Star Program Assignment

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- The first two parts are given to help you efficiently conduct your research project. If you are not convinced, please refer to: http://keysan.me/okst/ :)
- We want you to contribute to theoretical parts as well, or at least understand it, not just improve your practical skills on using some software.
- Go step-by-step in your assignment. If you got stuck, please do not hesitate to consult us. You can always send e-mails, or drop by to PowerLab offices to talk in person.
- Try to show your progress and get feedback from us during the assignment. Do not wait until you have a "final" version. Github is a good way to show your progress.
- We encourage you to work with your friends, share ideas and help each other. They are NOT your opponents. After all, Research League is a team !

1. Version Control

- Learn about version control. You may refer to: http://keysan.me/presentations/is500/version_control.html
- Get a Github account, follow https://github.com/ozank and https://github.com/mesutto/
- Download Sourcetree (https://www.sourcetreeapp.com/)
- Create your first repository and make your first commits
- **Use Github to reveal your progress during this assignment**

2. Research Tools

- Get a Mendeley account (https://www.mendeley.com/) and follow https://www.mendeley.com/profiles/mesut-ugur1/ and https://www.mendeley.com/profiles/ozan-keysan/
- Download Mendeley to your computer and add papers of your interest to a folder you created
- Check the properties (taking notes, highlighting etc.)
- **Use Mendeley to reveal your research progress during this assignment**

3. Join to PowerLab Maillist - Seminars

- Please visit PowerLab web page (http://power.eee.metu.edu.tr/)
- Join to the PowerLab maillist (http://power.eee.metu.edu.tr/join-us/)
- Attend to the PowerLab Seminars (http://power.eee.metu.edu.tr/seminars/) and workshops

4. Research Topic

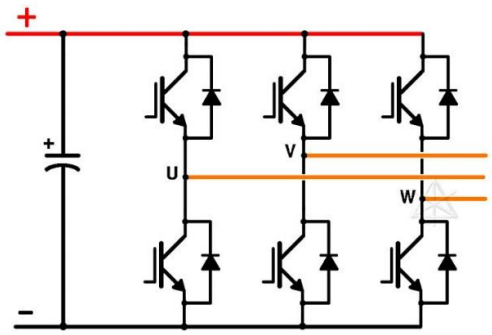
- Add the following papers to your mendeley folder and study them throughout this assignment.
    - Tenconi, F. Profumo, S. E. Bauer, and M. D. Hennen, “Temperatures evaluation in an integrated motor drive for traction applications,” *IEEE Trans. Ind. Electron.*, vol. 55, no. 10, pp. 3619–3626, 2008.
    - J. Wang, Y. Li, and Y. Han, “Evaluation and design for an integrated modular motor drive (IMMD) with GaN devices,” *2013 IEEE Energy Convers. Congr. Expo. ECCE 2013*, no. Immd, pp. 4318–4325, 2013.
    - S. M. Lambert, B. C. Mecrow, R. Abebe, G. Vakil, and C. M. Johnson, “Integrated Drives for Transport - A review of the enabling thermal management technology,” *IEEE Veh. Power Propuls. Conf.*, pp. 1–6, 2015.
- Prepare a brief presentation (10 minutes long) related to the papers.

5. Challenge

Thermal modeling, analysis and heat sink selection for the power electronics of a 100 kW grid connected wind energy system.
In this assignment, you are asked to:

- Obtain the thermal model of a three phase inverter with the given specifications
- Analyze the thermal model via computer simulations
- Design and select a proper heatsink for the system

The inverter circuit diagram is shown below. There are a total of 6 IGBTs and 6 anti-parallel diodes. A dual IGBT-diode package will be used for each leg and its datasheet is given: http://www.pwrx.com/pwrx/docs/cm300dx-24s.pdf



- Power loss data of each component will be provided.
- The ambient temperature will be 40 ^{0}C.
- **Operating junction temperature of any device should not exceed 80 % of its maximum value.**
- The analysis can be applied at steady state.
- Forced air cooling should be applied. You can select the heat sink (with a fan) from: http://www.fischerelektronik.de/en/
- After the design is finalized, find the required heat sink with natural cooling (no fan).

Bonus-1: Calculate the component power losses under a given operating condition; i.e., verify the power loss data given to you.
Bonus-2: Apply transient state analysis by considering thermal storage in your model.