EXP 01- DESIGNING AN UNCONTROLLED RECTIFIER

Report by:

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AIM:

Designing the uncontrolled rectifier with different circuit and load configurations.

COMPONENT USED:

- 18-0-18 volt Transformer
- Resistors - 47kΩ, pot 5kΩ and Rheostat
- 100 uF Capacitor
- PCB Board
- 1N4007 Silicon Diodes
- Regulator IC 7815 & LM317
- Soldering Equipment
- Oscilloscope

SUMMARY:

Designing a power supply using an uncontrolled rectifier, then adding a linear regulator and observing the changes in the output waveforms.

CIRCUIT DIAGRAM:

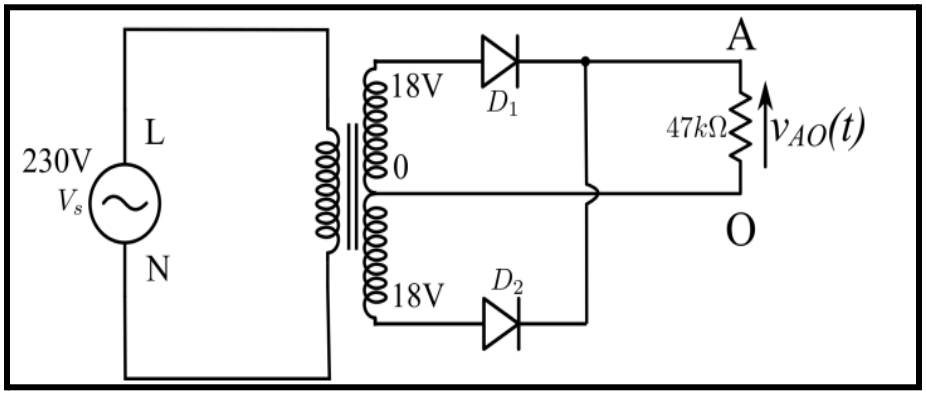


Fig1: Center tapped transformer and passing output waveform from rectifiers with resistors.

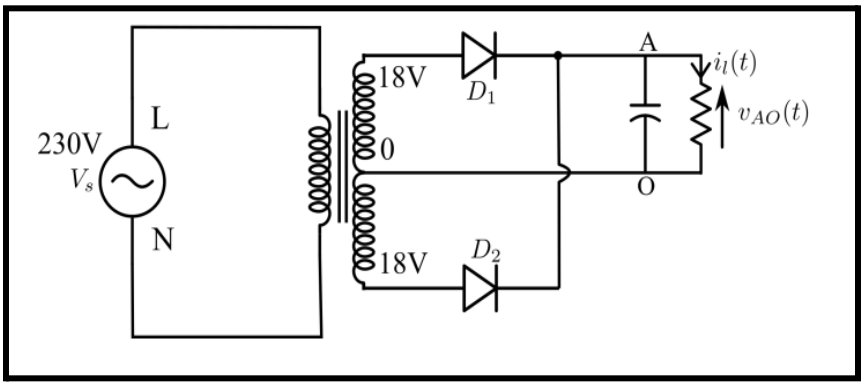


Fig2: Center tapped transformer and passing o/p waveform from rectifiers with single bypass C.

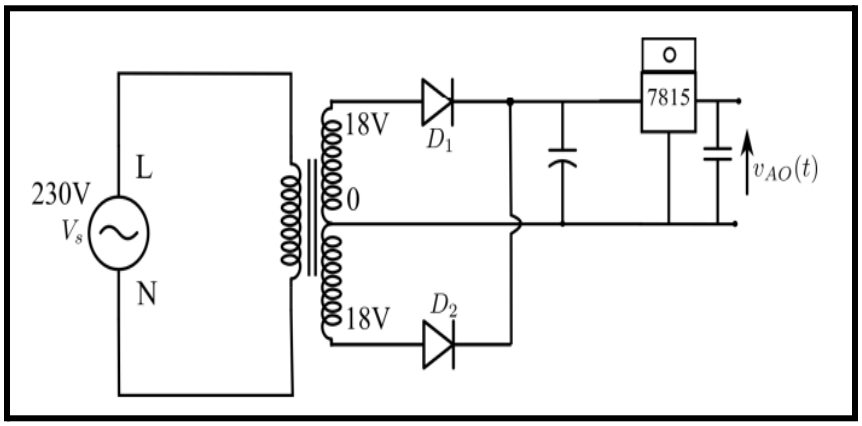


Fig3: Adding 7815 IC and input, output bypass C.

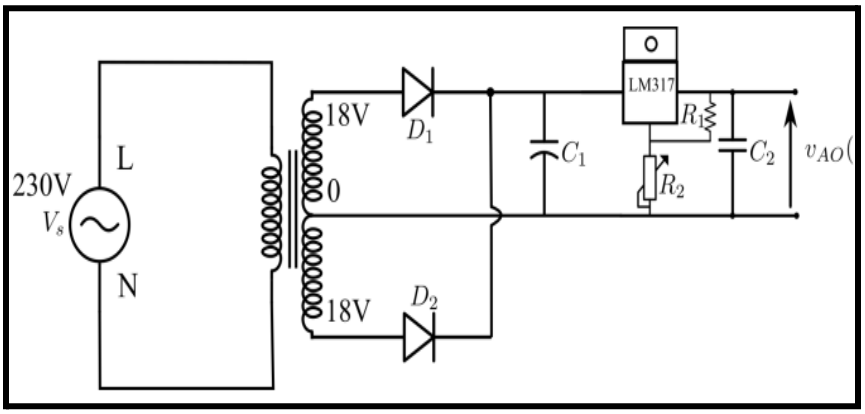
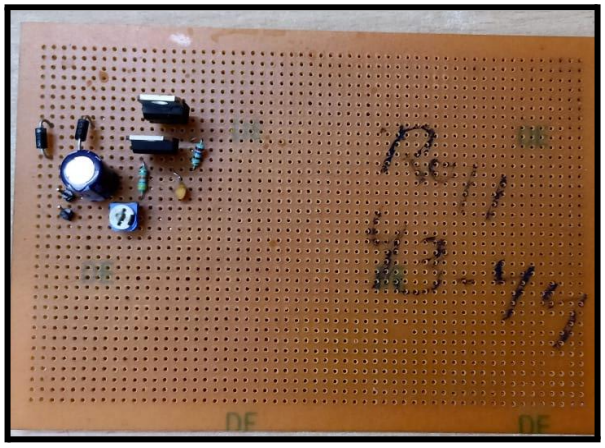


Fig4: Replacing 7815 IC with LM317, adding bypass capacitors and potentiometer to the circuit.

PROCEDURES:

1. At first, connected the center tapped transformer to a single phase 230V power supply. This is the snapshot of a PCB board with the implementation of a rectifier circuit.



2. And then we added one of the input bypass capacitors to the circuit measuring 1000uF.
3. In the next circuit construction, inserted the voltage regulator IC 7815 with bypass capacitors.
4. Now to get the desired output straight waveform of voltage in the range of approx. 1.25v to 37v, we replaced IC7815 with LM317 and implemented a potentiometer for o/p voltage adjustment.
5. For each circuit in the above diagram, we measured the output voltage waveform with the help of a digital storage oscilloscope (DSO). We also observed the output response of the circuit when resistance is varied using rheostat(0-100kΩ) connected between OUT and ADJ pins of LM317.

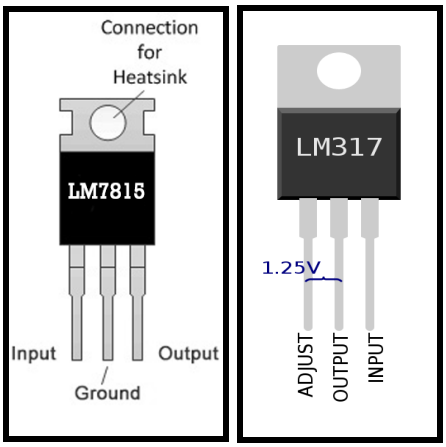
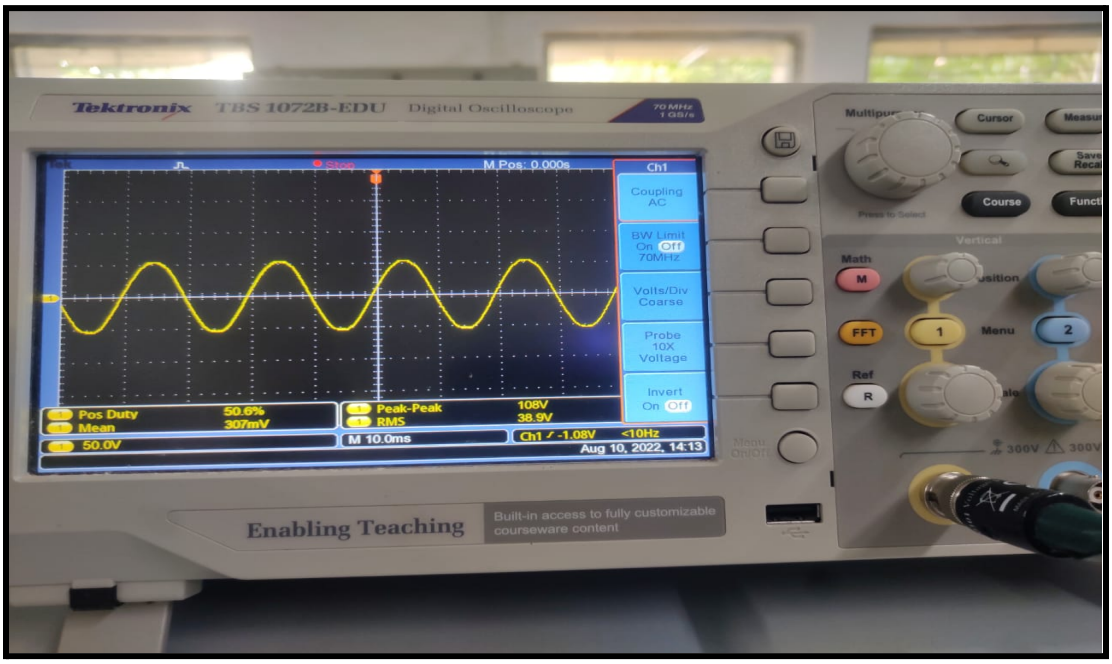


Fig: PINOUT of 7815 and LM317 IC.

RESULTS and OUTPUTS:

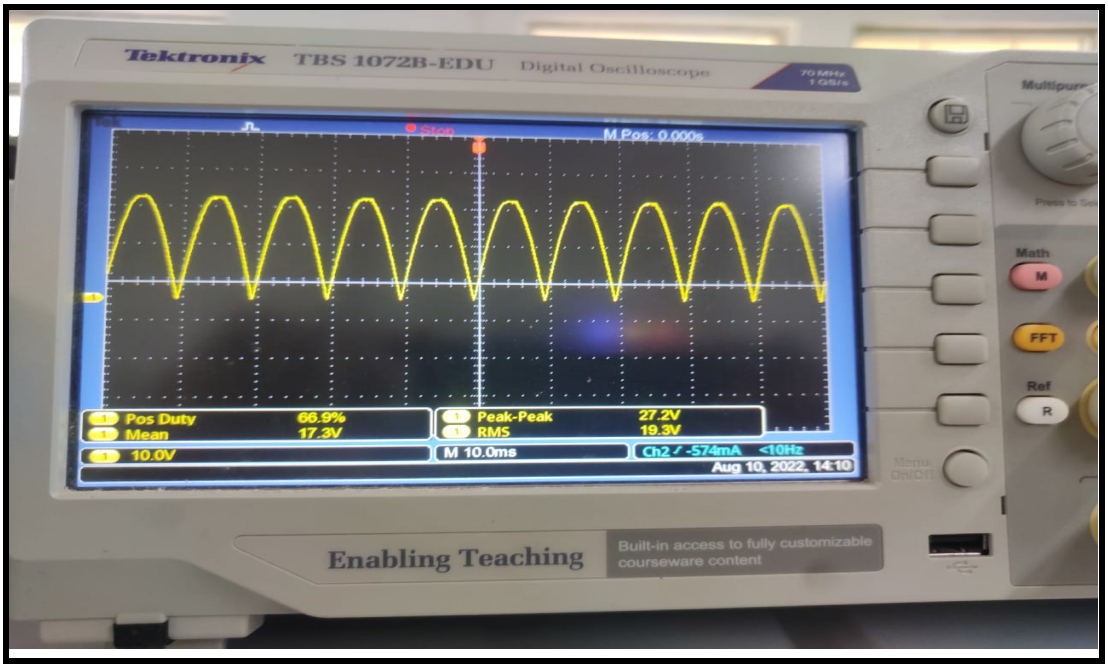
1. First of all we observed the input AC-voltage waveform(~38v) for our initial circuit consisting of 1N4007 diodes, resistance, and transformer in the DSO. Snapshot of such waveform:



Vrms=38.9V

RESULT: Ripple of a sinusoidal voltage waveform. So, the transformer o/p is actually sinusoidal with few noises only.

2. In case of the circuit, when input AC voltage is passed by circuit consisting of center tapped transformer with bridge rectifier and resistor we got such waveform:

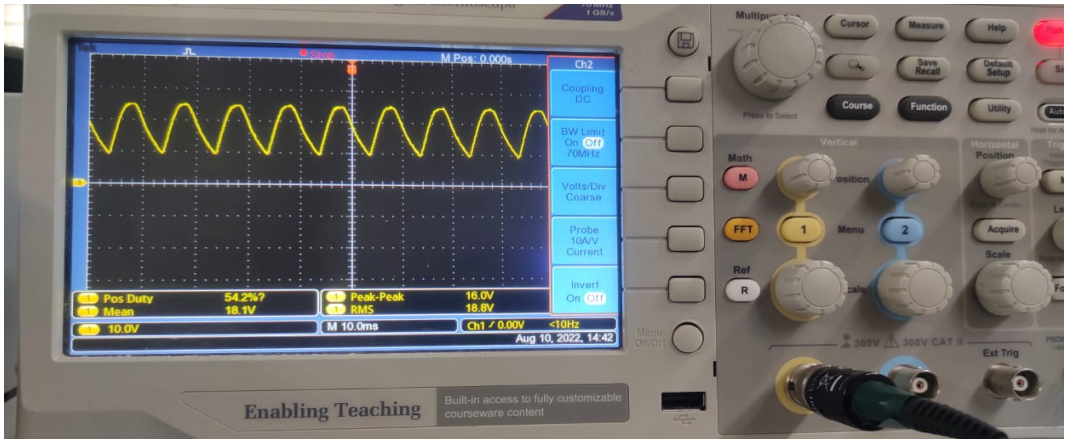


Vpp=27.2V

Vrms=19.3V

RESULT: Diodes are used for rectification of AC signal in o/p.

3. When there is a capacitive element with the load of resistance in the circuit we got such o/p waveform of the rectifier circuit:

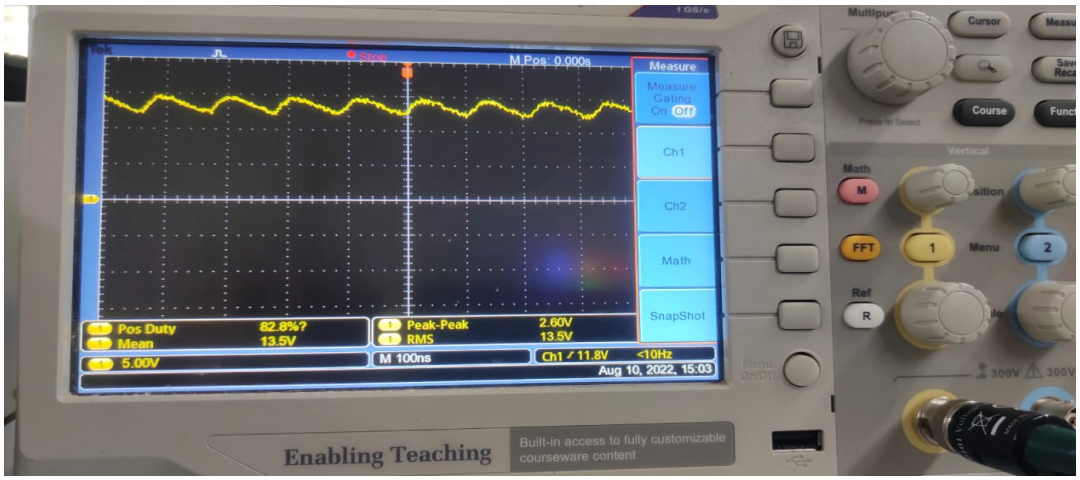


Vpp=16.0V

Vrms=18.8V

RESULT: The voltage ripples can be controlled by connecting a smoothing capacitor in parallel to the load. Also we can use the capacitors in order to minimize the voltage fluctuations in the circuit.

4. After adding linear regulator IC7815 in the circuit with both the bypass capacitors and load resistance, we observed such output waveform in DSO:

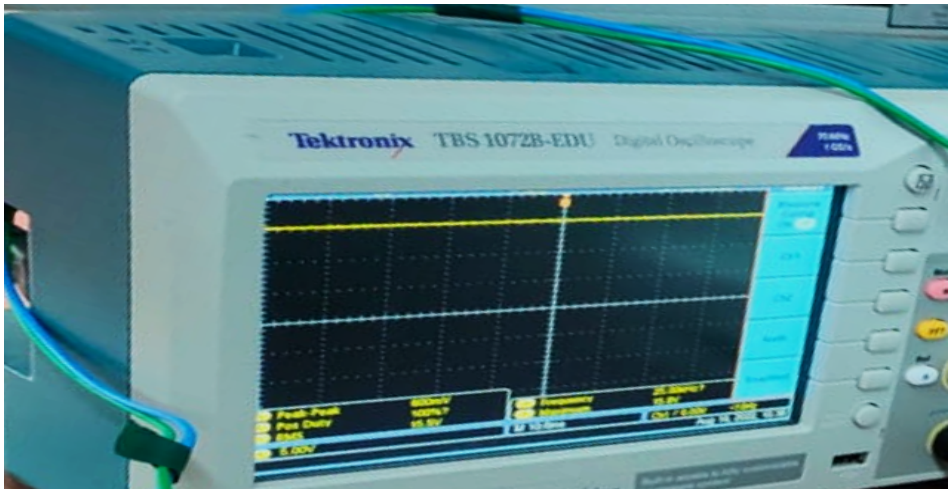


Vrms=13.5V

Vpp=2.60V

RESULT: Regulated voltage output due to IC7815 and capacitive filter load in the circuit.

5. Now we replaced IC7815 with LM317 linear regulator and configured it with potentiometer to get such adjustable range of o/p voltage waveform similar to DC with no ripples:

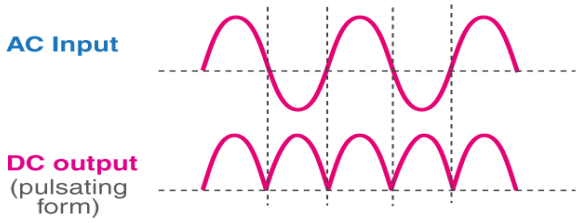


Vpp=16.8V

Vrms=450mV

ANALYSIS:

1. When load is higher, in SMPS supply, the ripple current across the load is also higher, thus the ripple voltage or power is also higher as well.
2. 7815 vs LM317: When the circuit is operated with 7815 then it acts as a voltage regulator for our power supply. But we are using LM317 with a pot connected to its ADJ and OUT pins to get a desirable ripple-free voltage waveform and we can control the o/p amplitude by varying the potentiometer.
3. Another capacitor in the output side is used to further smooth and clean noise in DC output voltage and finally, we get a desirable output.
4. Diode D1 is used to rectify positive half of the input voltage cycle and diode D2 in negative half of the input voltage cycle. So the overall waveform of voltage after passing both the diodes will be like this:



5. The main application of the uncontrolled rectifier circuit with linear voltage regulator in the conversion of AC to controlled DC output for further uses like in Op-amp configuration, audio buffering/mixing, in buck converter, etc.
6. One of the main disadvantages of using a center tapped transformer as compared to a bridge rectifier is that the former requires more winding whereas the latter is able to deliver good voltage regulation.
7. Talking about advantages of using a center tapped transformer as compared to a bridge rectifier is that the latter has twice the voltage drop than the former because it consists of 4 diodes.