IFEC 2019

Design proposal of drive for E-bike

1. Introduction

Use this section to provide a high-level introduction to the design, including major features and innovations. The proposal should not have any identifying information regarding the team, institution, country, members, faculty advisors, sponsors, etc. Any such information in the proposal will disqualify the team from the competition.

2. System Block Diagram

Provide a high-level block diagram for the overall system that includes source, load, power circuit, control, sensing and user interface, along with a description of the relationship between the blocks.

3. Circuit topology

Provide a power conversion circuit diagram (source to load) that includes only ideal power processing components (inductors, capacitors, semiconductor switches, transformers, etc).

4. Control and protection

In this section, provide an overall approach to the realization of the drive control and protection.

Controller Block diagram

Provide a block diagram of the controller in the s-domain or the z-domain, either in single phase, three phase (abc) or other coordinate system (D-Q, $\alpha\beta$, etc.) along with an explanation of the various blocks.

Controller Hardware

Provide a detailed description of the hardware realization of the control block-diagram, identifying any FPGAs, ASICs, Microcomputers, DSPs, etc. along with any high-level circuit diagrams if necessary. Please do not provide printed circuit board schematic diagrams here.

Software flow-chart

Provide a state transition diagram or flowchart along with a high-level description of your software operating modes. This may include interrupt timing, protection flags, user interface, power up/down sequence, etc…

5. Design analysis

Power circuit components

Document your design approach used to select power circuit components and their ratings.

Losses, efficiency and thermal analysis

Show detailed calculations that have been used to determine the losses in the power converter and how they relate to the thermal design of the converter to meet the design requirements.

Sensing, protection, control and interface hardware

Justify the selection of additional sensors and protection components, interface hardware (such as gate drives, house-keeping power supplies) that are used in your design.

Electro-mechanical assembly

Provide a sketch of the electromechanical assembly of the system along with details of where different components are mounted, how they are held together, etc.

6. Simulation results

Provide results from a computer simulation of the drive including ideal switch model for the power converter(s), block-diagram level controller for the system, electromechanical model for the motor showing steady state waveforms at 250W motor output power, over two electrical cycles of the output waveforms illustrating

The diagram should include the following:

- Battery current
- Motor 3-phase currents
- Motor 3-phase voltages
- Motor electrical speed
- Motor electrical torque

7. Cost analysis

Provide a high-level cost estimate for a quantity of 500 units including materials, components, printed circuit boards, wiring, mechanical enclosures, and fasteners. The high-level cost estimate is a summary not a complete Bill of Materials (BOM). Submit a complete BOM as a separate excel document. The BOM should include manufacturer part number, description, quantity, vendor, vendor part number and price. If possible, use verifiable published prices (no quote, except for PCB's) from vendors such as Digikey, Newark, mouser, allied, etc...

8. Conclusions

Provide an overall summary of the design. This document should be less than 25 pages, including figures, tables, photographs, references. Entire document should also conform to the minimum 11-point single spaced Times-Roman (except for special symbols such as μ) font including figures, tables, references etc. Figure captions and table captions should be italicized.

9. References

Provide a list of references cited in the design.