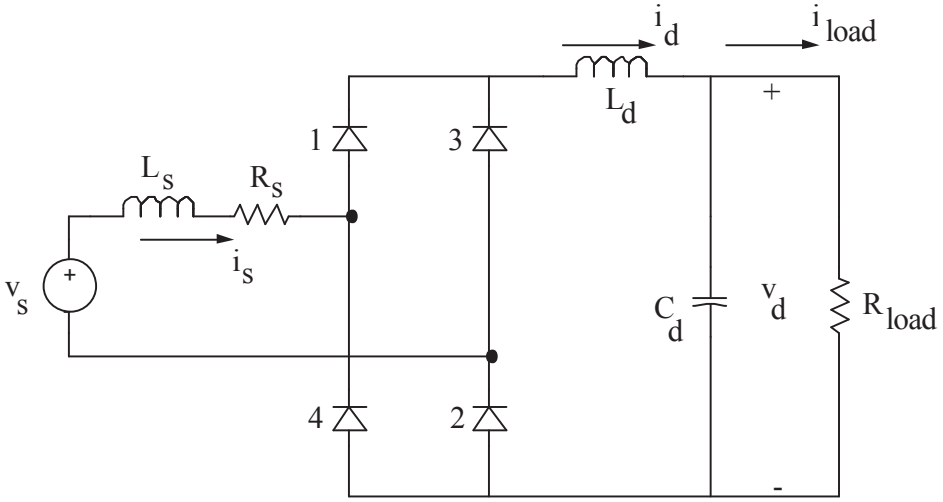
Example 1

1-Phase Diode Bridge Rectifier



Nominal Values: V_S(rms) = 120V at 60 Hz
L_S = 1 mH
R_S = 10 mΩ
L_d = 1μH
C_d = 1,000 μF
R_{load} = 20 Ω

Problems

1. Execute DBRECT1 to obtain v_S, i_S and v_d waveforms.

2. From the results of the Fourier analysis contained in the output file DBRECT1.OUT, calculate the input power factor and the displacement power factor.

3. Make use of the Fourier analysis in DBRECT1.OUT to plot i_S, i_{S1}, i_{S3} and i_{S5}. Superimpose the distortion current component $i_{distortion} = i_S - i_{S1}$ on the above plot.

4. Calculate I_{cap} (the rms current though the filter capacitor) as a ratio of the average load current I_{load}.

5. Plot the current and voltage associated with one of the diodes, for example, d1, and obtain the average and the rms values of the current as a ratio of the average load current.

6. Vary L_s as a parameter to investigate its influence on the input displacement power factor, the input power factor, %THD, and the peak-peak ripple in the dc voltage v_d.

7. Vary the filter capacitor C_d to investigate its influence on the percentage ripple in v_d, input displacement power factor and %THD. Plot the percentage ΔV_d (peak-to-peak)/V_d(average) as a function of C_d.

8. Vary the load power to investigate its influence on the average dc voltage.

9. In the nominal circuit input file, remove the limit on the maximum time step during the simulation and observe its influence on the circuit waveforms.

10. Obtain the v_s, i_s and v_d waveforms during the startup transient when the filter capacitor is initially not charged. Obtain the peak inrush current as a ratio of the peak current in steady state. Vary the switching instant by simply varying the phase angle θ of the source v_s.

11. Replace the dc side of the diode bridge by a current source I_d = 10 A, corresponding to a very large L_d. Make L_s almost equal to zero. Obtain V_d(average).

12. Make L_s = 3 mH in Problem 10 and obtain V_d(average), displacement power factor, power factor, %THD, and the current commutation interval.

Reference: Section 5-3-4, pages 95 - 99.

PSpice Schematic: DBRECT1