AC-DC Converter

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Contents

***Abstract*—This manual provides the design of a mobile charger.**

1 AC-DC Converter

1.1 Components required

1) Step-Down Transformer (230 V AC to 12V-0-12V , 750 mA)
2) Diodes - 4
3) Capacitor - 100 μ F , 0.1 μ F - 2 no's
4) Voltage Regulator - LM7805

1.2 Circuit Diagram

The circuit diagram is shown in 1.0

1.3 Steps to Convert 230V AC to 5V , 2A DC

1.3.1 Step Down the Voltage Level:

Problem 1.1. Connect the 230V AC supply to the input of the step-down transformer.

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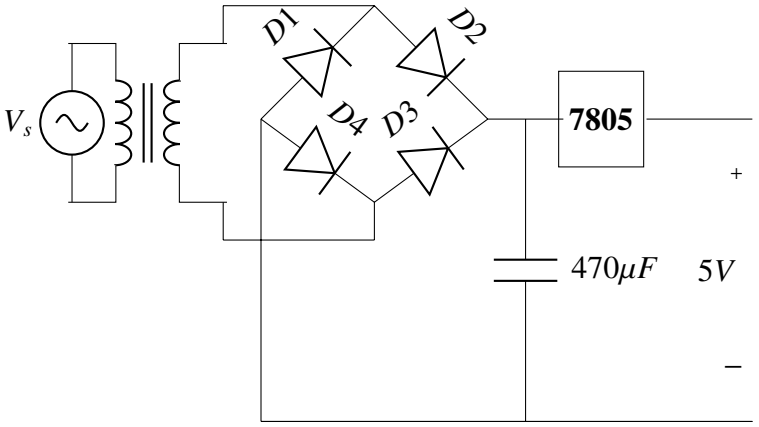

Fig. 1.0: AC-DC circuit diagram

1.3.2 Convert AC to DC:

Problem 1.2. Connect the 4 diodes in bridge as shown in fig 1.0 .

Problem 1.3. Connect the 12V and OV wires of the transformer to the to the juction of diodes D1, D2 and D3 , D4 .

Problem 1.4. Observe the output of the Bridge Rectifier between junctions of D1,D4 and D2,D3 on oscilloscope. What do you observe.

Solution:

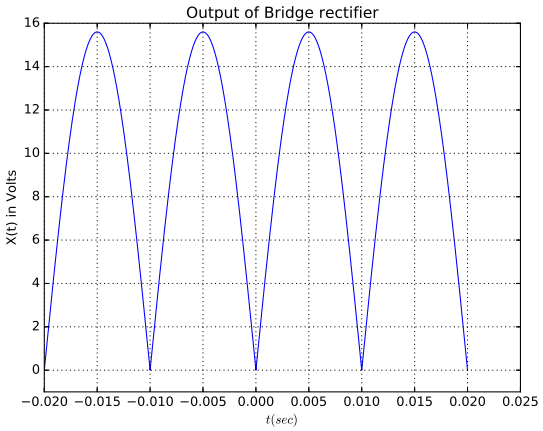

Fig. 1.4

1.3.3 Smoothing the Ripples using Filter:

Problem 1.5. Why does capacitor needed in the circuit?

Solution: The output of the diode bridge is a DC consisting of ripples also called as pulsating DC. This pulsating DC can be filtered using an inductor filter or a capacitor filter or a resistor-capacitor-coupled filter for removing the ripples. Consider a capacitor filter which is frequently used in most cases for smoothing.

Problem 1.6. Measure the output of the capacitor filter using multimeter. What do you observe?

1.3.4 Regulating 12V DC into 5V DC: The pin description of LM7805 is shown in 1.6

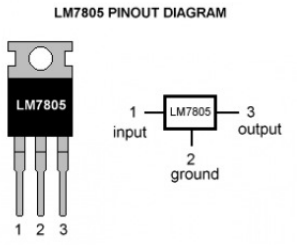

Fig. 1.6

Problem 1.7. Connect pin 1 and pin 2 of LM7805 to positive and Ground terminals of capacitor.

Problem 1.8. Measure the Voltage across and current passing through the pin 3 and Ground of LM7805. What do you observe?

2 Fourier series analysis of AC-DC converter

Problem 2.1. The following expression

$$X(t) = \sum_{n=0}^{\infty} a_n \cos 2\pi n f t + b_n \sin 2\pi n f t \qquad (2.1.1)$$

is known as the Fourier series expansion of $X(t)$, where $f = \frac{1}{T}$. Find

$$a_n = \frac{2}{T} \int_0^T X(t) \cos 2\pi n f t \, dt \qquad (2.1.2)$$

$$b_n = \frac{2}{T} \int_0^T X(t) \sin 2\pi n f t \, dt \qquad (2.1.3)$$

Find the Fourier series expansion for $X(t)$ shown in fig 1.4 .

Problem 2.2. From the problem 2.1 eliminate the AC term and compare it with the capacitor filter output. What do you observe?