

## Department of Electrical & Computer Engineering

### ECED – 3901 Design Methods II

#### Assignment #2

**Due: June 4th, 2015 @ 12:30 PM - Submitted via BBLearn Website (PDF files only), OR printed files in 3901 Mail-Slot at ECED Office**

NOTE: See Dr. Gregson's ECED3901 Manual, available on BBLearn, for details of the motor driver, which includes solutions to most of these problems.

1. What is the purpose of the commutator and brushes on a DC motor?
2. A motor has an inductive component. Example the following:
  - a. What happens when we try changing the current flow through the inductor (i.e. if we turn the power off to the motor)?
  - b. Why is what happens in part (a) a problem?
  - c. We can solve this problem by adding a diode. Explain how it solves the problem and which way is it installed.
  - d. The H-Bridge or Full-Bridge MOSFET-based driver does not require individual diodes. Why is this?

1. Fill in the following table, using the datasheets on BBLearn, or find them online:

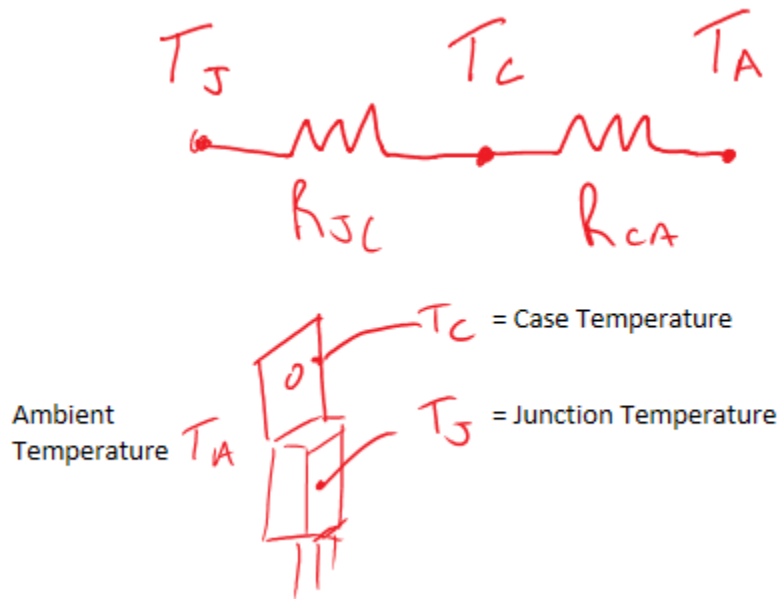
FQP27P06: <https://www.fairchildsemi.com/datasheets/FQ/FQP27P06.pdf>

HUF74321P3: <http://ecee.colorado.edu/ecen4517/components/parts/HUF75321P3.pdf>

MOSFET Part Number	Type (N- or P-Channel)	Approximate minimum gate-source Voltage to Carry 20A *Be sure to specify + or – voltage*	Maximum continuous drain current @ 25°C
FQP27P06			
HUF74321P3			

3. The power dissipation of a device is important in the design of any sort of power electronics (such as motor driver or power supplies).
  - a. What is the problem with very slow transitions in the MOSFET, how does it affect power dissipation?

- b. A MOSFET has a maximum junction temperature of 125°C. You have the following thermal model of a MOSFET:



And the following values:

Maximum $T_J$	125 °C
$R_{JC}$	3.2 C/W
$R_{CA}$	45 C/W

Assume we are modelling the on-resistance of the MOSFET as a constant 0.1 ohms. What is the maximum current your MOSFET can continuously handle, assuming ambient temperature is 25°C, and the requirement to limit the junction temperature to 125°C.

- c. Assume instead we have an additional requirement that the case temperature of the MOSFET must stay below 80°C, as we wish to avoid badly burning someones finger that touches the MOSFET. Is the current limit reduced, and if so what is the new limit?