LFEV-Y1-2013 Subsystem Compliance Memo

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Abstract

This document presents an analysis of each subsystem of the delivered system presented by the LFEV-2013 team and explains whether or not they were included in the LFEV-2014 system. Delivered components which met all necessary requirements were not to be redesigned as per R003.

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Introduction

The LFEV-2013 team made great bounds in starting this electric vehicle project off on the right path. Much of their research and design sketches produced the general framework for how the entire LFEV system might work together in the actual vehicle. As part of their project, the LFEV-2013 team delivered 7 main components to the system:

1. Safety Controller
2. Load Controller
3. 3-Cell Battery Pack with Cell AMS
4. Charging Unit
5. Central SCADA Computer
6. Pit Station
7. GLV Power Hub

These seven components make up much of the electronics necessary for the electric vehicle to function. However, many of the subsystems either did not work at the beginning of the semester or did not meet the necessary requirements and therefore needed revision.

Subsystem Analysis

Safety Controller

The safety controller operates the safety loop providing ±12 Volts to the AIRs and detects when the safety loop in the system is tripped. It also features three emergency stop buttons and a brake over travel switch designed to shut down the tractive system should any of the stop buttons be pressed or the brake over travel switch is triggered. This system was deemed to be useable for the LFEV-2014 system as it can successfully open the AIRs in the event of any safety loop disruptions. This system will need to be repackaged before being placed in the actual electric vehicle. However, for use as a test apparatus, the safety controller works excellently.

Load Controller

The purpose of the load controller delivered by the 2013 team was to provide a way turn on and off the voltage being applied to their test load without triggering the safety loop and using the AIRs as the means of controlling power to the load. As such, the load controller contains 2 relays which connect the load to the battery pack voltage and are controlled by use of a switch on the outer panel. This subsystem was also shown to be functional sound and was integrated into our current testing setup. As with the safety controller, the load controller will need to be repackaged before being integrated into the electric vehicle.

3-Cell Battery Pack with AMS Units

The LFEV-2013 team delivered a 3-cell pack to demonstrate the general function of the subsystem. Although much of the design concepts were indeed incorporated into the new pack, many features of the pack delivered in 2013 where inadequate for the project.

1. The charging port of the battery back is not isolated, breaking FEV rules that state tractive system voltage cannot be present outside the accumulator containers.
2. The battery pack only uses 3 cells instead of the necessary 7 cells, so the battery pack needed to be expanded to accommodate the additional cells.
3. The wiring inside the battery pack was fairly jumbled and did not meet the spacing requirements between high voltage and low voltage components.
4. I2C was used for communication between the AMS as well as the central SCADA. I2C is not designed for communication over long distances, so a different protocol is necessary for use in the car.

The AMS boards produced by the 2013 team were in pretty good shape for the final design. Much of the original design was retained. However, improved current sensing capabilities were added to fix the shortcomings of the previous AMS systems. In addition, a remote reset ability was added to each of the boards and a smaller heatsink was used in the new AMs boards.

Charging Unit

The same power supply chosen by the LFEV-2013 team to charge battery packs was implemented into the LFEV-2014 design. A revised Anderson connector was built to attach to the charger in order to accommodate the charger port of the new pack design.

Central SCADA Computer

The central SCADA computer had many downfalls in its design and implementation. Foremost, its software would not boot up at the beginning of the semester. In addition, the PICASO uLCD Display Module used did not have much community support and as a result was difficult to program with. In addition, since the communication interface between the AMS and SCADA systems was changed from I2C to RS-485, the SCADA system will need to be redesigned to illustrate these changes. The LFEV-2014 team focused most on self-contained smart battery packs, so the central SCADA computer was seen as outside the scope of the project and therefore not incorporated into the LFEV-2014 test setup.

Pit Station

The Pit Station was designed to record cell data during charging. It would also handle the cell balancing and charge completion algorithms to automatically manage the battery pack during the charging process. This system required the use of a windows netbook to record cell data and

process the cell balancing algorithm. However, the cell monitoring program was extremely slow to run on the windows netbook and it was decided early on that we could not use the pit station in its current form because it was too unresponsive to be useful. In addition, the I2C protocol used for overall system communication was replaced by RS-485, so the pit station needed revision. In addition much of the functionality of the pit station computer has been moved to the Pack Managers within each battery pack.

GLV Power Hub

The GLV Power Hub delivered by the LFEV-2013 team was more than capable of providing the necessary power to each subsystem. There are no issues with its functionality. However, in the actual electric vehicle, the GLV power hub will likely be replaced by a battery, so this unit will only be used for testing and development of the other subsystems of the electric vehicle and will need to be redesigned before implementation into the electric vehicle.

Summary

1. Safety Controller: Integrated into LFEV-2014 system, needs repackaging for vehicle-ready version.
2. Load Controller: Integrated into LFEV-2014 system, needs repackaging for vehicle-ready version.
3. 3-Cell Battery Pack with AMS: Battery pack redesigned for 7 cells and additional pack management hardware, AMS boards slightly revised for LFEV-2014 system.
4. Charging Unit: Same power supply used with different charging port interface.
5. Central SCADA Computer: Not used in LFEV-2014 system, needs to be revised
6. Pit Station: Delivered system not used in LFEV-2014 system. Functionalities incorporated into pack manager in the battery pack.
7. GLV Power Hub: Integrated into LFEV-2014 system, needs redesign and packaging for vehicle-ready version.