5 Volts Charger

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Contents

***Abstract*—This is a lab report on constructing a 5 Volts charger using a low pass analog filter.**

1 Components of the Circuit

The components of the circuit are:

1) **Step-down transformer**

   The transformer is a centre-tapped 12-0-12 step-down transformer. The ground and one of the output wires is used in the charging circuit. The output waveform at this stage is a 12 V, 50 Hz AC sinusoid.

2) **Full-wave bridge rectifier**

   The full-wave rectifier is realized using four Si diodes arranged in a bridge form as shown in Fig. 1.1. The output waveform at this stage is a DC 12 V, 50 Hz rectified sinusoid.

3) **RC filtering circuit**

   This is the main component of the charging circuit. The 100 *mu*F capacitor acts as a first order analog low pass filter. It filters around the zero frequency DC component and partially eliminates the even harmonics associated with the rectified sinusoid. The output waveform at this stage consists of the constant DC component. Note there is no gain and hence we require a regulator to obtain the required DC 5V supply.

4) **5 V Regulator**

   The regulator used in this circuit is a 7805 regulator, which outputs a constant DC supply of 5 V with very little ripple through a feedback mechanism. The regulator will work because the DC component associated with the rectified waveform is

$$V_{DC} = \frac{2V_p}{\pi} = \frac{2 \times 12\sqrt{2}}{\pi} > 5\,\mathrm{V} \qquad (1.1)$$

   where V_p is the peak voltage. Thus, we obtain an almost constant supply of 5 V DC to charge a mobile phone.

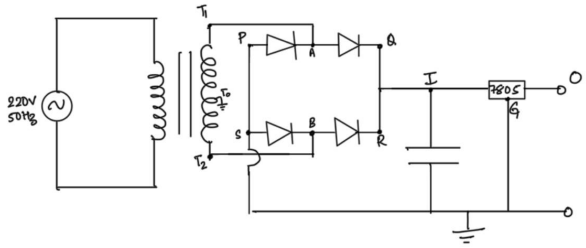

Fig. 1.1: Diagram of the circuit.

2 Observations

1) Peak voltage after transformer and rectifier stage is $V_p = 18\,\mathrm{V}$.
2) DC component after filter stage is $V_{DC} = 18\,\mathrm{V}$.
3) DC component after regulator stage is $V'_{DC} = 5\,\mathrm{V}$.
4) Ripple after regulator stage is $\epsilon = 5\,\mathrm{mV}$.

The images of the waveforms at each stage can be found in the following page

3 Conclusion

1) Working and implementation of a low-pass analog filter.
2) Use of regulator to help realise an analog low-pass filter with very low cutoff frequency.
3) Use of lab equipment such as solder, oscilloscope, breadboard, PCB, etc. to build a circuit.

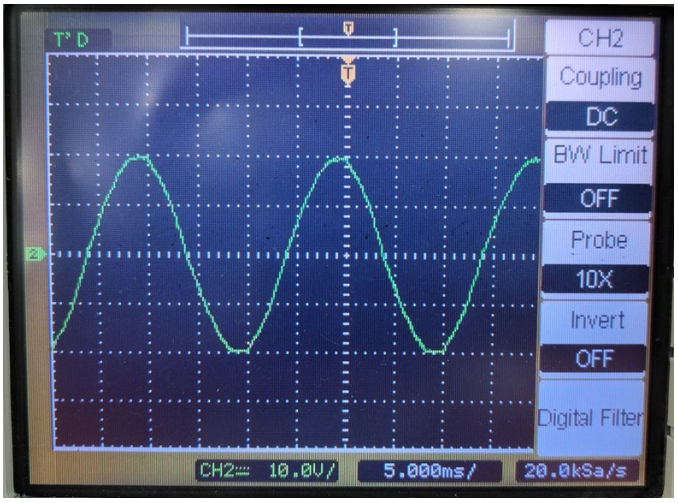

Fig. 2.1: Output AC waveform at transformer stage across T_1T_0 (18 V peak).

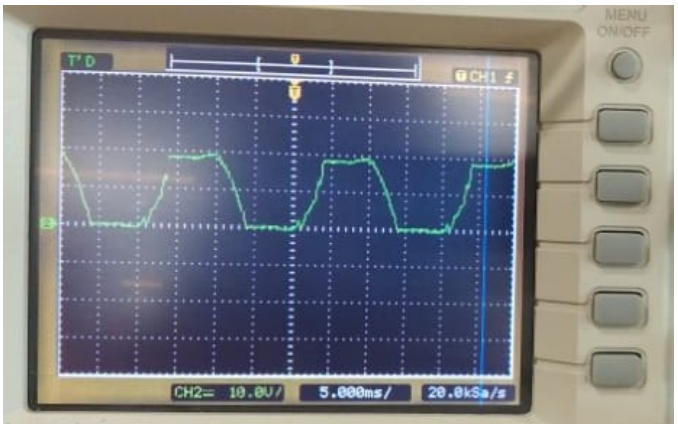

Fig. 2.2: Output half-wave rectified waveform across diode across AQ (18 V peak).

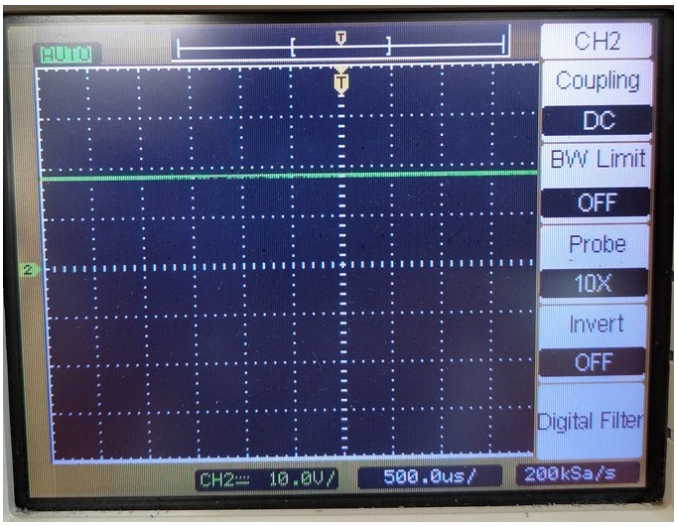

Fig. 2.3: Output DC waveform at filter stage across IS (18 V).

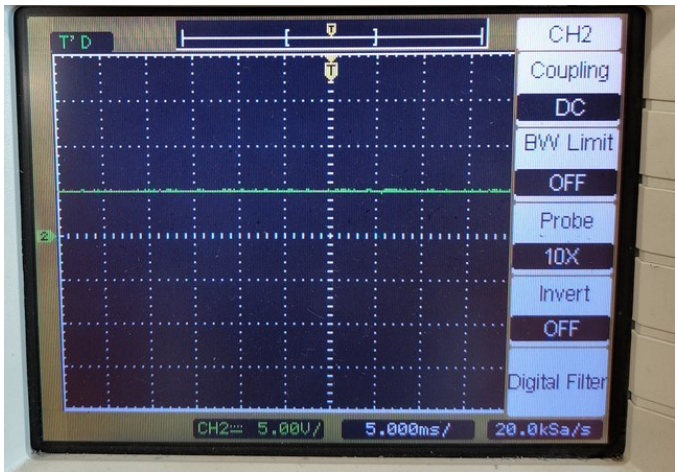

Fig. 2.4: Output DC waveform at regulator stage across OG (5 V).

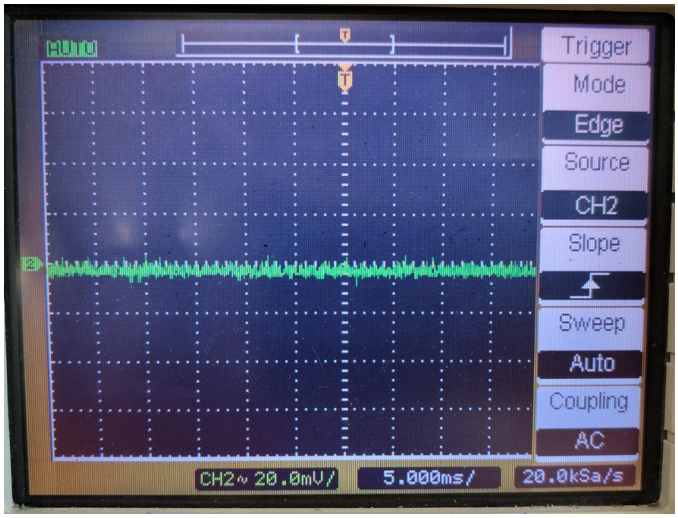

Fig. 2.5: Output AC ripple at regulator stage across OG (5 mV).

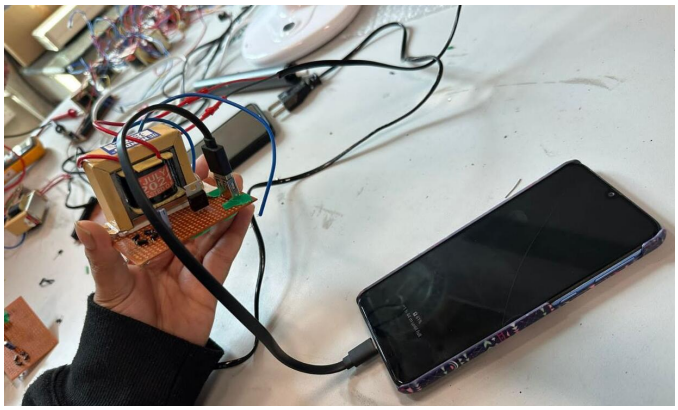

Fig. 2.6: Image of the charger charging a mobile phone