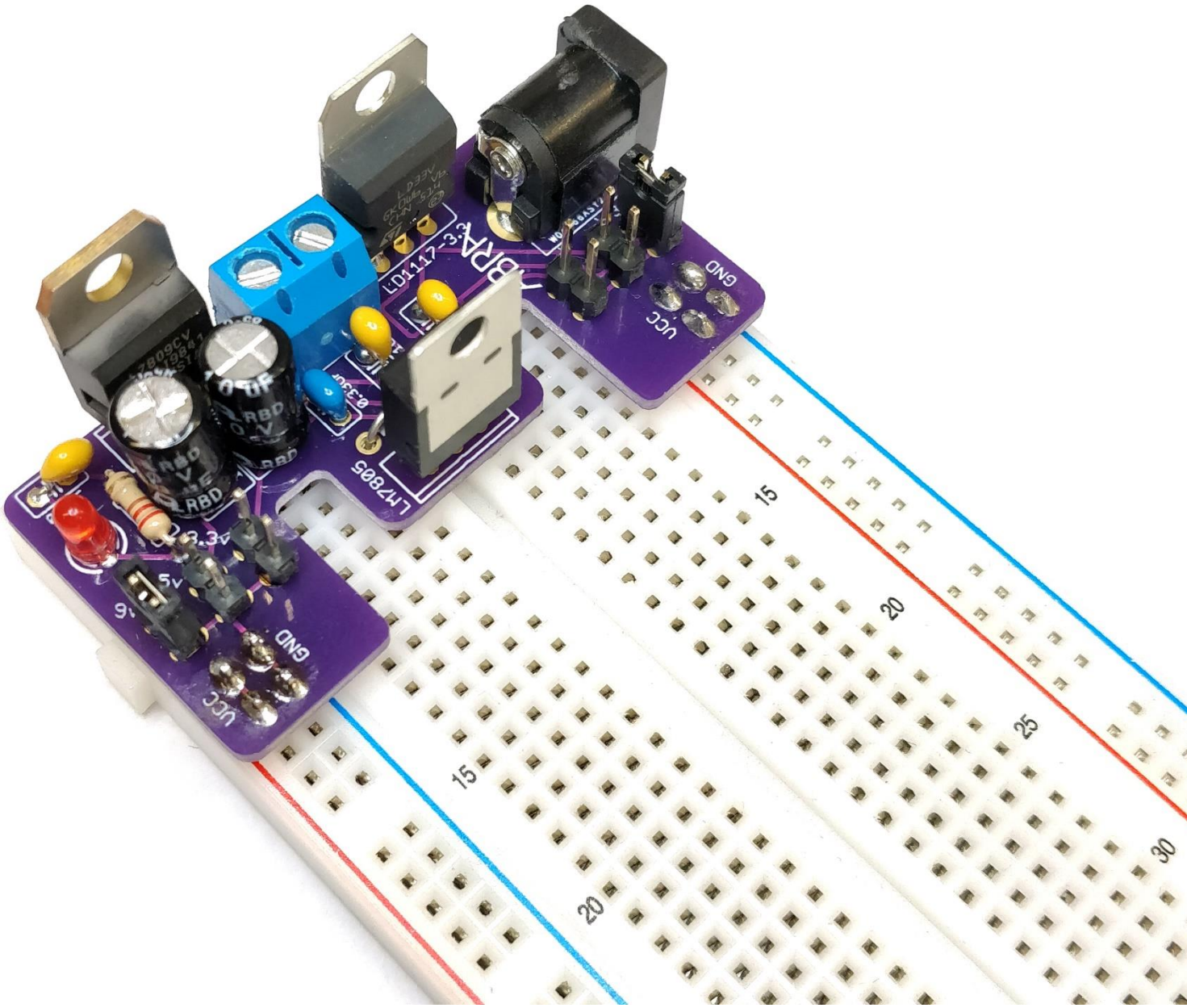
STEM AK-250

Breadboard Power Supply Module – Educational D.I.Y Kit



ABRA

www.abra-electronics.com

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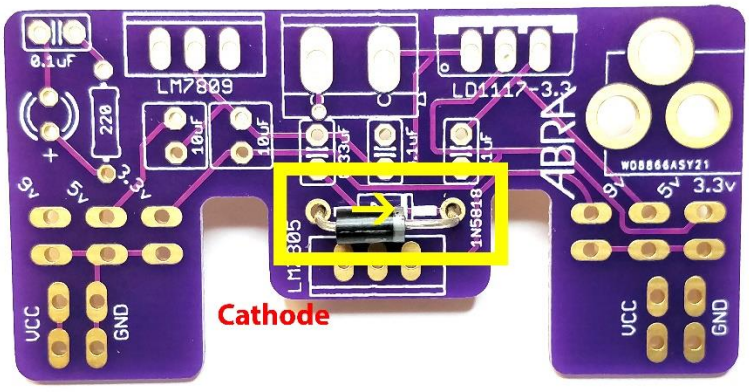


Figure S1

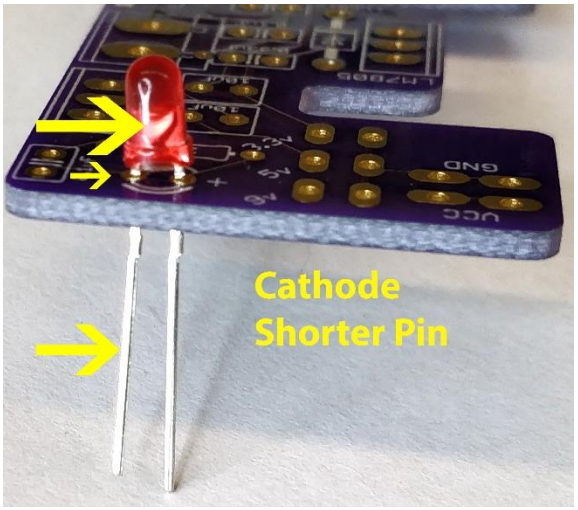


Figure S2

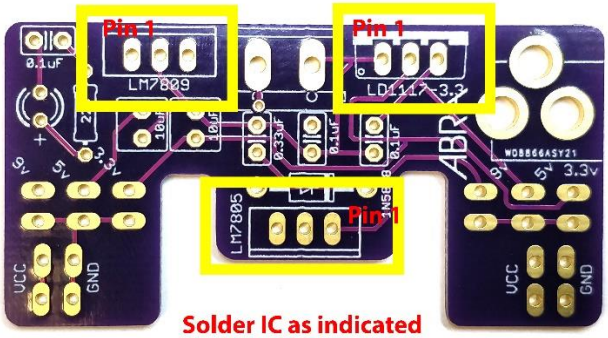


Figure S3

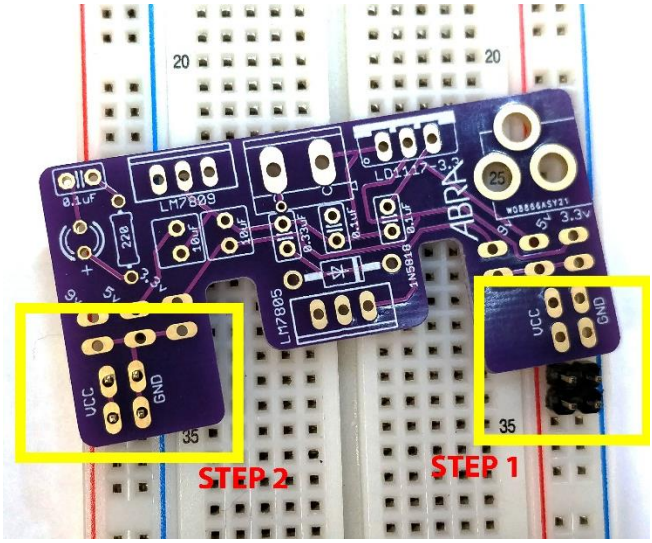


Figure S4

About this Product

This Breadboard Power Supply Module was designed to deliver regulated voltage from any external power source, either from the DC barrel jack or terminal block. The unique feature of this solderable module is the usage of three different voltage regulators offering three different voltages. The end user can select 5v, 3.3v or 9v to any of the power rails. This feat is done by simply placing the jumper over whichever location desired as labelled on the board to achieve the desired power for the rail.

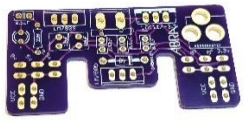
You can have two different output voltages provided to either rail simultaneously if desired and the ground pin is shared as common.

This product was designed for students and beginner hobbyist to learn, sharpen and improve their knowledge in electronics.

For more kits please visit
www.abra-electronics.com/educational-kits-trainers/educational-kits/

Bill of Materials

Custom Board



x1

Header – 2 Pin

X10

Screw Terminal Block – 2 Pin

X1

10µF Bi-Polarized Capacitor

x2

33µF Ceramic 50V Capacitor

x1

1N5818 Diode

x8

5V regulator 7805

x1

3mm red LED

x1

220Ω Resistor ¼ Watt

x1

.1µF Ceramic 50V Capacitor

x3

9V regulator 7809

x1

3.3V regulator LD1117

x1

DC Barrel Jack 2.1mm

x1

Shunt/Jumpers

X2

Tools Required/Suggested

Temperature Adjustable Soldering Iron

Needle Nose Plier

60/40 or 63/37, Tin-Lead Solder

Phillips Screwdriver

Flush Cutters

Lint Free Cloth

Soldering Instructions

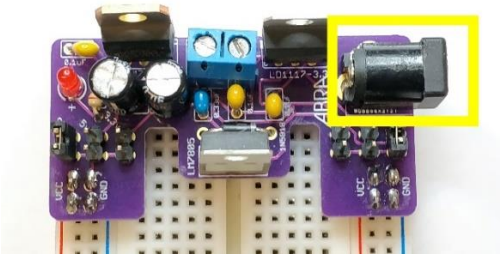
1. Start by soldering components that have a smaller height clearance. A good example is to solder the following components in the order that they are mentioned:
    a. Diode
    b. Resistor
    c. Ceramic Capacitors
    d. LED
    e. Header pins top side only!
    f. Terminal Block
    g. Non-polarized Capacitors
    h. ICs – 7805T, 7809T and LD1117V33
    i. Bottom Pins
    j. DC Barrel Jack

Note: when soldering lower height components, ensure you provide a gap between the board and the component itself before soldering to help prevent heat transfer from the components to the board.

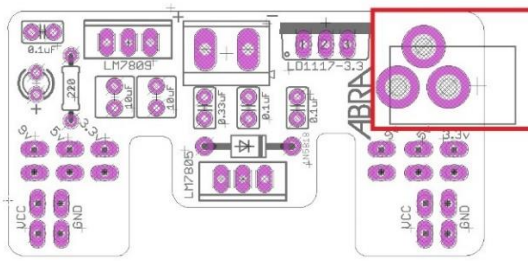
2. After soldering, use the flush cutter to help remove excess wires and allow ease of access to the solder joints.
3. Pay attention to the polarity of the Diode, white marking is to indicate that the negative (cathode) band on the diode is to be soldered into that location.
   (*See figure S1 in the Table of Figures section*)
4. Please Pay attention to the marking on the board for the LED. The layout in white shows a flat side to the round LED body. This Flat side is the negative pin (Cathode) for the LED.
   (*See figure S2 in the Table of Figures section*)
5. Solder the ICs with the corresponding name assigned to each area.
   (*See figure S3 in the Table of Figures section*)
6. Place the bottom pins into a breadboard for support and solder the board from the top side. (*see figure S4 in the Table of Figures section*)
7. Clean the board with a lint free cloth and some isopropyl for a clean solder work. (Optional)

Wiring/Interfacing Guideline

BOARD VIEW

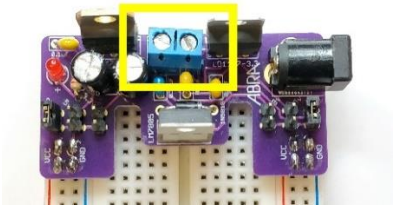


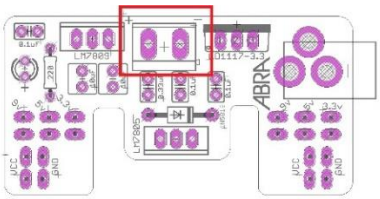
PCB SCHEMATICS VIEW



(Optional) Supply External Voltage from a wall power adapter that has a 2.1mm dc barrel jack connector with a maximum current rating of 1 amp and voltage rating of 35VDC.

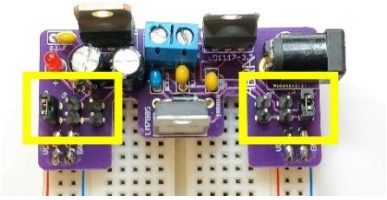
[Cannot use DC Barrel jack and Terminal Block at the same time]

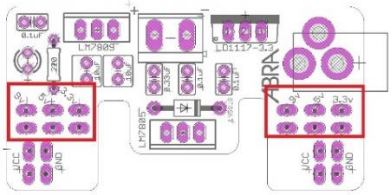




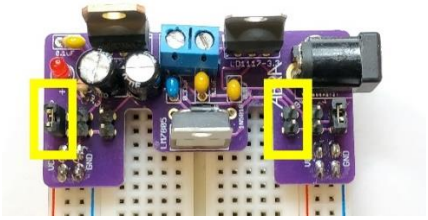
(Optional) Supply External Voltage from screw terminal block, pay attention to marking for polarity, with a maximum current rating for 1 amp and voltage rating of 35VDC from a bench power supply.

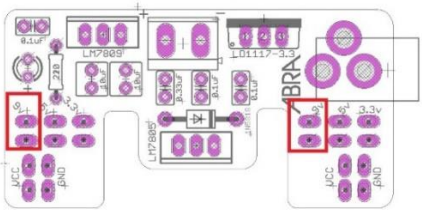
[Cannot use DC Barrel jack and Terminal Block at the same time]



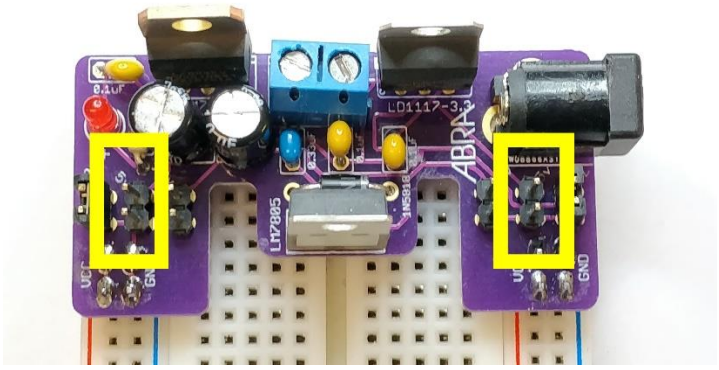


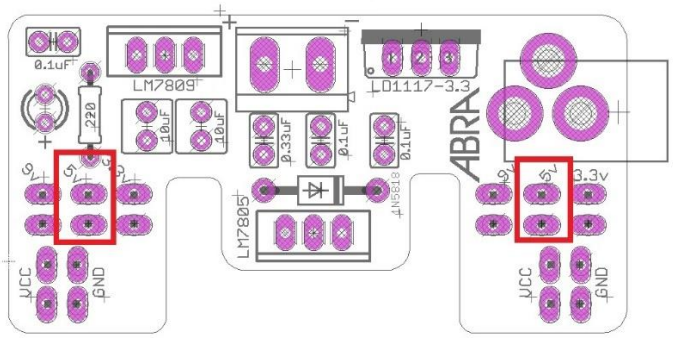
This region is where you required to insert a 2 pin shunt/jumper to supply the rail with your desired voltage.



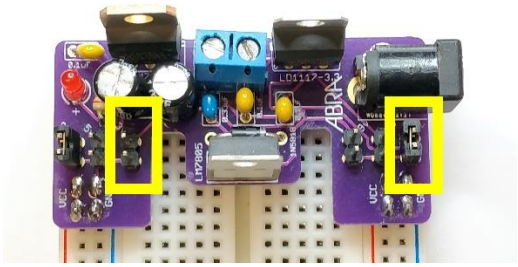


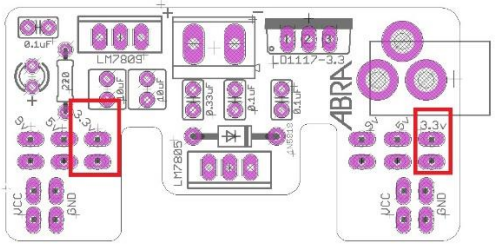
Placing jumper on 9v will allow the rail to be supplied with 8.2 volts to the entire rail, unless there is a break in the rail by default.



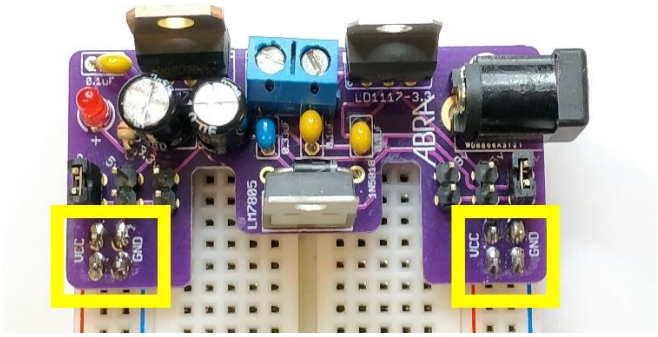


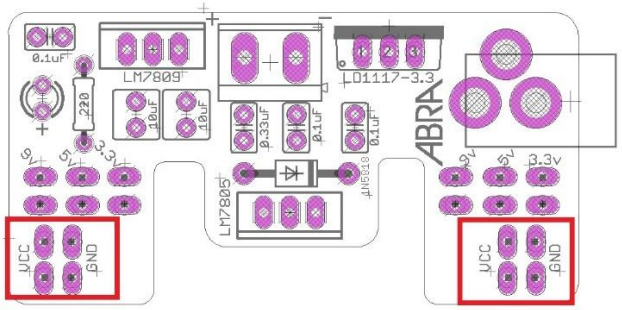
Placing jumper on 5v will allow the rail to be supplied with 5 volts to the entire rail, unless there is a break in the rail by default.





Placing jumper on 3.3v will allow the rail to be supplied with 3.3 volts to the entire rail, unless there is a break in the rail by default.



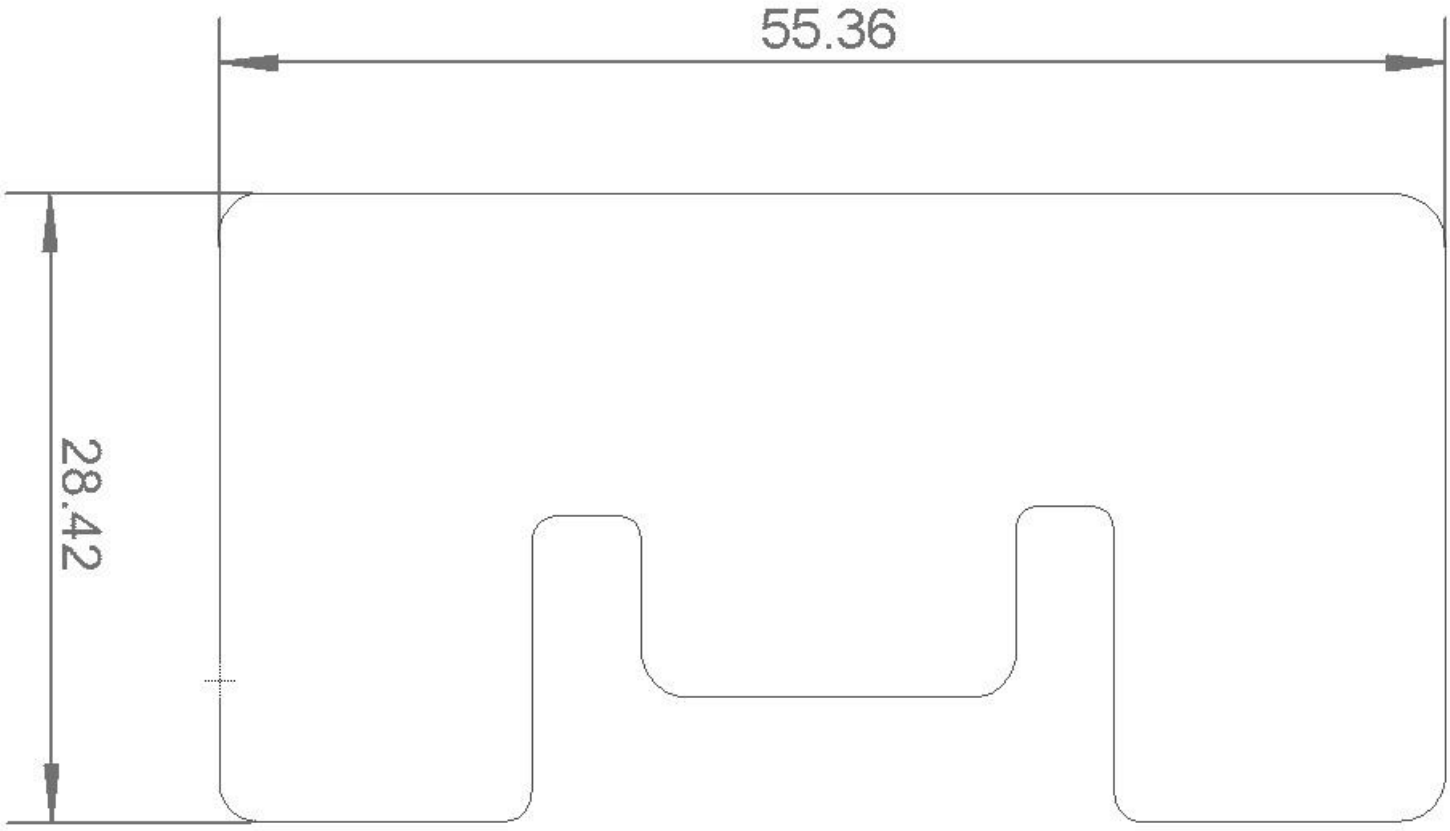


VCC voltage will be the output of what the jumpers for the rails are set as.

Board Specifications

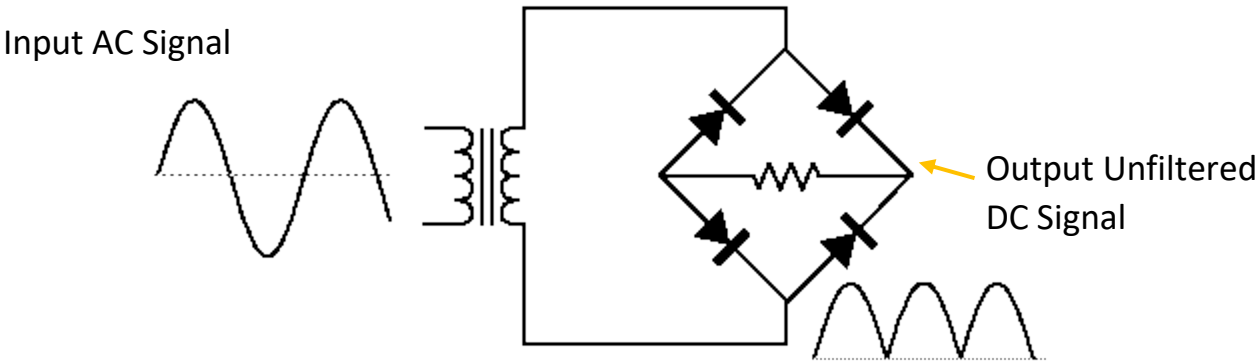
Absolute Maximum Ratings

Parameter	Value	Unit
Power Input	35	V
Max Current	1	A
Reverse Current Protection	1	A
Regulated Output Voltage (DC)		
- **9v**	8.3	V
- **5v**	5	V
- **3.3v**	3.3	V
Power Dissipation	30	W
Junction Operating Temperature	-40 to 50	ºC
Trace Thickness	1	Oz



Theory of Operation

The two types of voltage possible from a power source is in AC or DC format. AC is an abbreviated form for Alternating Current and DC for Direct Current. The AK-250 module only focuses on the DC aspect and never really touches AC. To convert AC to DC, you will require a bridge rectification circuit.

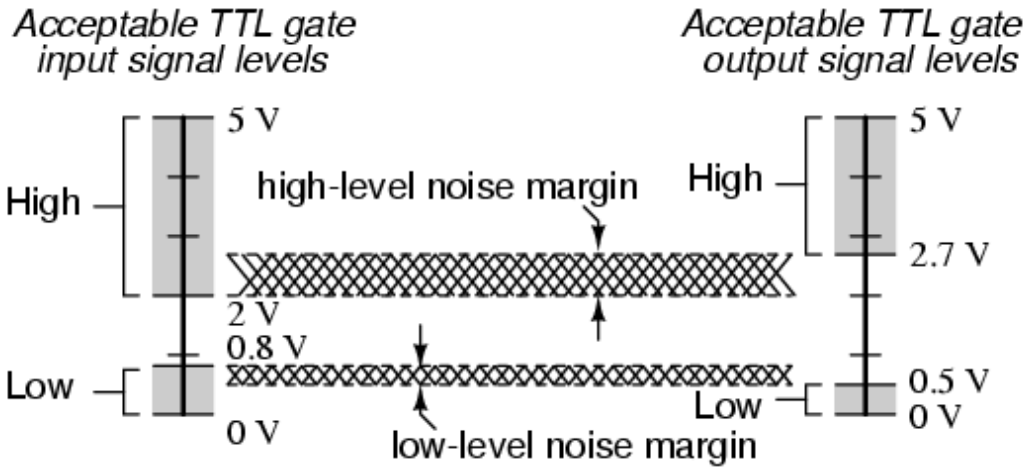


Source: http://hyperphysics.phy-astr.gsu.edu/hbase/Electronic/rectbr.html

In discrete electronics, digital circuits use DC more often than AC voltage, as DC can be manipulated into various waveforms for the required functions and needs. Because of the usefulness of DC, this adapter board is designed to regulate voltage to bring down higher voltage to power the smaller microcontrollers that require lower voltage to operate.

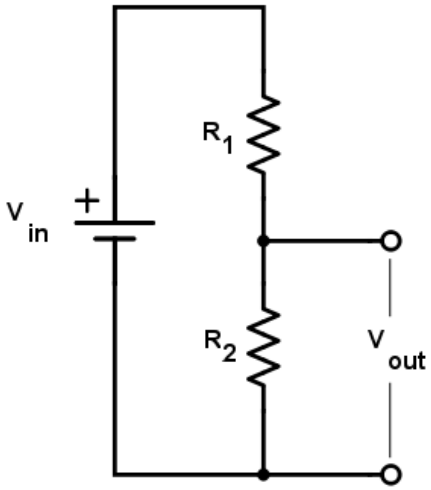
The notion that dictates why motors run at a certain voltage and microcontrollers run at another is defined by a simple formula called ohms' law V=I*R. V stands for voltage, I for current and R for resistance. All devices be it motors, microchips or even fans run by means of current hence why we call it AC and not AV or DC and DV. Current is the driving the force that allows work to be done, it is the measurement of electrons flowing through a path to create a transfer of joules or energy.

Microcontrollers only need 3.3V or 5VDC for as the logic level, to create energy efficient circuits. There are two states in programming that is considered useful. Logic High (1) or Logic Low (0). Voltage from 5v and 3.3v have a threshold to be considered in either state.



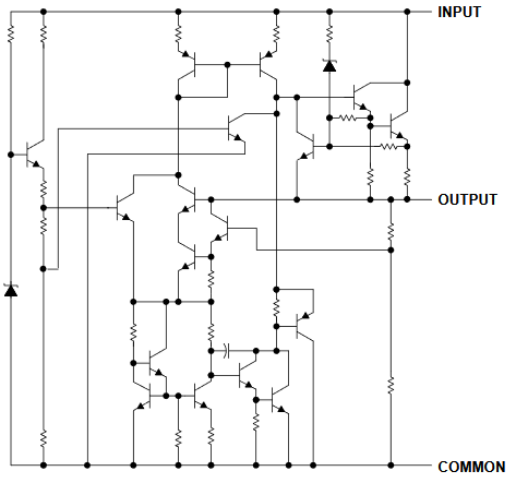
Source: https://www.allaboutcircuits.com/textbook/digital/chpt-3/logic-signal-voltage-levels/

To help reduce voltage we can use a current limiter also known as a resistor to limit the amount of current travelling and the voltage drop across the resistor would be dissipated as heat. We can also use Voltage Divider circuits to help obtain the voltage we desire. A voltage divider is a simple circuit which converts large voltage into a smaller one. Using just two series resistors and an input voltage, we can create an output voltage that is a fraction of the input.



Source: https://www.allaboutcircuits.com/tools/voltage-divider-calculator/

However, the issue with voltage divider circuit is the current source is never stable and this could cause issues. The first resistor will also suffer from high current that it needs to dissipate by heat and will melt. To resolve this, we use voltage regulators. Voltage regulators are made of a more detailed circuit as shown on the next page.



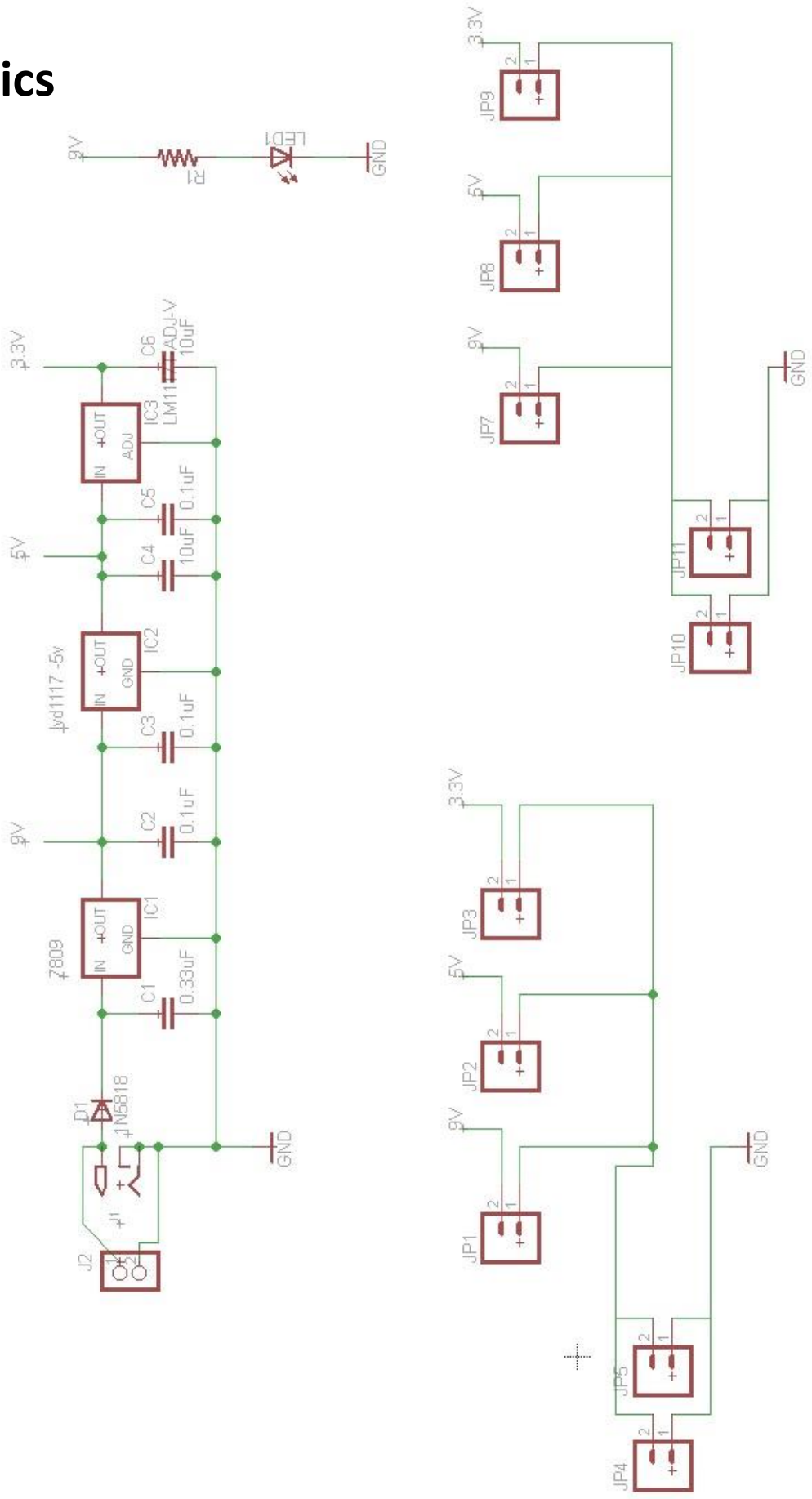
Source: https://www.sparkfun.com/datasheets/Components/LM7805.pdf

This block diagram was taken from the datasheet that the supplier offers. In exchange for bringing the voltage down, the output is controlled by the middle section transistors to ensure the voltage output is regulated and any excess energy is dissipated by heat.

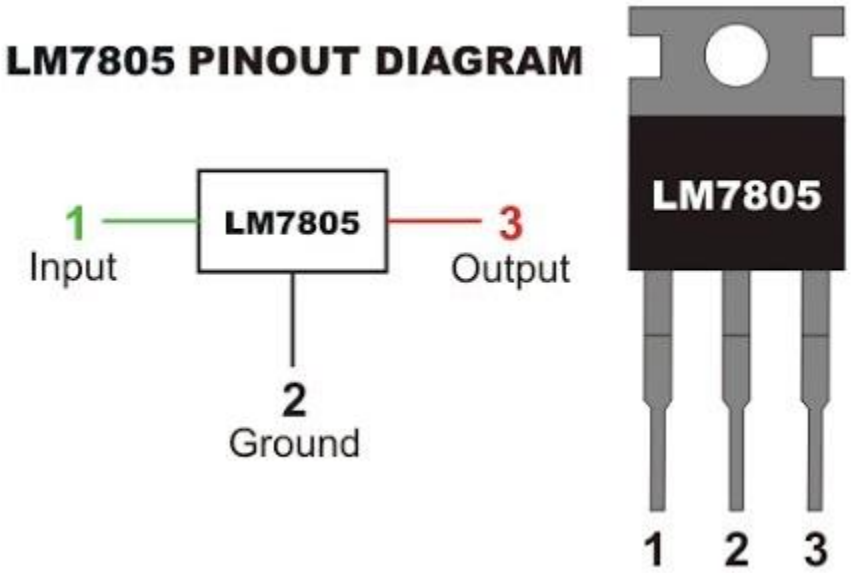
These regulators are found on all microcontrollers and 5v devices that offer external input an example of a voltage regulator is the AMS1117 that can be found on Arduino Uno see picture below.

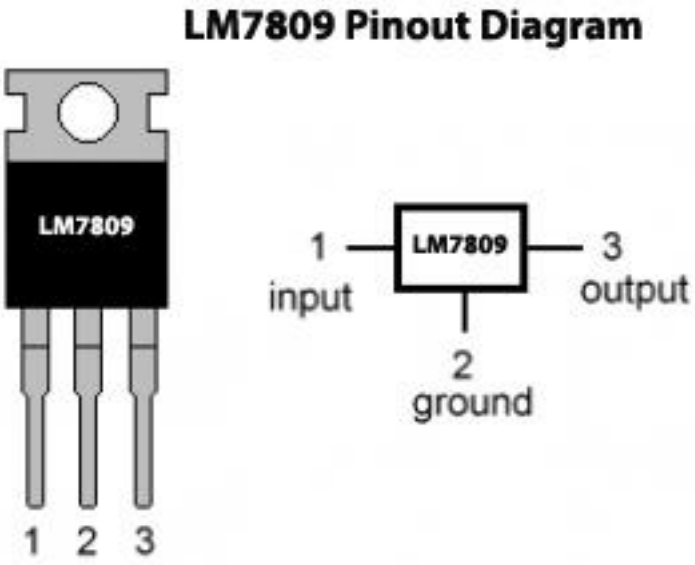
Source: https://store.arduino.cc/usa/arduino-uno-rev3

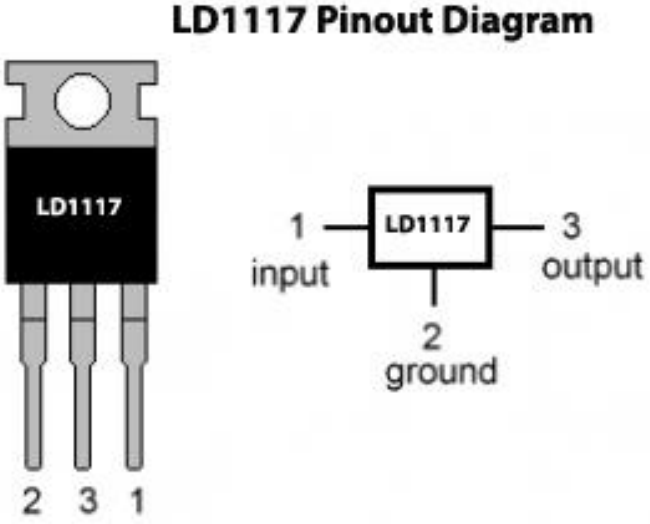
Schematics


9V
R1
LED1
GND
3.3V
C6
ADJ-V
10uF
IC3
LM117
IN
+OUT
ADJ
C5
0.1uF
5V
C4
10uF
IC2
lyd1117 -5v
IN
+OUT
GND
C3
0.1uF
9V
C2
0.1uF
IC1
7809
IN
+OUT
GND
C1
0.33uF
D1
1N5818
J1
J2
GND
3.3V
JP9
5V
JP8
9V
JP7
GND
JP11
JP10
3.3V
JP3
5V
JP2
9V
JP1
GND
JP5
JP4

Pinouts


LM7805 PINOUT DIAGRAM
1
Input
LM7805
3
Output
2
Ground
LM7805
1 2 3


LM7809 Pinout Diagram
LM7809
1 2 3
1
input
LM7809
3
output
2
ground


LD1117 Pinout Diagram
LD1117
2 3 1
1
input
LD1117
3
output
2
ground

ABRA Educational Kits

AK-30 Speaker Kit

Intermediate soldering skills required. Includes acrylic enclosure requiring some assembly to acquire an elegant DIY speaker.

AK-60 Thermostat Kit

A more practical kit that is already pre-programmed. Has a useful function to act as a thermostat.

EK-1 Theremin Kit

Simple easy to solder board for beginners to practice on. Sound changes depending on the proximity of the user hand or fingers to the photocell sensor.

AK-40 Alarm Clock Kit

Complex and time invested circuit board with acrylic enclosure for a DIY clock and alarm functionality!