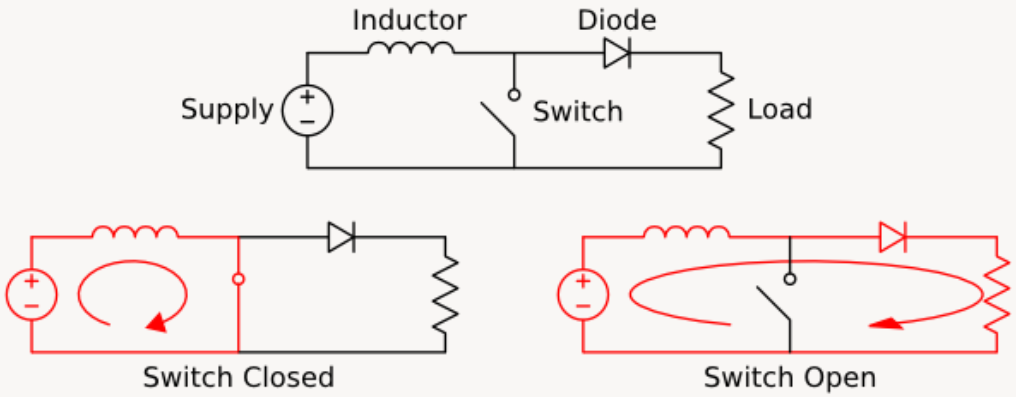
WORKING OF BATTERY BOOSTER SHIELD

How it All Works

When powering an arduino from 6 volts or higher through the DC jack, any voltage in excess of 5 volts is simply wasted as heat in the voltage regulator on the Arduino board. It is simple to figure out the amount of power wasted by the simple "linear" voltage regulator, it is simply the voltage drop across the regulator multiplied by the amount of current drawn by your circuit. For example, powering your Arduino with a 9v battery will drop 9 – 5 = 4 volts in the regulator. If you circuit draws 100 milliamps (mA), then 4v * 0.1A = 0.4 watts of power wasted in the regulator, and 5v * 0.1A = 0.5 watts of power are delivered to your circuit. In this example, of the 0.9 watts of power drawn from the battery, 0.4 watts (over 44%) of power is wasted as heat! This leads to an efficiency of less than 66%.

The Battery Booster Shield can drastically improve the efficiency of your battery use by using a high-frequency switching circuit to boost a lower voltage up to a nice 5 volts for use by your Arduino. The core idea of a boost DC-to-DC converter is shown in the circuit figures below, with the lower-voltage supply on the left running through an inductor, with a diode in line with the load.



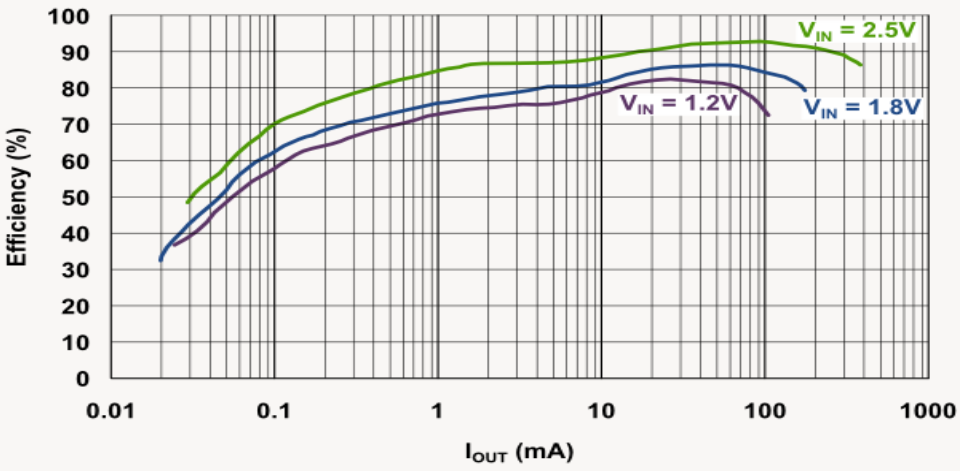
When the switch is closed, current flows from the lower-voltage voltage supply through the inductor. An inductor is simply a small coil of wire, which generates a magnetic field when current flows through the coil. The key property of an inductor is that it resists changes in the coil current, due to the magnetic field. When the switch changes from “closed” to “open”, the inductor sustains the flow of current through the diode and into the load. If this switching happens fast enough, a voltage is generated at the load that is larger than the supply voltage.

The Battery Booster Shield is based on the **MCP1640 chip** from Microchip Technology. This chip contains the high-speed switching circuitry needed by the boost converter. While this chip has an adjustable output voltage that can be set anywhere between 2.0 and 5.0 volts, we have used two resistors on the Battery Booster Shield circuit board to fix the output voltage to 5.0 volts.

More details about the inner workings of this boost converter chip, suggested circuit designs, etc, are available in the **MCP1640 datasheet**, and two companion application notes:

- **AN1337 – Optimizing Battery Life in DC Boost Converters Using MCP1640**
- **AN1311 – Single Cell Input Boost Converter Design**

As mentioned before, efficiency is an important measure of how good our converter is. For 5v output, this is the efficiency at three different values of input voltage, for a wide range of output current. We see that for 2.5v, which is approximately what you would get from a pair of alkaline AA cells, the converter will have greater than 90% efficiency when drawing anywhere between 20mA and 250mA.



TODO: explain more about the battery sensing concepts, and the Vref cap, with some sample code, etc

Source: https://www.wayneandlayne.com/projects/battery-booster-shield/