Electrical Engineering
Energy in Transition

THE HAGUE UNIVERSITY OF APPLIED SCIENCES

DC Project – SELV EV Motor Driver

A Safe Voltage Level For EV Motor Controllers

Client: *The Hague University of Applied Sciences*
Research Group Energy in Transition

Mentors: *P. J. van Duijsen* (*P.J.vanDuijsen@hhs.nl*)
D. C. Zuidervliet (*D.C.Zuidervliet@hhs.nl*)

Duration: *Shift 3 & 4*

Start date: *PROk 2020-2021*

Location: *The Hague University of Applied Sciences – Delft*

Theme: *Direct Current Research*

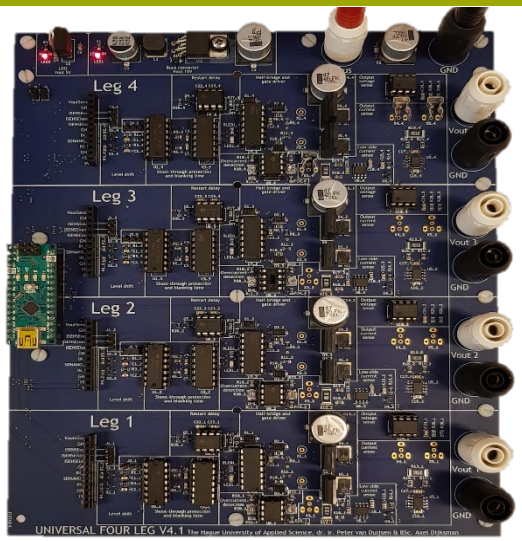
Introduction

Typical 24 volt systems have been popular in Europe for some time. In the early 2000s, proposals for 42-volt systems fizzled out because of cost concerns and practicality. Compared with 24V, only half as much current is required to get the same power. Today, the industry seems better prepared, thanks to a better understanding of their capabilities.
48V's limited range of 30-60V has led to its re-emergence. The reason this range is effective, regardless of capping voltages below a 60V cut-off, is because they meet Safety-Extra Low-Voltage (SELV) requirements. 48V can distribute power to your commercial EV components, minimising copper losses without causing unsafe SELV issues. The output can reach 57.6V before the power supply shuts down, and protects your downstream circuitry from damage.

Source: [https://www.dalroad.com/resources/48-volt-what-it-is-and-why-its-important/]

Assignment

For this assignment you will design a 48Vdc motor driver circuit compatible with a C2000 as a microcontroller. So called booster circuits that are sold as demonstration kits give a good representation of the components needed for the hardware in combination with the C2000. PCB designs can be found in the application notes of these booster circuits. Circuit should be simulated in CASPOC, after testing the circuit in CASPOC the schematics and PCB files can be designed in KiCad. Next to the PCB the code for the TI C2000 can be tested on the Universal Four Leg (U4L). Multiple small size motors can be used (hoverboard) can be used to test the implementation of the control code.



Source: [https://conti-engineering.com/highlights/new-mobility-ecosystem-development-kits/48v-drive-system-kit/]

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For this assignment we have the following requirements:

- Simulation models of the full circuit using CASPOC Simulation Research.
- Design a 48Vdc motor drive PCB (KiCAD) with the footprint of a TI C2000 as microcontroller, the maximum power will later be determine. Voltage limit will be 60Vdc, current will be around 100A.
- Thermal calculations for the power electronics, also thermal simulations with CASPOC.
- Verify accurate voltage and current measurements, needed for accurate control.
- The motor should be controlled trough FOC (Field Oriented Control).
- Possibility to use RPM control.
- First code can be tested on the Universal Four Leg (U4L), limitations will be 10A depending on the motor.

Deliverables

The following products must be delivered during the assignemntt :

- A plan of approach with an analysis of what is needed to achieve the desired result within the first two weeks.
- Simulation models (if needed) (using CASPOC Simulations). (http://www.caspoc.com/support/download/)
- A PCB design of a SELV EV Motor Driver using the TI C2000, also with simulation models.
- Final report in Paper format (not more than 6 pages), include additional Appendix I, II, III (this can be Simulations/PCB-Designs/Measurements,etc.) and all in one LaTaX file.
- Progress report from all students in a weekly progress format, all in one LaTaX file.
- All reporting is done online with Overleaf (LaTaX). (https://www.overleaf.com/) and the online files are shared with the mentors.
- All documents / designs / simulations are shared online trough Microsoft Teams. All organized within folders and sub-folders, all files should have a good name, version numbers and date stamps.
- Design a project poster on A1 format, this poster should be able to sell your product.
- YouTube recording with a step by step system overview, this should be an educative clip where you give a demonstration, use recorded material you gain during the weeks you work on this project.
- Finished with a Power Point presentation in the assessment-week.

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Electrical Engineering, P.J. van Duijsen, D.C. Zuidervliet
Faculty of Technology, Innovation & Society, TIS