Control of PMAC motor for an electrical kart

Semester project. Ver. 1.
1. Semester – Electronics – spring 2018.

Brushless permanent DC (BLDC, PMAC) motors is very important in the electronics industry today, since they are more robust, have higher torque, higher efficiency, lower noise, lower EMI generation compared to brushed motors. Since the electrical commutation of the motors are more complex and requires knowledge of the rotor position, an electrical motor controller is required to keep the motor spinning.

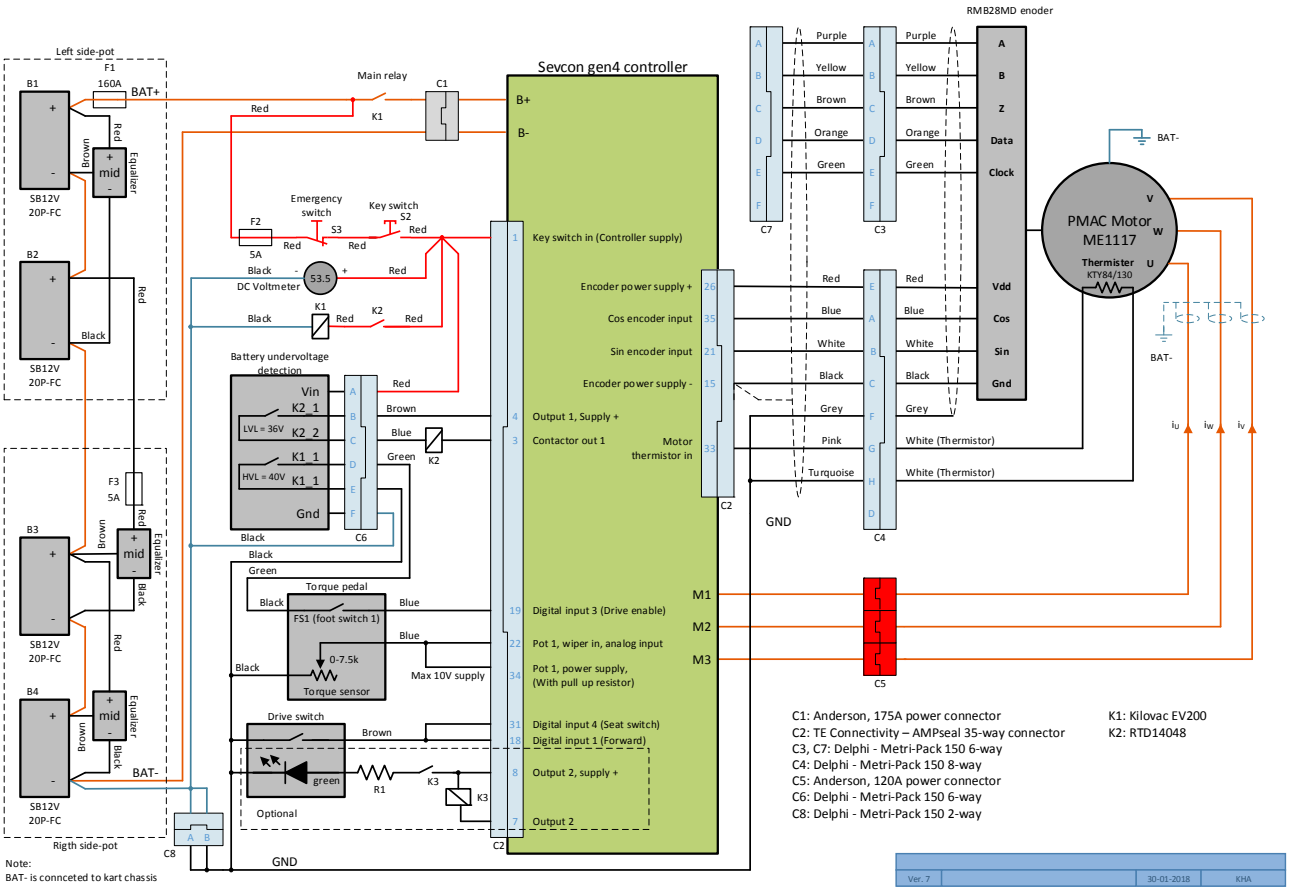

Figure 1. Wiring diagram of SDU's electrical kart.

SDU's electrical kart consist of a Lifepo4 Battery pack with a nominal voltage of 51.2V and fuses. A control part, which controls the main safety relay between the battery and the Sevcon gen4 controller, a battery under voltages shutdown detection circuitry for protection against battery under voltage, control switches and a torque sensor. The Sevcon gen4 motor controller controls the PMAC motor (ME1117) and the motor is equipped with a position encoder module (RMB28MD). The module outputs the relative or absolute position of the rotor as described in the modules datasheet.

Project description:
The goal of this project is to design and implement a motor controller, which can replace the Sevcon gen4 motor control used in SDU electrical kart (The green part of figure 1.). The new controller must use the same type of connectors (C1-C3, C5, C8) shown in figure 1. as interface. The motor controller should only be able to control the PMAC motor in forward direction. In order to minimize the complexity of the solution, avoid drive in reverse direction, change of direction, support for regenerative braking and other advance functionalities/features.

Figure 2. shows, a possible solution for the motor controller, where the Sevcon gen4 controller is replaced with a self-designed 3-phase bridge inverter, interface board and an Zybo board with a Xilinx Zynq FPGA.

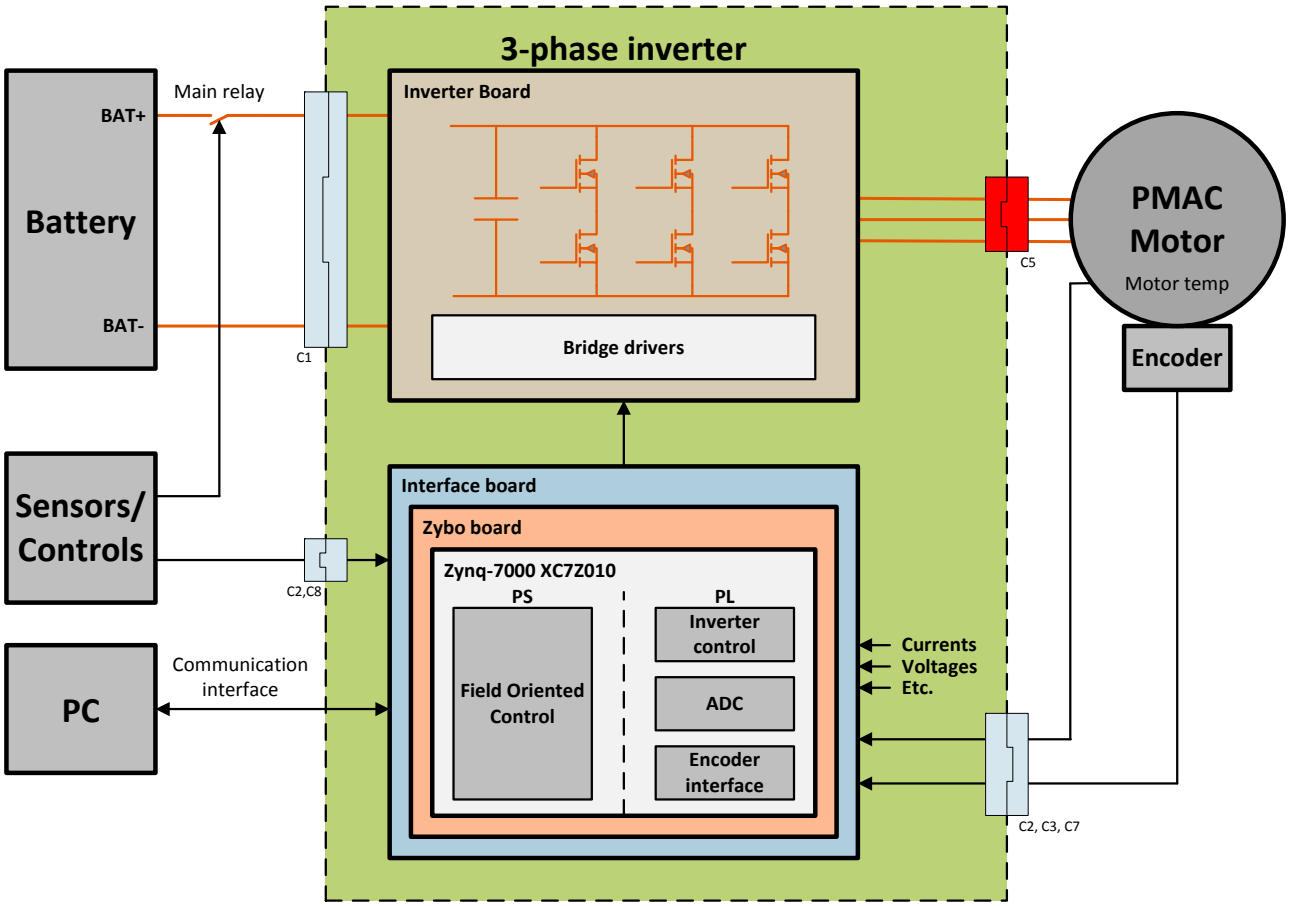

Figure 2. Simplified diagram of PMAC motor control solution, based on a self-designed 3-phase inverter, interface board and a Zybo board.

Project requirement:

- The solution must use a Zynq FPGA and a self-designed 3-phase inverter to control the PMAC motor.
- It should be possible to set and get relevant parameters through a communication interface by a computer. Note: It is possible to use the UART interface on the Zybo board as communication interface.
- It is not allowed to change any mechanical or electrical parts on the kart, except replacing the Sevcon gen4 controller.

The below documents/materials can be found on Blackboard.

- Wiring diagram for SDU's electrical kart
- Sevcon gen4 manual
- Schematic of "Battery under voltage detection" circuitry
- A Vivado project, which includes an Encoder interface IP-core and a demo project which uses the Encoder IP-core to output the position of the encoder through the UART on the Zybo board.
- Application note. Implementation of a Speed Field Oriented Control of 3-phase PMAC Motor using TMS320F240.
- Relevant datasheets

The report:

The report must contain documentation for the work done during the project period including analysis, design, implementation, test and conclusion. The maximum numbers of pages is 70 pages, (A4 size, text size 12, margin minimum 3 cm), including appendixes, but excluding program code (C, C++, VHDL etc.).

Each group must submit two-hardcopy and one electronic version (PDF format) of the report no later than 29. Of May 2018 at 12.00. Each hardcopy version must be submitted to the supervisor and include a CD or USB stick with all relevant documents/information, such as Matlab/Simulink scripts, program code, diagrams, Xilinx project etc. The electronic version and all relevant documents/information must be uploaded to Blackboard.