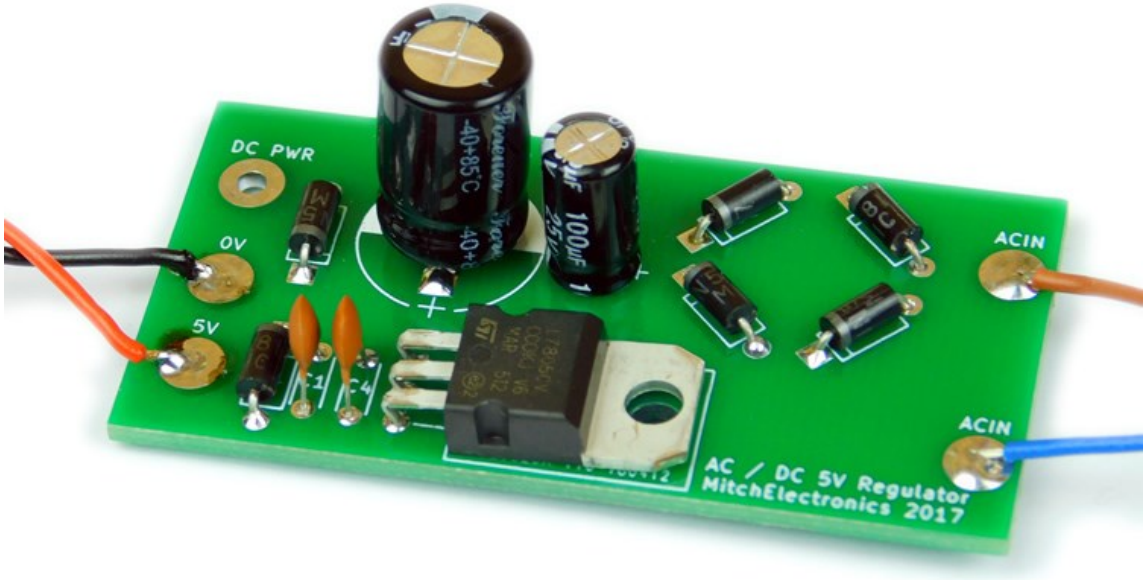
AC-DC Converter Kit

MitchElectronics 2018



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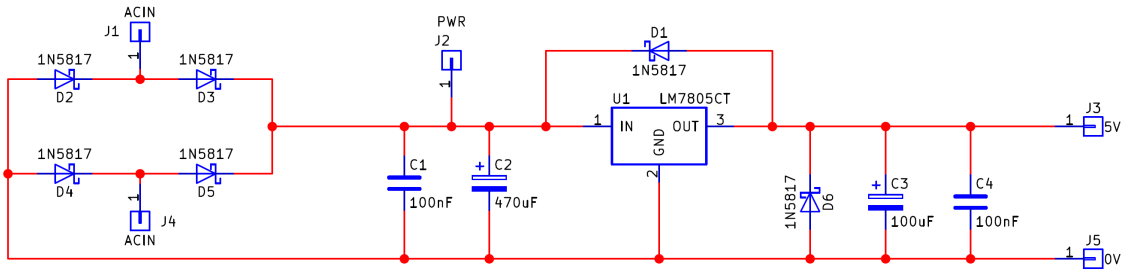
INTRODUCTION

Many circuits require a voltage supply that is constant and unchanging and such circuits would include radios, calculators, computers, monitors, phones, and even cars. Batteries are a good source of constant voltage but since they are usually limited in size, weight, and power capacity the mains electricity are often used. But this source of electricity is constantly changing as it is AC (alternating current), which is not suitable for DC (direct current) circuits. Therefore, an AC-DC converter is needed to convert the alternating current into a direct current! This kit will not only do this but it will also regulate this converted DC source so that it outputs a smooth constant 5V which can be used to power many projects.

Power stations generate AC as opposed to DC and often require a conversion to DC so that everyday devices can use it

Image courtesy http://www.geograph.org.uk/photo/35089

SCHEMATIC



Note—This is an educational kit and can only handle up to +-16V!

DO NOT CONNECT TO THE MAINS SUPPLY!

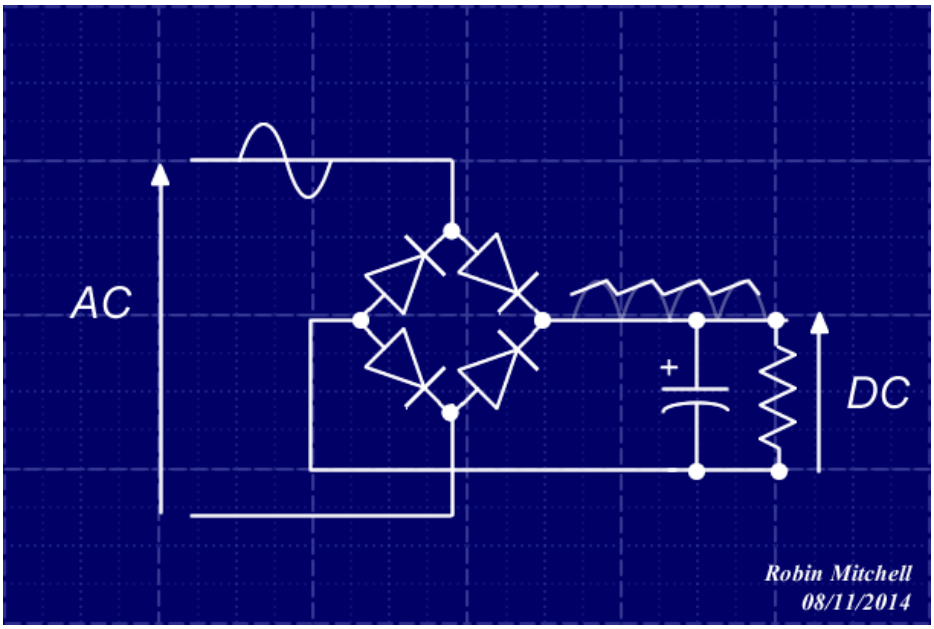
SCHEMATIC EXPLANATION

The AC-DC converter consists of two stages

- Rectification
- 5V Linear Regulation

Input Rectification

The input is rectified via D2, D3, D4 and D5. These diodes are Schottky which reduces the voltage dropped by this stage. The typical forward voltage for a Schottky is 0.3V and with two Schottky diodes in series at any one time (D3 and D2 pair or D1 and D4 pair), the typical voltage drop would be 0.6V.



If J1 (ACIN) is positive and J2 (ACIN) is negative then

D3 and D4 would be forward biased.
Current enters J1 and flows through D3
This current goes round the circuit (regulator, IC etc)
The return path (ground), goes back to the rectifier and through D4
The current returns to the original power source through J2

If J2 is positive and J1 is negative then

D2 and D5 would be forward biased
Current enters J2 and flows through D5
This current goes round the circuit (regulator, IC etc)
The return path (ground), goes back to the rectifier and through D2
The current returns to the original power source through J1

SCHEMATIC EXPLANATION

Output Regulation

While the converted AC voltage source which looks like a sine wave with both positive and negative peeks the resultant DC conversion looks like lots of positive bumps shown below. This cannot be used to power circuits and requires further processing to create a solid unchanging voltage.

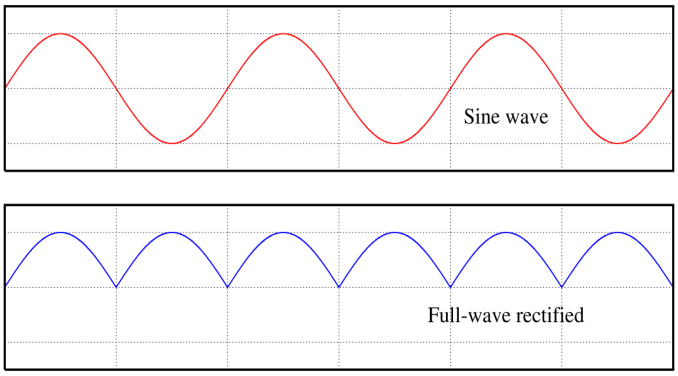
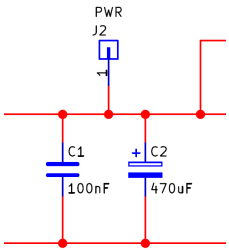
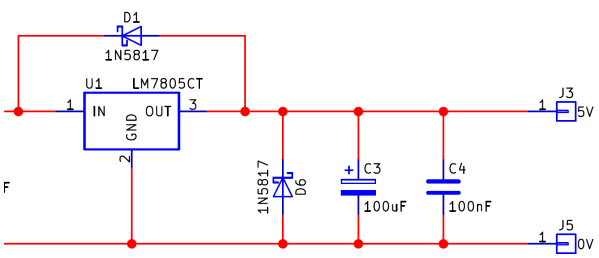


Image courtesy Wikipedia

The first step is to convert the large DC bumps from the full wave rectifier into a more consistent with smaller bumps. This is done using smoothing capacitors C1 and C2 which store energy during the peaks of the DC bumps and then discharge this energy back into the circuit during the dips of the DC bumps.

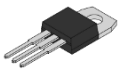


But this voltage will be greater than 7V on average (since this circuit has a minimum input voltage of +-5V), and is too large to feed into common circuits. The smoothed voltage will also be slightly bumpy which will cause issues with many circuits and so it requires regulation before it can be used. To do this we use the 7805 regulator which converts the now slightly wobbly voltage into a very smooth 5V.



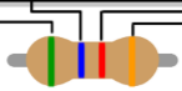
MATERIALS

Check that you have the following components

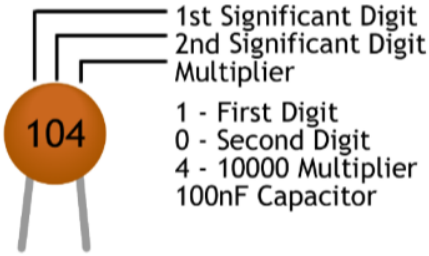
Component	Component Name	Quantity	Looks like
100nF Capacitor **(Ceramic)**	C1, C4	2	
100uF Capacitor **(Electrolytic)**	C3	1	
470uF Capacitor **(Electrolytic)**	C2	1	
Schottky Diode	D1, D2, D3, D4, D5, D6	6	
7805 Regulator	U1	1	
Black Wire	GND	1	
Red Wire	5V	1	
Green Wire	ACIN, ACIN	2	
PCB	-	1	

RESISTOR AND CAPACITOR IDENTIFICATION

Colour	1ST Band	2ND Band	3RD Band	Multiplier	Tolerance
BLACK	0	0	0	1Ω	
BROWN	1	1	1	10Ω	±1%
RED	2	2	2	100Ω	±2%
ORANGE	3	3	3	1kΩ	
YELLOW	4	4	4	10kΩ	
GREEN	5	5	5	100kΩ	±0.50%
BLUE	6	6	6	1MΩ	±0.25%
VIOLET	7	7	7	10MΩ	±0.10%
GREY	8	8	8		±0.05%
WHITE	7	7	7		
GOLD					±5%
SILVER					±10%



4 Band Resistor
5.6k ±5%



CONSTRUCTION

Download the electronics construction manual

To learn how to construct circuits on PCBs download the Electronics Construction Manual from Mitch-Electronics using the link below. This document shows you how to install all electronic components used in MitchElectronics kits. The list below shows the sections relevant to this kit so do not worry if you see component sections in the document that don't come with this kit!

www.mitchelectronics.co.uk/electronicsConstructionManual.pdf

Relevant sections in the electronics construction manual

Capacitors

Diodes

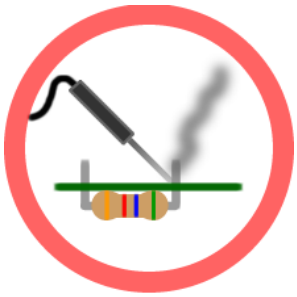
Regulators

Wires

IMPORTANT INFORMATION

RoHS Compliant Kit (Lead free)

Low Voltage Kit



Caution! Soldering Required