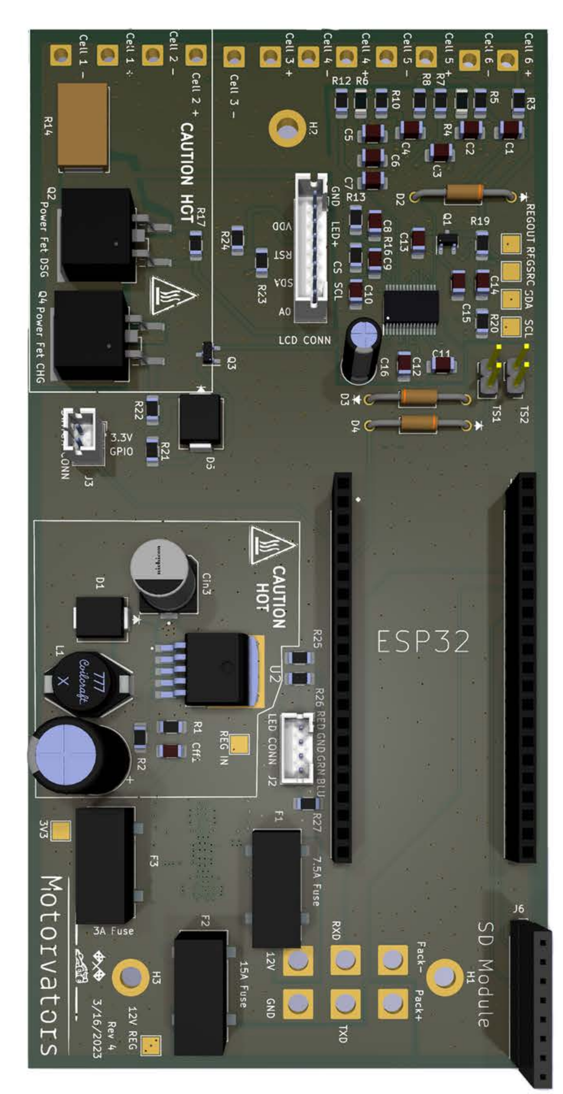

## ACKNOWLEDGEMENTS

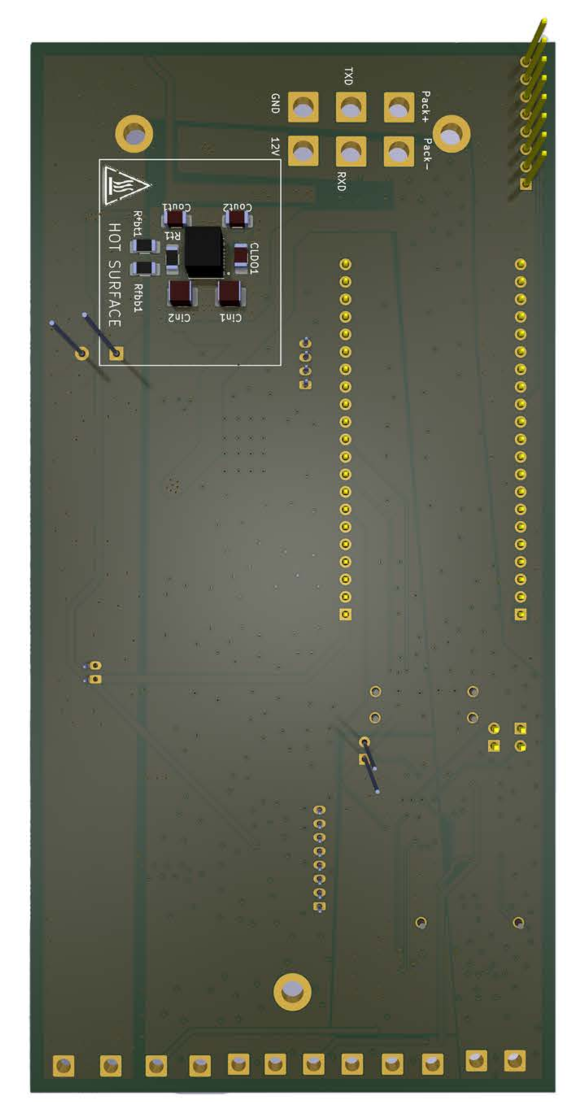

The Motorvators would like to acknowledge and thank the numerous members of the Aztec Electric Race Team including our sponsor Andrew Da Cunha, Eli Uva, Eli Wooten, Samuel Kneale, Jesus Figeroua, and Bryan Chaiyasane for their aid in design guidance, testing, and use of their shop; additionally, Dr. Scott Shaffar, Barry Dorr P.E., Michael Lester, Mark Bruno, and Drake Jones at San Diego State University for providing guidance and general manufacturing and design assistance throughout the project cycle.


## SYSTEM LEVEL DIAGRAM

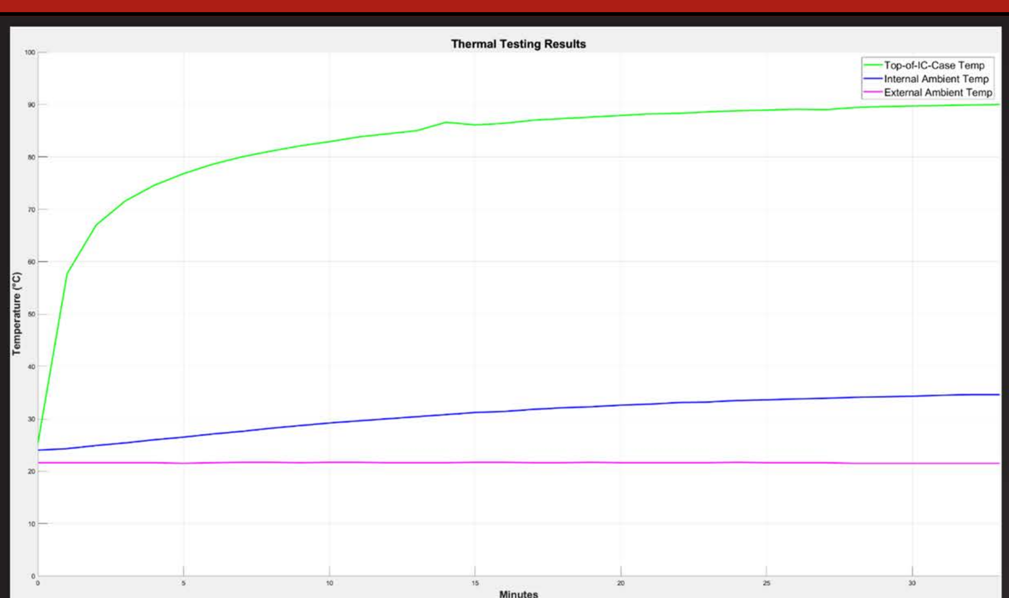



## CAD MODELS



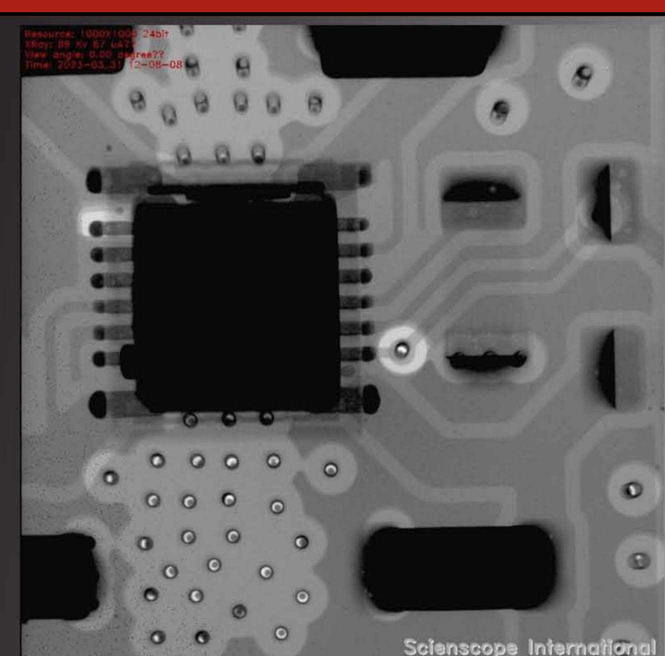



## TESTING METHODS



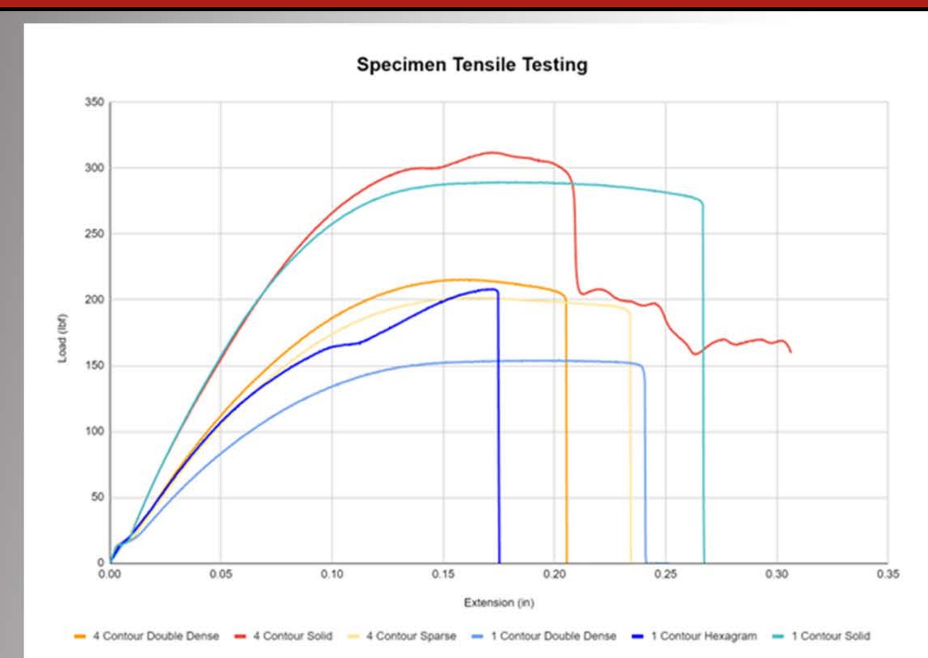

### HEAT SINKING TEST

Testing if the PCB will be an effective heat sink for our 2-buck convertors and if the enclosure will withstand the heat dissipation of our system. The results prove that our PCB is an effective heat sink for our buck convertors and that the enclosure can survive in our system. The graph demonstrates the ambient temperature of 26 degrees. The max temperature of our of the top-of-case for our PCB which was 90 °C. From that 90 degrees we calculated the junction temperature of the LM 317 which gave us 108 degrees which is well within the operational range.



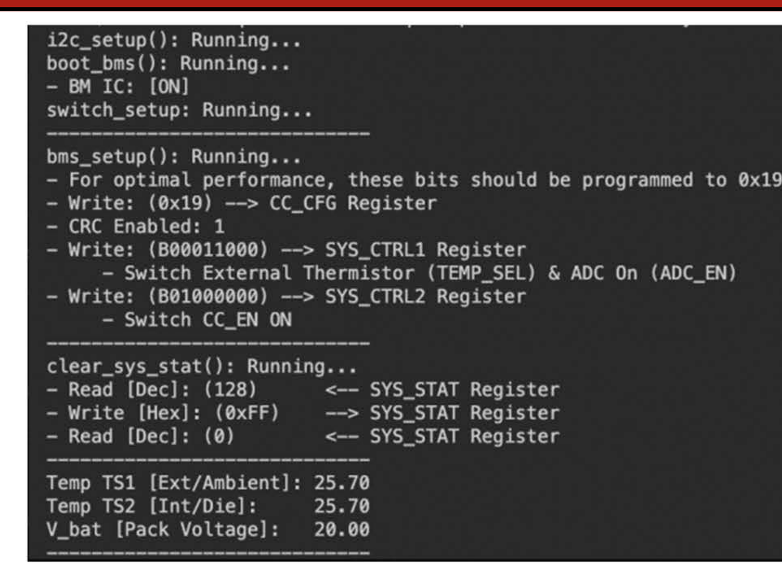

### X-RAY VERIFICATION

X-Ray analysis of the 12V buck converter IC. This test confirmed that the solder joints were formed properly.




### TENSILE TESTING

3D printed PC-ABS dog bone specimens with varying infill patterns and countour numbers were assessed for tensile strength. As expected the highest infilled specimens performed the best, reaching 300 lbf. Contour number did not appear to make a significant impact.




### FIRMWARE DEVELOPMENT

The GLV Firmware first sets up communication between components. It then turns on the main chip, which will boot up the printed circuit board. As shown, the firmware will configure all parameters needed for the desired GLV functionality. After configuration, data is gathered, printed and logged to the SD card, upon the user's request.


Departments of Mechanical, Electrical, and Computer Engineering, SDSU, Spring 2023