

# Control of PMAC motor for an Electric go-kart

## Semester project

### 1. Semester – Electronics – spring 2021

Brushless permanent magnet (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.

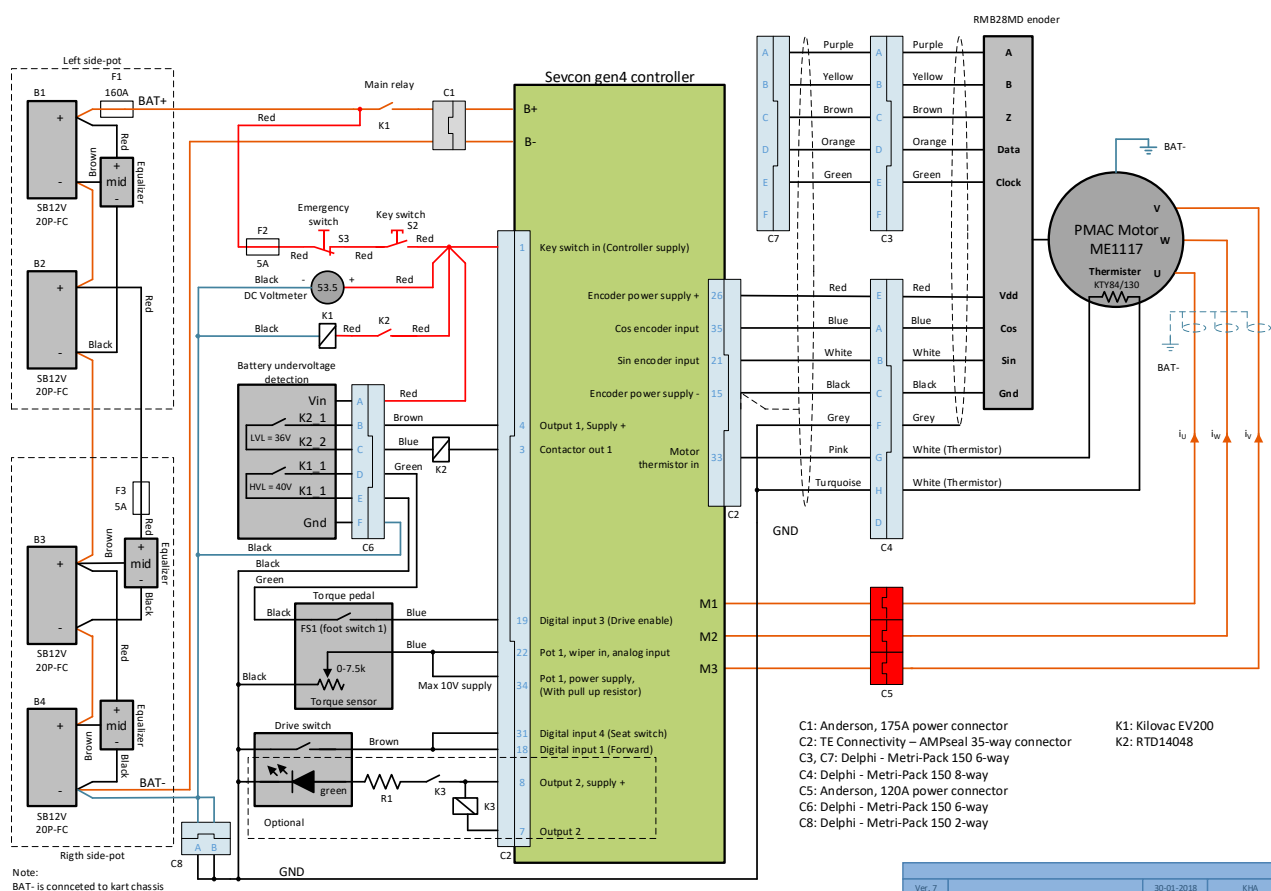


Figure 1. Wiring diagram of SDU's electric go-kart.

The wiring diagram of SDU's electric go-kart, shown in figure 1 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 motor 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 self-designed motor controller, which can replace the Sevcon gen4 motor control used in SDU electric go-kart (The green part of figure 1.). The new controller must use the same type of interface connectors (C1-C3, C5, C8) as shown in figure 1. The motor controller should only be able to control the PMAC motor in forward direction. In order to minimize the complexity of the project 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.

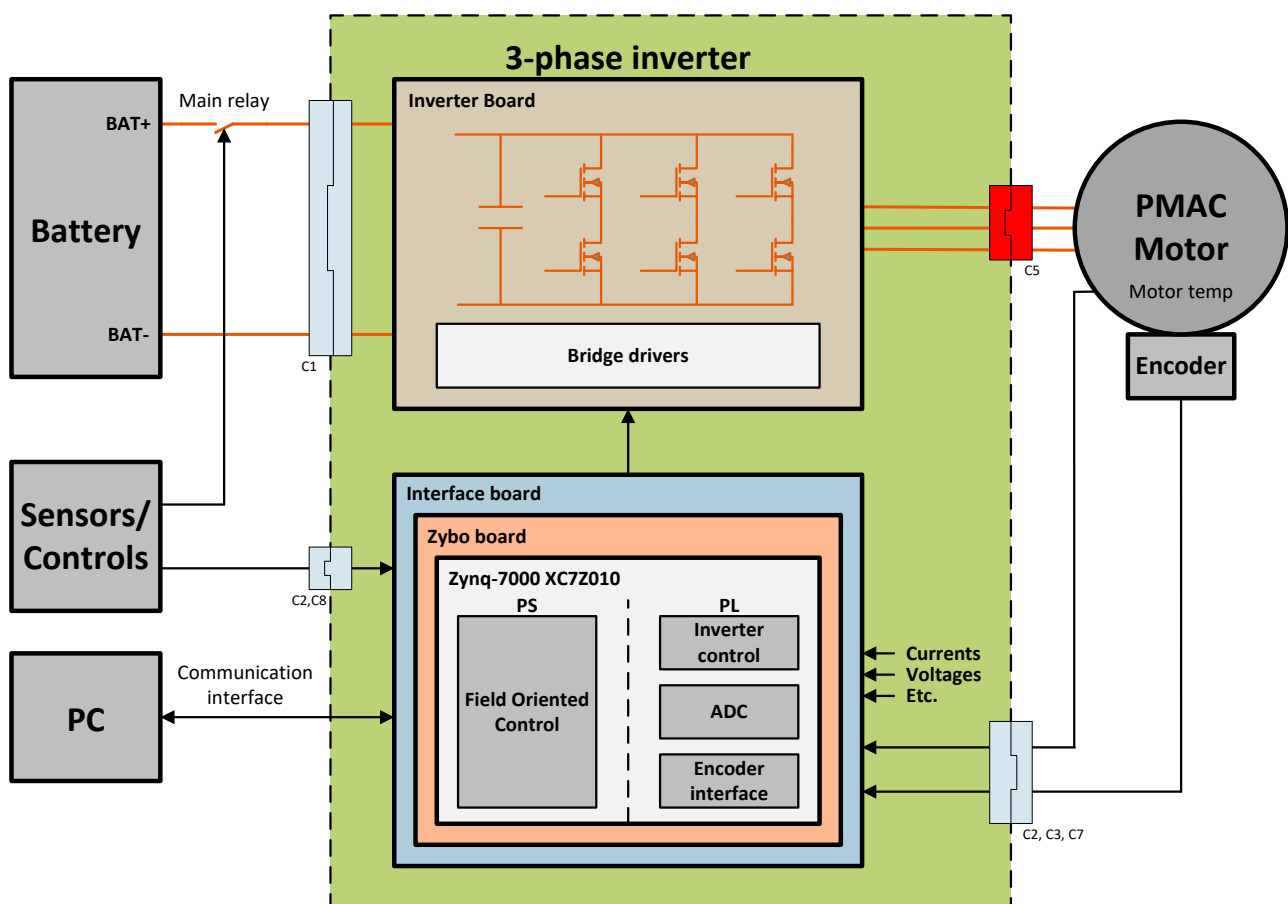


Figure 2. Simplified diagram of PMAC motor control solution, based on a self-designed 3-phase inverter, interface board and a Zybo board.

**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.

**Final project 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 upload an electronic version (PDF format) of the report and related documents/information, such as Matlab/Simulink scripts, program code, diagrams, Xilinx project etc. to Digital exam platform not later than 25<sup>th</sup> May, 2021 at 12.00.