

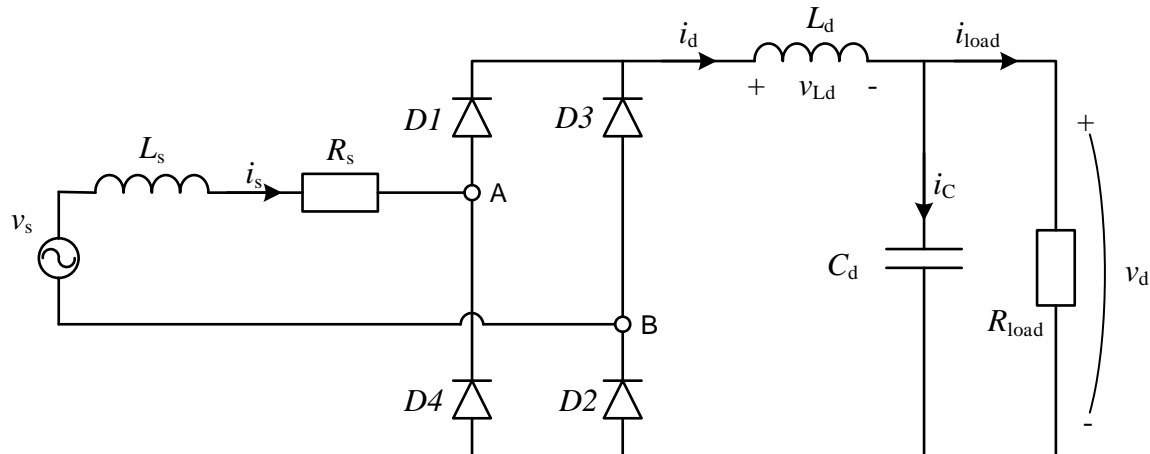


Assignment 6

Single- and Three-Phase Diode Rectifier

The questions marked HA are home assignments to be completed before the laboratory starts.

Single-phase diode rectifier



Voltage stiff DC side

Source voltage	$v_s = 169.7\text{V}$
Source frequency	$f_s = 60\text{Hz}$
Source inductance	$L_s = 1\text{mH}$

DC capacitance	$C_d = 20\text{mF}$
Load resistance	$R_{\text{load}} = 5\Omega$
DC inductance	$L_d = 10\text{nH}$

Current stiff DC side

Source voltage	$v_s = 169.7\text{V}$
Source frequency	$f_s = 60\text{Hz}$
Source inductance	$L_s = 1\text{mH}$

DC capacitance	$C_d = 10\mu\text{F}$
Load resistance	$R_{\text{load}} = 5\Omega$
DC inductance	$L_d = 1\text{H}$

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Tasks/Questions:

HA 1: Sketch the waveforms of the voltages and currents for the single-phase diode bridge rectifier with a voltage stiff DC side (neglect L_d and assume a large C_d) and with a current stiff DC side (neglect C_d and assume a large L_d).

1. Do the current and voltage waveforms agree with the ones you have already sketched?

HA 2: How do you determine the input power factor as well as the input displacement power factor?

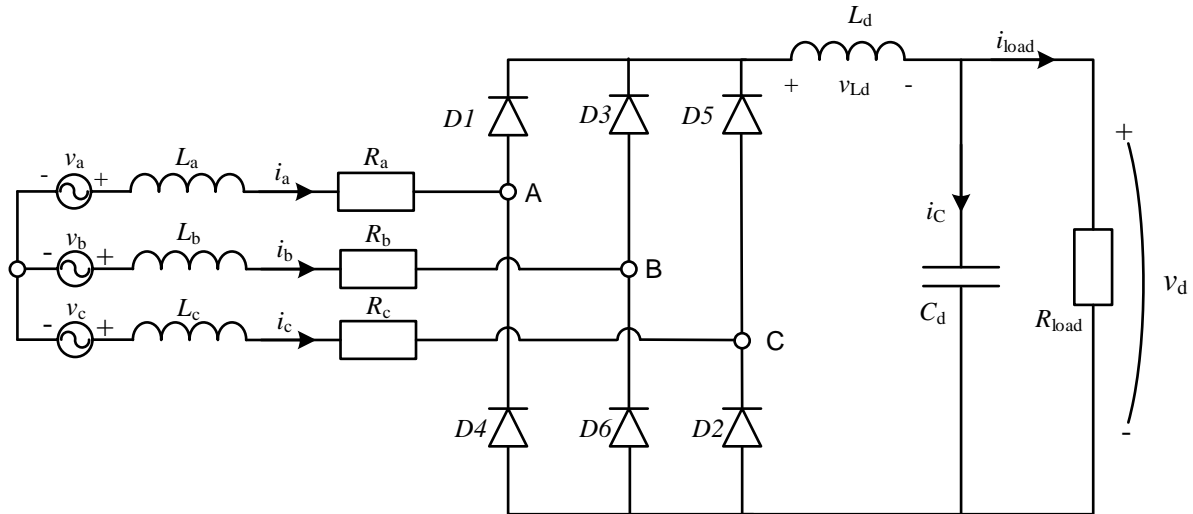
2. Determine the input power factor, the input displacement power factor, the ripple output voltage and the input current THD. Compare the two types of DC sides. Compare with figure 5-18 in Undeland.

HA 3: What is the effect of the source inductance?

3. For current stiff DC side, determine the commutation angle for $L_s=1\text{mH}$ and $L_s=0.5\text{mH}$. What influence does the source inductance have on the commutation angle and the output voltage?
4. Change the source inductance to $L_s=1\text{nH}$ and study the waveforms for both current stiff and voltage stiff DC-side. What happens with the waveforms?



Three-phase diode rectifier



Voltage stiff DC side

Source voltage	$v_{a,b,c} = 230V$
Source frequency	$f_{a,b,c} = 50Hz$
Source inductance	$L_{a,b,c} = 100\mu H$

DC capacitance	$C_d = 5mF$
Load resistance	$R_{load} = 5\Omega$
DC inductance	$L_d = 10nH$

Current stiff DC side

Source voltage	$v_{a,b,c} = 230V$
Source frequency	$f_{a,b,c} = 50Hz$
Source inductance	$L_{a,b,c} = 100\mu H$

DC capacitance	$C_d = 10\mu F$
Load resistance	$R_{load} = 5\Omega$
DC inductance	$L_d = 500mH$

Source file: *assignment_6b.opj*

Tasks/Questions:

HA 4: Sketch the waveforms of the voltages and currents for the three-phase diode bridge rectifier with a voltage stiff DC side (neglect L_d and assume a large C_d) and with a current stiff DC side (neglect C_d and assume a large L_d).

- Do the current and voltage waveforms agree with the ones you have already sketched? When does the phase current flow from the source?
- For current stiff DC-side, determine the average current in diode D1. Assume that the forward voltage drop is $V_f = 1.2V$ and calculate the power losses in the six diodes.
- Change the source inductance to $L_{a,b,c}=1nH$ and study the waveforms for both current stiff and voltage stiff DC-side. What happens with the waveforms?