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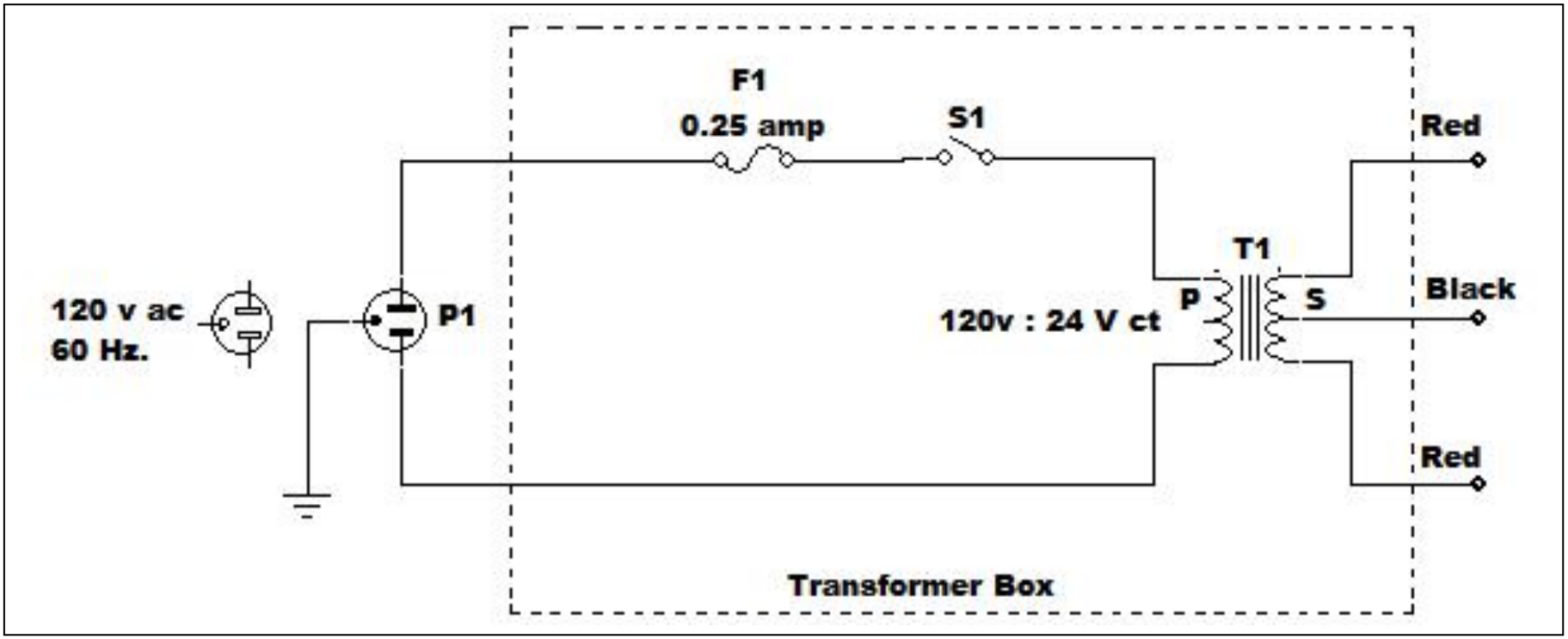
Lab 07

Transformers
Diodes
Capacitors
Regulator Diodes and Devices

Test Equipment Needed: Trainer, Digital Multimeter, Dual Trace Oscilloscope with matching probes, 24 volt transformer box.

1. Plug the transformer box in to a standard wall outlet. Turn the switch (if your box is so equipped) so that the light shows "on".



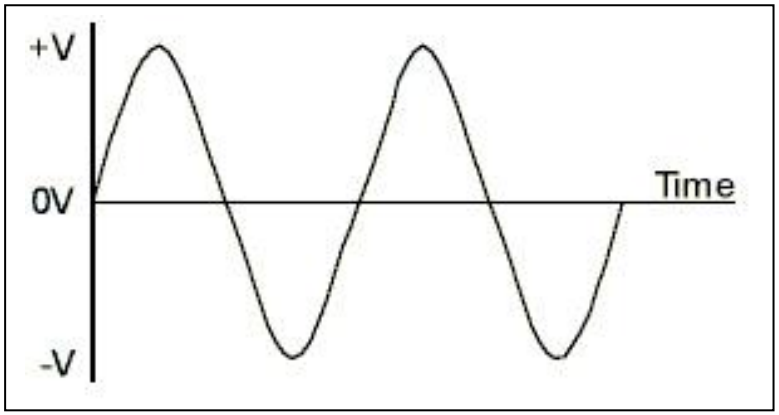
(**NOTE** --Remember that you may have a transformer box with two black terminals and one red terminal. The single color will always be the secondary center tap and the two same colors will always be the ends of the secondary. Make the appropriate changes in the text below.)

2. Make the following tests:

- Measure (digital multimeter) the AC voltage between the black terminal and either one of the red terminals. Measure the other red terminal. They should be the same.

- Measure from red terminal to red terminal. It should be twice the voltage that you read in the last step from black to red.

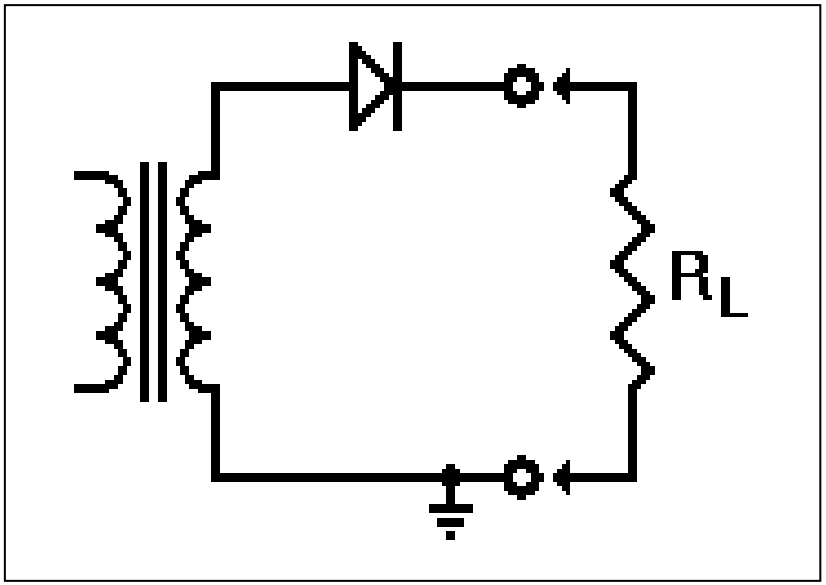
- With an oscilloscope, observe the waveform from black (ground) to one of the red terminals. You may use a black test lead to get your ground on the black terminal but do not use a test lead on the red terminal. It should show the sine wave thus:



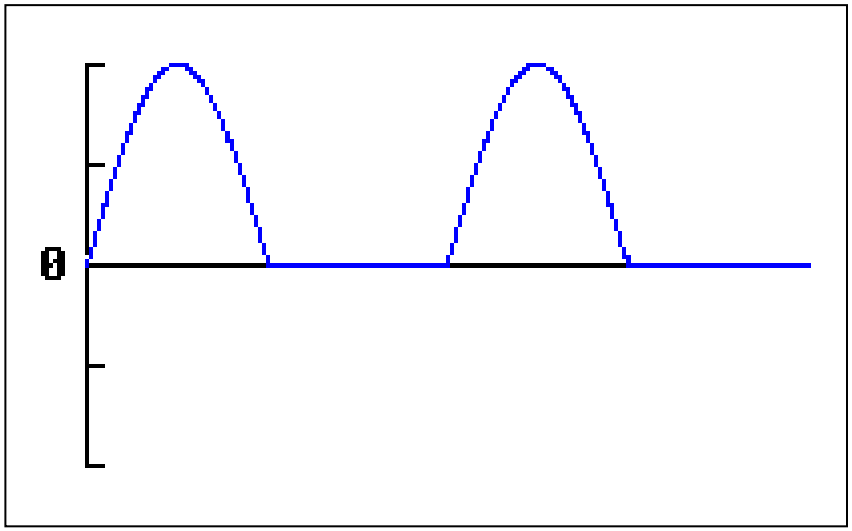
- Have your instructor or lab tech show you how to set the oscilloscope up to measure "dual trace" (two vertical traces at the same time). With the oscilloscope set up as in the last step, you should see two sine waves, but they should be 180° out of phase with one another … as one is going up, the other should be going down and vice versa.

3. Install a single 1N400x (x means I don't care what the last number is) diode as shown onto the proto board to make a **HALF WAVE** rectifier. Run a test lead from the black terminal on the transformer box to the black terminal on the trainer. Run a test lead from either of the red terminals on the transformer box to the anode (non-striped end) of the diode.

CAUTION -- from this point on, if the red terminal wire touches the black terminal wire, you WILL blow the fuse on the transformer box. Not a big deal, but just takes time to first determine that the fuse is blown and then replace the fuse.



- Use the single-channel oscilloscope to observe the waveform at the cathode of the diode with respect to ground (the black terminal of the transformer box). The waveform should look like this:



- Load the output with R_L 22 ohms 10 watt as shown in the diagram. Did it change the waveform materially? **NOTE** – 22 Ω reistors get HOT after a minute or two.

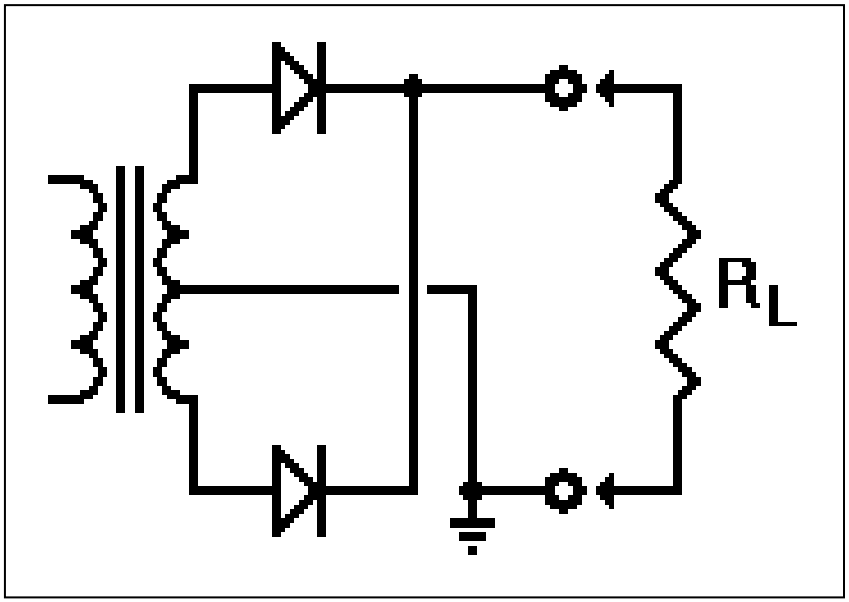
- Repeat the two steps above with a 1000 µf capacitor from the cathode of the rectifier diode to ground. Caution … from the CATHODE to ground and with the correct POLARITY (- to ground, + to the cathode of the diode).

4. Install a second 1N400x diode to make a **FULL WAVE** rectifier.

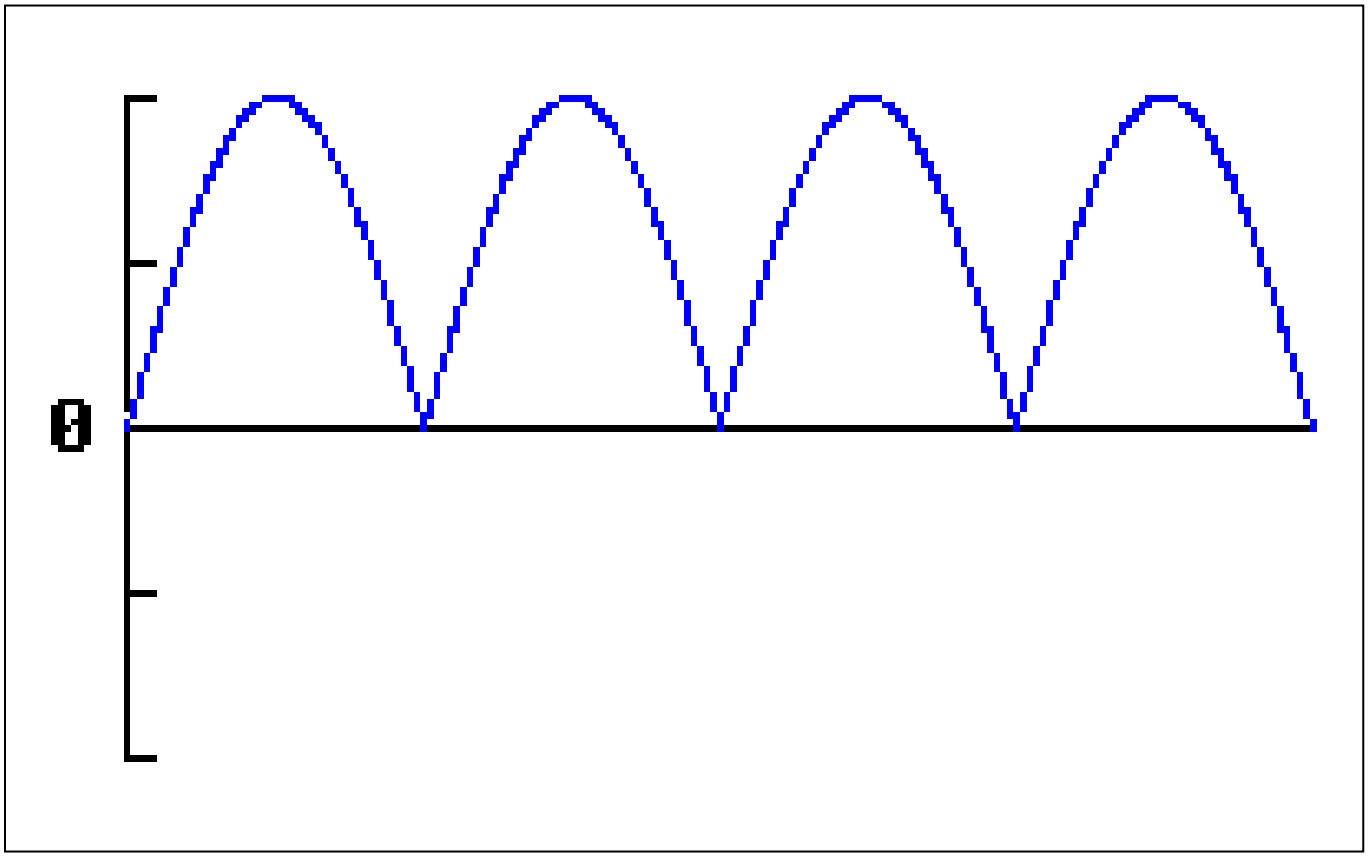
- Note the conventions in the schematic diagram. Where two wires MEET to make a connection, there is a black dot.

- Where there is NO connection, there is no dot.

- The "break" in the center tap to ground wire is NOT the conventional way to show the circuit. Generally, two wires crossing without a dot is the correct way to show the circuit.



- Use the single-channel oscilloscope to observe the waveform at the cathodes of the diodes with respect to ground (the black terminal of the transformer box). The waveform should look like this:



- Load the output with R_L as shown in the diagram. Did it change the waveform materially? (Note – R_L is a large 22 ohm 10 watt resistor.)

- Repeat the two steps above with a 1000 µf capacitor from the cathodes of the rectifier diodes to ground. Caution … from the CATHODES to ground and with the correct POLARITY (- to ground, + to the cathodes of the diodes).

National Semiconductor

May 2000

LM78XX
Series Voltage Regulators

General Description

The LM78XX series of three terminal regulators is available with several fixed output voltages making them useful in a wide range of applications. One of these is local on card regulation, eliminating the distribution problems associated with single point regulation. The voltages available allow these regulators to be used in logic systems, instrumentation, HiFi, and other solid state electronic equipment. Although designed primarily as fixed voltage regulators these devices can be used with external components to obtain adjustable voltages and currents.

The LM78XX series is available in an aluminum TO-3 package which will allow over 1.0A load current if adequate heat sinking is provided. Current limiting is included to limit the peak output current to a safe value. Safe area protection for the output transistor is provided to limit internal power dissipation. If internal power dissipation becomes too high for the heat sinking provided, the thermal shutdown circuit takes over preventing the IC from overheating.

Considerable effort was expanded to make the LM78XX series of regulators easy to use and minimize the number of external components. It is not necessary to bypass the output, although this does improve transient response. Input bypassing is needed only if the regulator is located far from the filter capacitor of the power supply.

For output voltage other than 5V, 12V and 15V the LM117 series provides an output voltage range from 1.2V to 57V.

Features

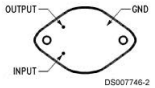
- Output current in excess of 1A
- Internal thermal overload protection
- No external components required
- Output transistor safe area protection
- Internal short circuit current limit
- Available in the aluminum TO-3 package

Voltage Range

LM7805C	5V
LM7812C	12V
LM7815C	15V

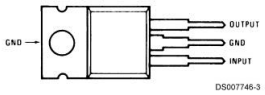
Connection Diagrams

Metal Can Package
TO-3 (K)
Aluminum



Bottom View
Order Number LM7805CK,
LM7812CK or LM7815CK
See NS Package Number KC02A

Plastic Package
TO-220 (T)



Top View
Order Number LM7805CT,
LM7812CT or LM7815CT
See NS Package Number T03B

5. Hook up the 7805 voltage regulator as shown:

- The LED at the output may be any color or size LED that you pick out of the stockroom.
- Be sure BOTH the electrolytic capacitors are installed with the proper polarity.
- Measure the output voltage both with and without the R_L load resistor. How much did the voltage change? You can calculate the % change with the simple formula $\left(voltage-change \middle/ output-voltage\right)*100$ Thus, for a voltage change of 0.08 volts on a nominal 5 volt regulator, you would have a 0.6% change. The specification on a 7805 voltage regulator from no load to full load is guaranteed to be less than 1%.
- Connect one lead of a 22Ω 10 watt resistor to the output of the +5 terminal. Tie the other end to the + battery terminal of your popsicle-stick motor. Connect the - battery terminal of your motor to ground. Did the motor work as well on your power supply as it did with the 1.5v battery?