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**SEE 4722**

FAKULTI KEJURUTERAAN ELEKTRIK
UNIVERSITI TEKNOLOGI MALAYSIA
KAMPUS SKUDAI
JOHOR

LABORATORY NAME
STUDENT PACK

4-Quadrant Converter for DC Motor Drives

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1. **Problem/Project Guide:**

A 4-quadrant DC-DC converter is used to control the DC motor drives that require forward and reverse motoring as well as forward and reverse braking. The four quadrant converter for DC motor drive which we will study in this lab consists of four power switches (IGBTs with anti-parallel diodes). Figure 1 shows the topology and control of this converter when it is used to fed a DC motor.

![Diagram](image)

Your task is to simulate the 4-quadrant converter and its control using SIMULINK and to show that the converter is indeed capable of operating in all quadrants of operation. You are then required to implement this 4-quadrant converter using the equipment modules available in the lab. The SIMULINK model of the DC motor can be downloaded at [http://encon.fke.utm.my/nikr/dc_motor.mdl](http://encon.fke.utm.my/nikr/dc_motor.mdl). You should also compare and discuss on the waveforms obtained from the simulation and experiment.

(a) **Problem-solving Time-line**

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<tr>
<th>Activities</th>
<th>Week1</th>
<th>Week2</th>
<th>Week3</th>
<th>Week4</th>
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<tr>
<td>Study on the 4-Q converter and its control</td>
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<td>Simulation of the 4-Q converter</td>
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<tr>
<td>Implement the 4-Q converter using the lab modules</td>
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(b) **Report Writing**

Prepare your report based on the general guide specified by the Laboratory Coordinator. Your report for this laboratory must also include,

- Discussion on the basic operation of 4-quadrant converter
- SIMULINK model and simulation results of the 4-q converter
- Experimental results from oscilloscope
- Discussions on all the simulation and experimental results

You are also expected to produce a two-page report on the progress of your project at the end of the second week. The format of your initial report can be obtained at [http://](http://)
2. Equipments list:

1. DC motor: $R_a = 8\Omega$, $L = 3.9\text{mH}$, Back EMF constant $= 0.0518$ $\text{V/\text{rad}}$.
2. DC generator to be used as a tacho generator (speed sensor).
3. DC power supply (input DC voltage for the converter): set to 30V.
4. Modules from the bench:
   a) 4 IGBT switches to construct the 4-quadrant DC-DC converter (735342).
   b) PWM generator (735341).
   c) Voltmeter.
   d) Ammeter.
   e) Potentiometer (73402).

Please ensure that your circuit is checked by the lab supervisor/facilitator before running the experiment.

3. Components list:

4. Softwares:

Matlab/Simulink Student Version Release 14 (available in the laboratory)

The SIMULINK model of the DC motor can be downloaded at http://encon.fke.utm.my/nikr/dc_motor.mdl

5. Additional resources:

You are expected to have the basic knowledge in power electronic DC-DC converter.

A brief description of 4-quadrant operation (just to help you get started) can be obtained at:

   http://encon.fke.utm.my/nikr/fourq.html

Knowledge in Matlab/SIMULINK will be an added advantage.

6. References: