Sohag University
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POWER ELECTRONICS

Sheet (1)

Ch3 Half Wave Rectifier

Uncontrolled Half wave

1. The half-wave rectifier circuit of Fig. 3-1*a* has V*s*(*t*) = 170 sin(377*t*) V and a load resistance *R* = 15 Ω .Determine (*a*) the average load current, (*b*) the rms load current, (*c*) the power absorbed by the load, (*d*) the apparent power supplied by the source, and (*e*) the power factor of the circuit.

2. A half-wave rectifier has a source of 120 V rms at 60 Hz and an *RL* load with *R* = 10 Ω and *L* = 15 mH. Determine (*a*) an expression for load current, (*b*) the average current, (*c*) the power absorbed by the resistor, and (*d*) the power factor.

(β = 3.65 rad, I_{avg} = 5.05 A, I_{rms}= 7.64 A , P = 585 W, PF = 0.64)

3. A half-wave rectifier of Fig. 3-5*a* has a 240 V rms, 60 Hz ac source. The load is a series inductance, resistance, and dc source, with *L* = 75 mH, *R* = 10 Ω, and V_{dc} = 100 V. Determine (*a*) an expression for load current, (*b*) the power absorbed by the dc voltage source, (*c*) the power absorbed by the resistance, and (*d*) power supplied by the source and the power factor.

(α = 0.299, β = 3.941 rad, P_{dc} = 313.4 W, P_R = 231 W, P = 544.4 W, PF = 0.47)

4. A half-wave rectifier of Fig. 3-6 has a 120 V rms, 60 Hz ac source. The load is a series inductance and dc voltage with *L* = 100 mH and V_{dc} = 48 V. Determine (*a*) an expression for load current, (*b*) Determine the power absorbed by the dc voltage source. (*c*) the power factor.

(α = 0.286, β = 4.485 rad, P_{dc} = 96.5 W, PF = 0.279)

5. The half-wave rectifier with a freewheeling diode (Fig. 3-7*a*) has R = 2 Ω and L = 25 mH, Vm is 100 V, and the frequency is 60 Hz. (*a*) Determine the average load voltage and current, and (*b*) the power absorbed by the resistor.

(V_{avg} = 31.8V, I_{avg} = 15.9 A, I_{rms}= 16.34 A, P_R = 534 W)

6. For the half-wave rectifier with a freewheeling diode and RL load as shown in Fig. 3-7a, the source is 240 V rms at 60 Hz and R = 8 Ω. (a) Assume L is infinitely large. Determine the power absorbed by the load and the power factor as seen by the source. Sketch Vo, iD1 , and iD2 . (b) Determine the average current in each diode. (c) For a finite inductance, determine L such that the peak-to-peak current is no more than 10 percent of the average current.

(I_{avg} = 13.5 A ≈ I_{rms}, P=P_R = 1459 W, PF = 0.637, ID_{avg} = 6.75 A, L=0.67 H)

7. The half-wave rectifier of Fig. 3-11a has a 120 V rms source at 60 Hz, R = 500 Ω, and C = 100μF. Determine (a) an expression for output voltage, (b) the peak-to-peak voltage variation on the output, (c) an expression for capacitor current, (d) the peak diode current, and (e) the value of C such that ΔVo is 1 percent of Vm.

(ΔVo = 43V, $I_{D,\,peak}$= 4.5 A, C = 3333 μF)