To: LFEV-ESCM Team

FROM: Drew Jeffrey and Naing Htet

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SUBJECT: Pack Manager Controller Board Choice

ABSTRACT:

The Pack Manager monitors and controls the charging process of an individual battery pack. This memo details the PM controller that the team chose for the LFEV-ESCM and the reasoning behind this hardware choice.

TECHNICAL FINDINGS:

Our two main choices for the hardware were microcontroller (for example- Arduino Uno) and microcomputer(for example- Raspberry Pi). Both were considered for their small sizes and low power consumption. Microcontrollers are the traditional choice for embedded applications, but we would prefer microcomputers for our familiarity with the development environment and platform. A typical microcontroller consumes at most 100mW and a typical microcomputer consumes around 2W. This poses an issue as a controller using 2W will deplete 11% of the total energy of the pack per day. However, a microcomputer generally provides more processing power and more hardware interfaces to the developer. In the end, we chose a low power microcomputer at around 1W as we decided that having to charge the battery pack once every two months is a reasonable compromise for the developer-friendly environment and more functionalities a Linux OS can offer. A power consumption of only around 1W will not affect the performance of the car on the track as the power consumed by a board operating at this wattage over the course of an approximately one hour endurance race would only equate to about 0.05% of the total pack energy lost due to the controller board.

The following single-board computers were considered in-depth for use in the pack manager: TS-8160-4200, TS-7260 from Technologic Systems and SBC LP3500 from Digi International. The SBC LP3500 utilized a Rabbit 3000 microprocessor, but required use of its own operating system instead of a more maintainable and supported Linux OS. Both the TS-8160-4200 and the TS-7260 support a Linux OS. The TS-7260 was a low powered platform consuming 0.75 W, however it lacked

some of the necessary interfaces including I2C and CAN. Furthermore, TS-7260 was released in 2005. Furthermore, The TS-8160-4200 features an ARM Atmel AT91SAM9G20 processor which allows it to use around 1 W of power under typical operating conditions. It also operates from 5-28V which will not require us to use an external voltage regulator on the breakout board we will design. For peripherals it contains 2x USB ports, 4x RS-232, 1x SPI bus, 1x I2C bus, 2x Text LCD headers, 1x PC/104 bus, and 1x Ethernet port. There are 28 DIO pins and 6 A/D pins, sparing the need for external A/D conversion chips for pack voltage measurements. One board costs around $308 including an additional $69 PC/104 to CAN peripheral board available for purchase to add CAN support to the TS-8160-4200.

RECOMMENDATIONS AND DECISIONS:

We recommend the TS-8160-4200. The main reason we chose TS-8160-4200 over other similar devices is its support for sleep mode. This means that the device can run at a very low power when it is not used. This device fulfils all the requirements listed in our Pack Manager Controller Requirements document attached. The device features I2C interface (R-1.1, R-1.4, R-1.6, 1.14). It also features an SPI interface which can be used for CAN communication and an LCD display (R-1.2, R-1.8, R-1.11). It can also read, write, and boot from 2 SD cards(R-1.3, R-1.13). The board also has 28 digital IO pins (R-1.5, R-1.7). The device is compatible with linux OS which the team is very familiar developing with. (R-1.10, R-1.15, R-1.16)

Technologic Systems offers full technical support, well-documented product manuals, Linux drivers, schematics, developer forums and product wiki pages. (R-1.9). Technologic Systems guarantee 8+ year product life cycle for all their products. The products will still be in production 8-10 years after their initial release. Our recommended product was released on July 2013. Therefore, the product will not be discontinued for at least another 7 years. (R-1.12). The suggested board also uses Linux, an open source OS which is widely used and frequently updated.

ATTACHED DOCUMENTS AND USEFUL INFORMATION:

Pack Controller Requirements Document
Product Website: http://www.embeddedarm.com/products/board-detail.php?product=TS-8160-4200
Tech Support Contact:
Mike Peters - (480) 837-5200