

ENEL 672: Power Electronics for Renewable Energy

Instructor: Dr. Ignacio Galiano Zurbriggen

Teaching Assistants: Ignacio Santana, Nicolás Agüero

Assignment 1

- Due on February 14^h, 11:59 pm.
- Submit a PDF file through D2L.
- Submit a typed report including the procedure and steps followed to reach the results. Lengthy derivations can be included in a non-typed appendix.
- Late submissions will be accepted, with a 10% mark deduction per day of delay.
- A 10% mark deduction (minimum) will be applied to hand-written assignments.
- Unprofessionally presented reports may be rejected.

1. (30%) In the power conversion architecture shown in Fig. 1:

find the maximum power at the output and the maximum current at the input of each converter. Converter I should be capable of keeping the 400V bus constant even when the load power is maximum, and the batteries are being charged at full power.

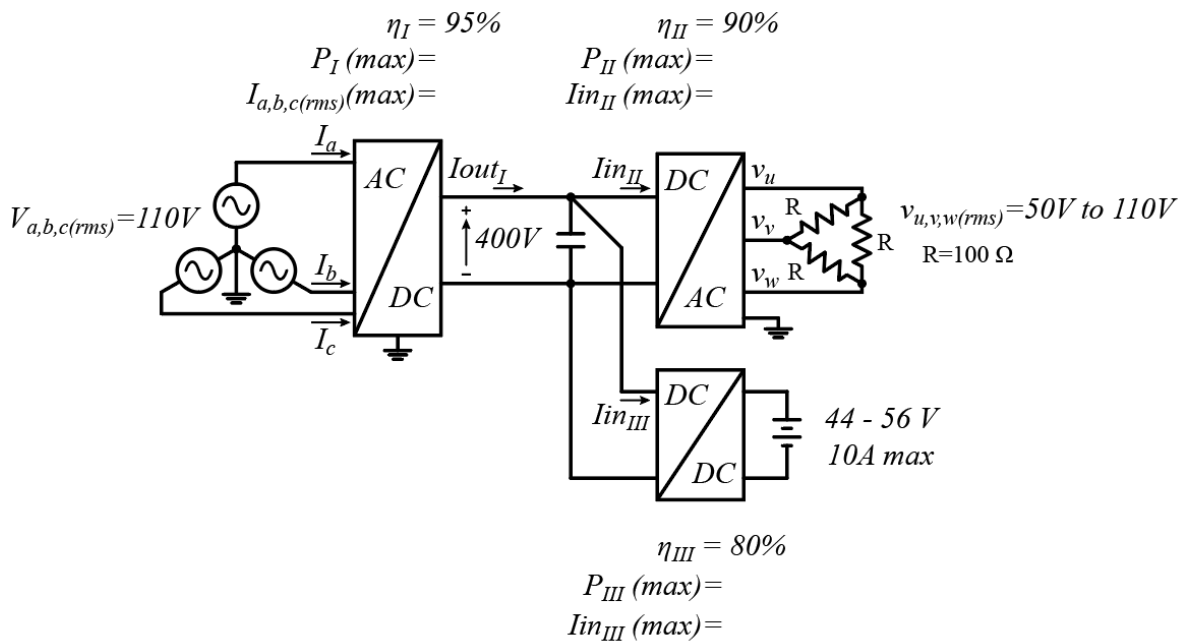


Fig. 1 – Power Architecture

2. (30%) Using the circuit in Fig. 2 and the following parameters:

- $v_{in} = \sqrt{2} 110 \sin(\omega t) \text{ V}; \omega = 2\pi 60 \text{ rad/sec}$
- $N1:N2 = 2:1$
- $R1 = 1 \Omega, R2 = 1 \Omega, R3 = 3.75 \Omega$
- $L = 2.5 \text{ mH}$

- Calculate magnitude and phase of the input current.
- Calculate the value of the capacitor, to be added in parallel with the input source, required to obtain a unity power factor.
- Simulate the circuit of Fig. 2 in PLECS for the scenarios posed in points a) and b). Plot input voltage and current in time domain (along with any other variables you consider relevant). Verify your calculations match the results obtained in simulation.

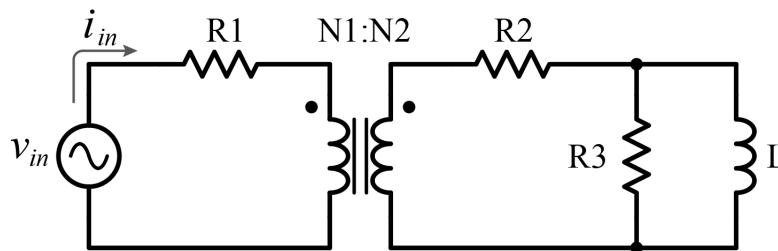


Fig. 2 – AC Circuit

3. (40%) Fig. 3 illustrates an ideal 3-Phase rectifier with the following parameters:

- $V_{a(rms)} = V_{b(rms)} = V_{c(rms)} = 120 \text{ V}$
- $\omega = 2\pi f; f = 60 \text{ Hz}$
- $R = 10\Omega$

- Calculate the average and peak-to-peak values of the output voltage and current.
- Simulate the circuit in Fig. 3 using PLECS and plot the output voltage, output current and the current in each diode.
- Explain what you observe from the waveforms. What diodes are conducting at each portion of time? What is the conduction angle for each diode? Explain why.

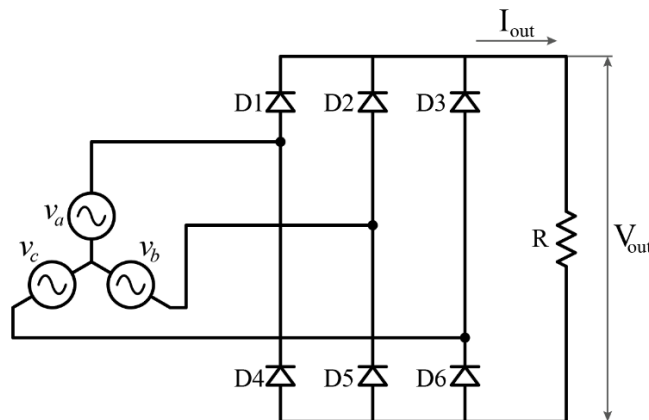


Fig 3 - Three Phase Rectifier