# AN INTRODUCTION TO LINEAR AC-DC POWER SUPPLIES

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# WHAT IS AN AC-DC POWER SUPPLY ?

- An AC-DC power supply converts AC electricity from a wall outlet into DC electricity that a sensitive electronic device can use
- Alternating current : AC stands for alternating current Which means the current constantly changes direction, Main electricity is an AC supply , and Tunisia mains supply is about 230V. It has a frequency of 50Hz ( 50 hertz) , which means it changes direction and back again 50 times a second. It's better for transporting current over long distances , which is why we use it for mains electricity..
- Direct current : DC stands for direct current which means the current only flows in one direction.Batteries and electronic devices like TVs, computers and DVD players use DC electricity -once an AC current enters a device,it's converted to DC A typical battery supplies around 1.5 volts of DC .

# EXAMPLES OF AC-DC POWER SUPPLIES

Go!

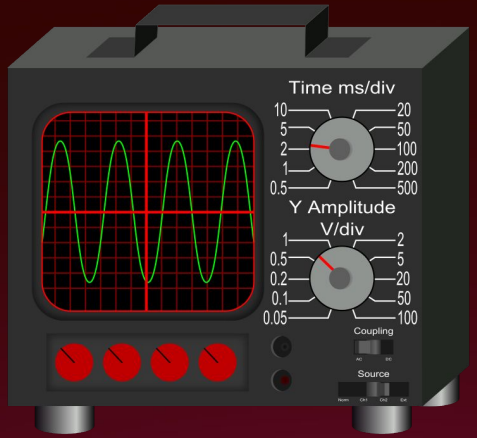
## LAPTOP POWER ADAPTER

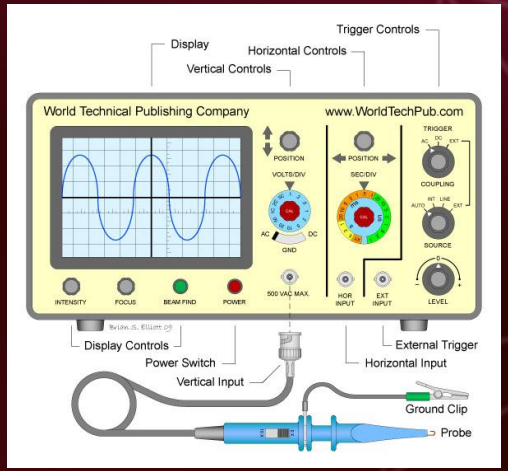

## PHONE CHARGER


## DESKTOP PC POWER SUPPLY

# USING AN OSCILLOSCOPE

An oscilloscope is an instrument which allows us to view changes in voltage over time

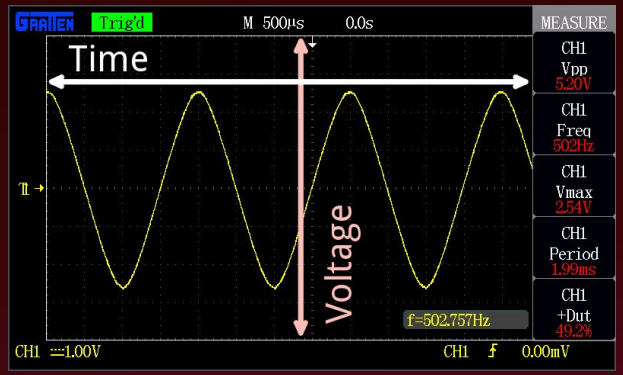



Go!

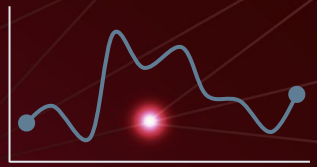
ISIS

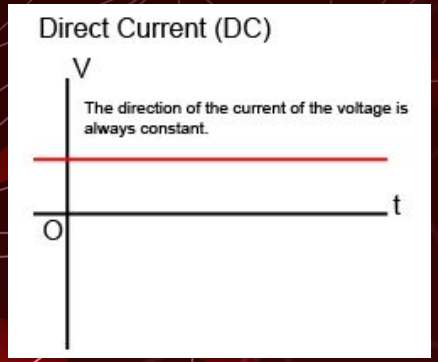
# USING AN OSCILLOSCOPE




- Time is on the x-axis
- Voltage is on the y-axis
- Each horizontal or vertical line is an increment of either unit.

Go to proteus isis



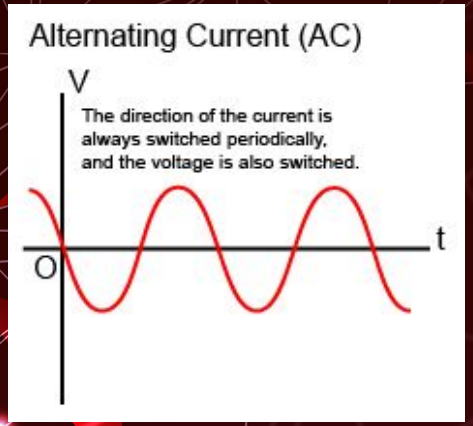


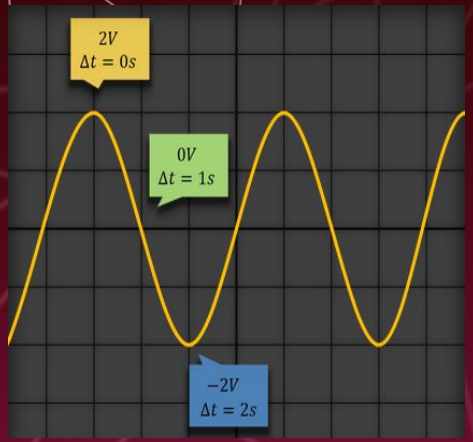


# DIRECT CURRENT (DC)

The direction of current is always the same because the voltage always remains greater than 0

Go!




# ALTERNATING CURRENT (AC)

The direction of current is constantly changing because the voltage is constantly passing through 0V

Remember V & I are proportional

Go!

# THIS IS THE SIMULATION

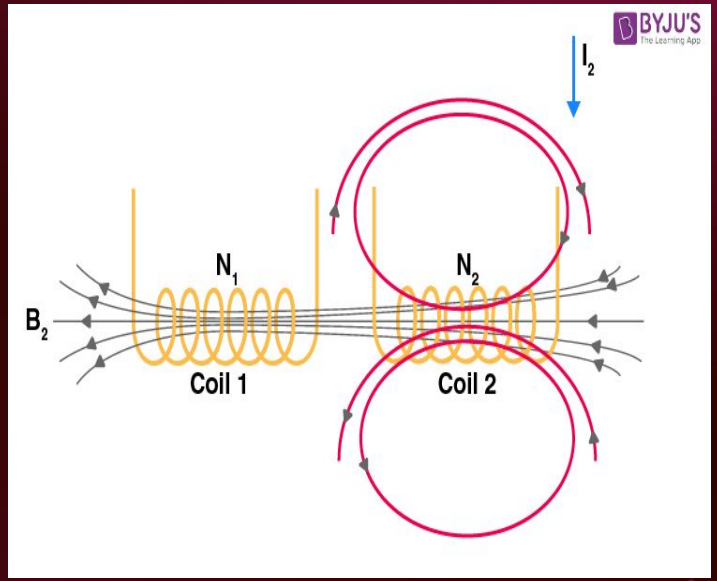
ISIS

First steps With ISIS
The simulation file on Github is : AC -DC LIneair Power Supply First Simulation .pdsprj

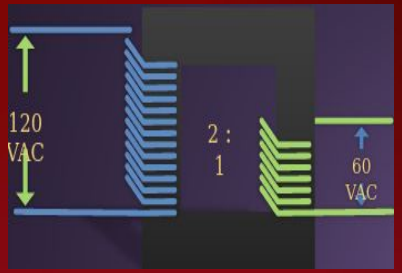
Questions ?

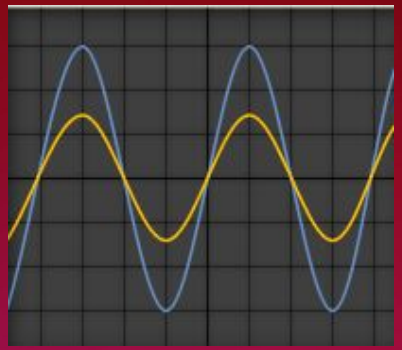
# STARTING

- The Voltage available at a wall outlet is much too high and is always changing Polarity, making it useless for sensitive electronics.
- The first step is to reduce the voltage using a transformer
- A transformer is a device that allows us to convert an AC voltage to a higher or lower level.
- Transformers can only be used with AC
- They operate on the basis of an electromagnetic theory called mutual inductance
- Mutual inductance is the main operating principle of generators , motors , and transformers.
- Any electrical device having components that tend to interact with another magnetic field also follows the same principle.
- The interaction is usually brought about by a mutual induction where the current flowing in one coil generates a voltage in a secondary coil .

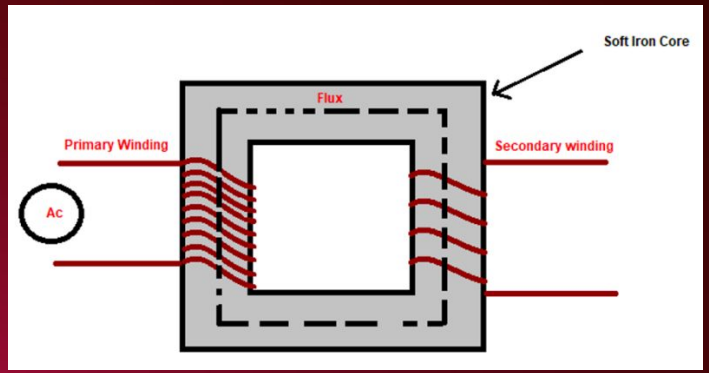


# TRANSFORMER OPERATION



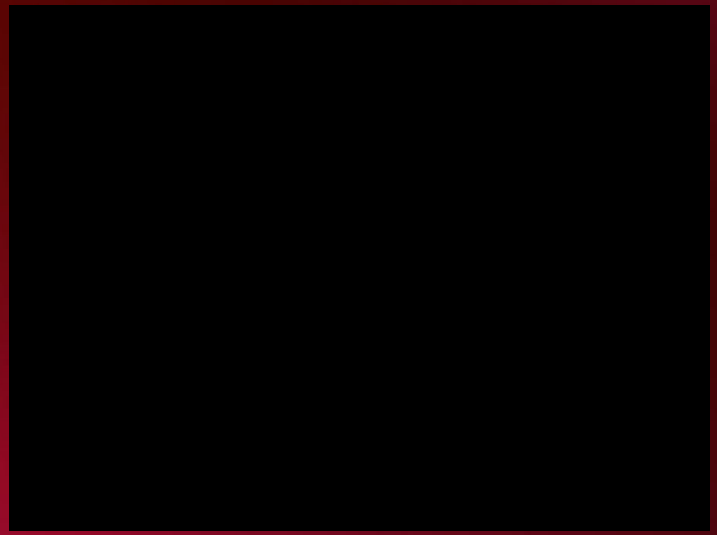
- A step-Down Transformer has more primary windings than the secondary side..
- Picture 2 : This is the effect of a step-Down transformer.
- NOte that only the amplitude (the voltage) has been reduced, not the frequency.



# THIS IS THE SIMULATION

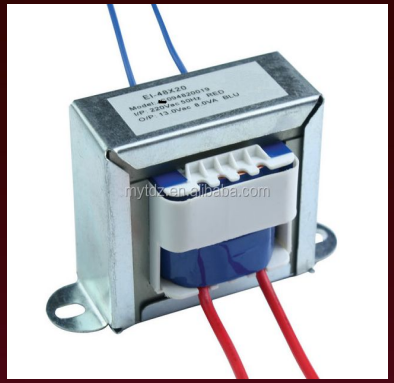
ISIS

Step-Down Transformer Simulation
The simulation file on Github is : Step-Down Transformer .pdsprj



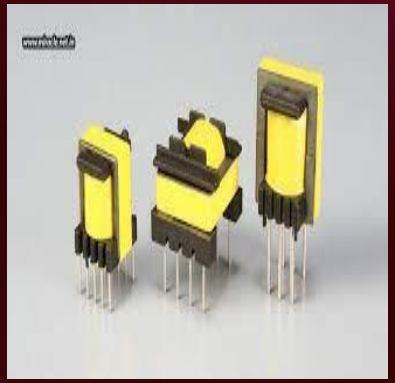
Questions ?

# EXAMPLES OF TRANSFORMERS



E-Core

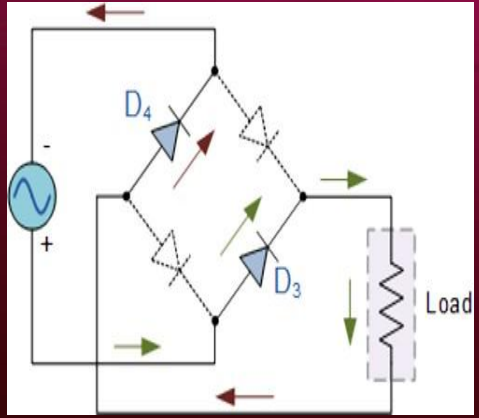

Toroidal Transformer

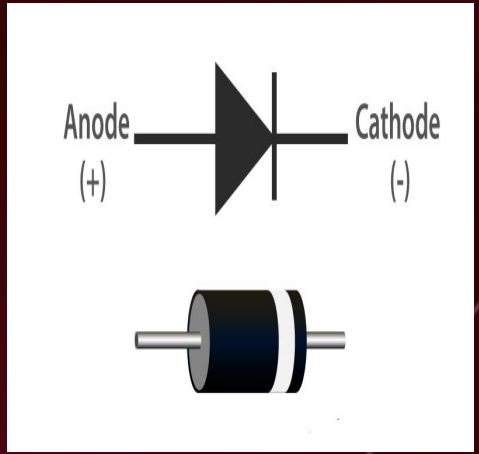


high frequency transformers

# NEXT

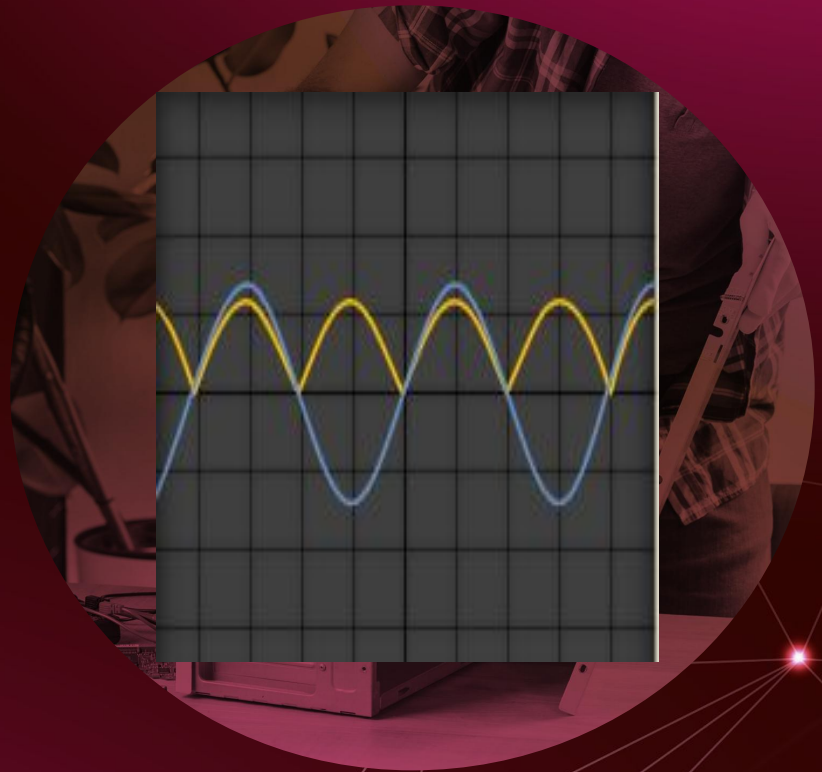
- Though we have successfully reduced the voltage, we still have the problem of the voltage fluctuating from positive to negative.
- To "force" the current to only flow in one direction we construct a bridge rectifier circuit, using 4 diodes
- Diode bridge is an arrangement of four diodes in a bridge circuit configuration that provides the same polarity of output for either polarity of input
- The most common application for Diode bridge is a conversion of an alternating-current (AC) input into a direct-current (DC) output



# EFFECT OF A BRIDGE RECTIFIER

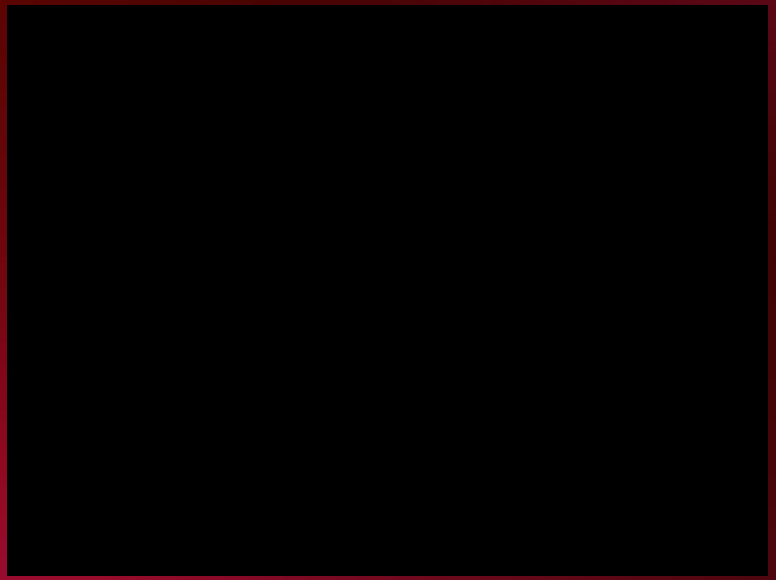
- A bridge rectifier basically takes the absolute value of the AC waveform
- Now, instead of the current constantly reversing, it now has only one direction.
- Voltage drops : it must not be forgotten that the current flowing in a bridge rectifier will pas through two diodes, as a result the output voltage will have been dropped by this amount.
- This drop will be a minimum of ⇒ 1.4V
- In the current waveform , we can observe that the voltage constantly dips to very low voltages ( including 0V) , which is problematic.



# THIS IS THE SIMULATION

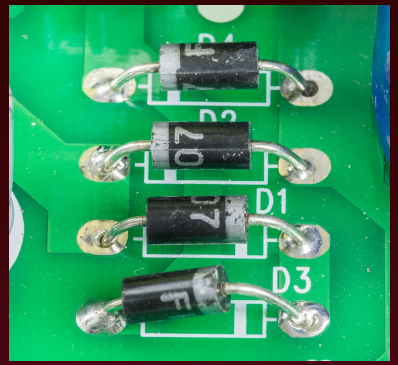
ISIS

Bridge Rectifiers  Simulation
The simulation file on Github is : Bridge rectifier .pdsprj

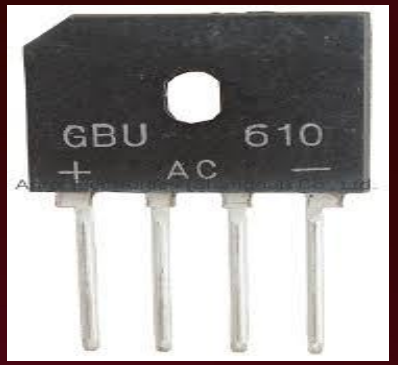


Questions ?

# EXAMPLES OF TRANSFORMERS




4 discrete diodes

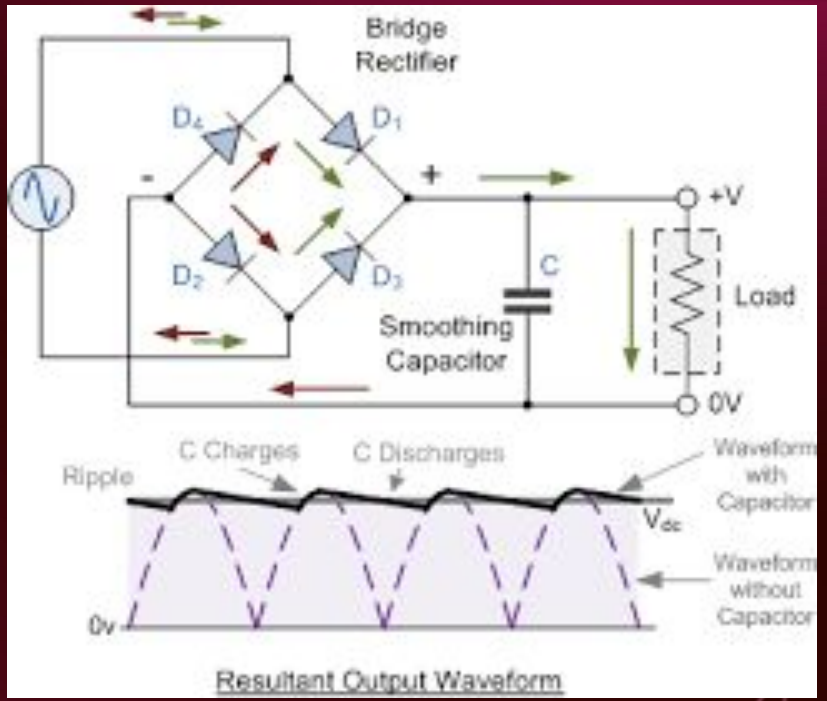



GBU-type bridge

High power bridge

# THE THIRD STEP

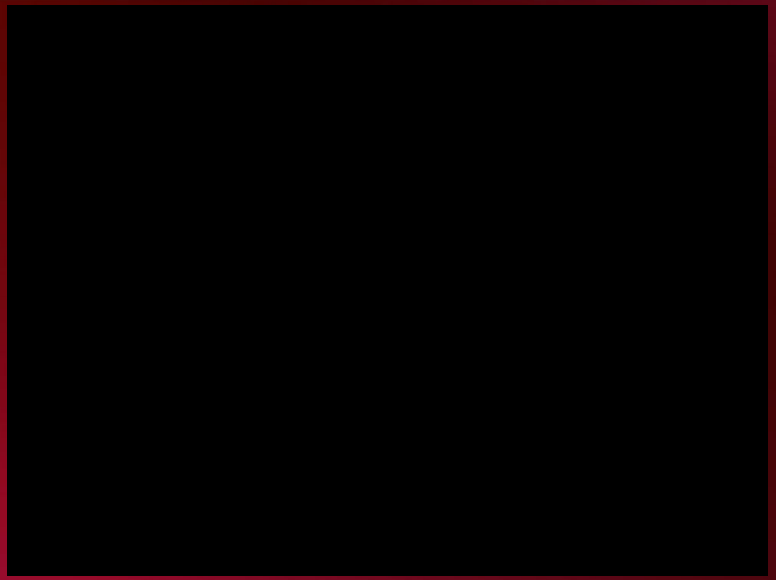
- To fix the previous problem , we use filter capacitors
- As the capacitor discharges it's voltage also decreases
- Bu using a higher capacitance, the capacitor can provide a greater voltage for a longer time



# THIS IS THE SIMULATION

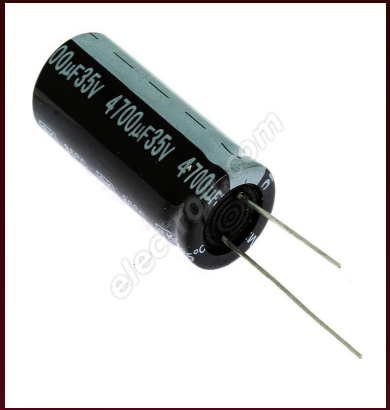
ISIS

smoothing Simulation
The simulation file on Github is : Filter.pdsprj



Questions ?

# EXAMPLES OF CAPACITORS



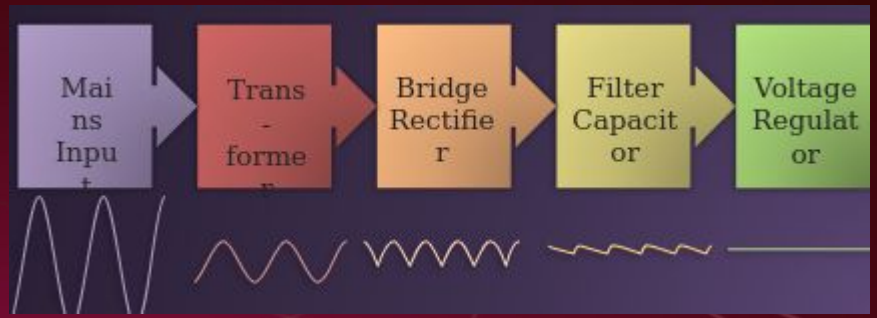

Electrolytic


Bulk (Electrolytic)

Solid Polymer

# FINAL STEP

- Looking back : this power supply is called an unregulated power supply
- The voltage it produces depends on the demand of the load and the capacitance provided
- Also, the output +voltage is highly dependent on the input voltage across the transformer
- Ideally we want the output of the power supply to remain constant regardless of the load, and fluctuations from the voltage source
- To accomplish this, we can use integrated circuit called a “voltage regulator” which does exactly what its name implies
- Let’s say we need steady 5.0V supply
- The voltage regulator will take care of any fluctuations in voltage, provided the input voltage never dips below the desired output voltage ( V out+ 2V ) .

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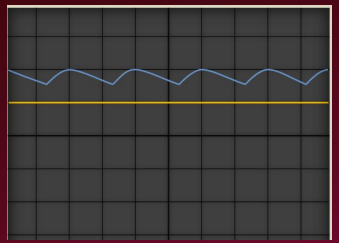
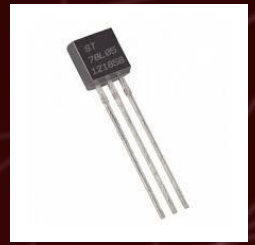
# YOU GOT IT RIGHT!!

Some part names of common voltage regulators:

-LM78xx
-LM317
-LM338
-LM723
-L200
-LT1085

TO-3C





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