Buck DC Chopper

Introduction:

The DC-DC converter is an electrical circuit that transfers energy from a DC voltage source to a load. The energy is first transferred via electronic switches to energy storage devices and then subsequently switched from storage into the load. The switches are transistors and diodes; the storage devices are inductors and capacitors. This process of energy transfer results in an output voltage that is related to the input voltage by the duty ratios of the switches.

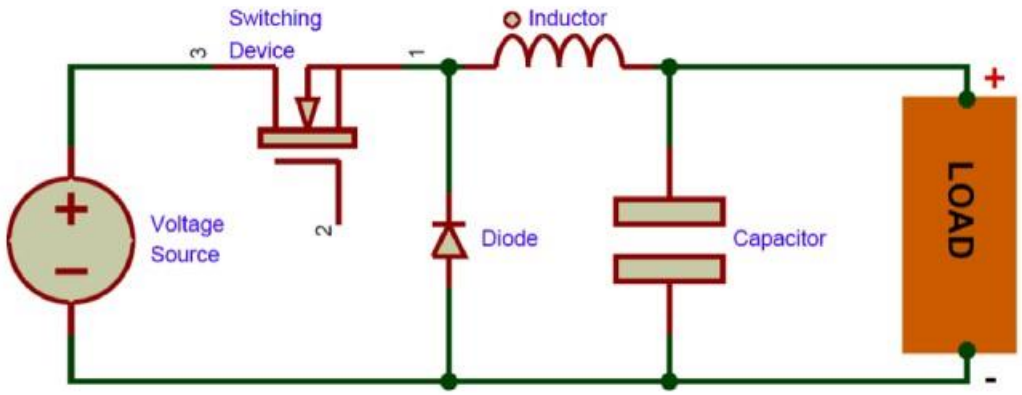
It is insightful and worthwhile to investigate why DC-DC converters are necessary before their detailed presentation and analysis. In addition to the constraints of size, weight, and cost, DC-DC converter technology also addresses the issues of efficiency and regulation.

A buck or step-down converter is a DC/DC switch mode power supply designed to buck (or lower) an unregulated DC supply's input voltage to a stabilized lower output voltage. Buck converters are highly appreciated for their extraordinarily high efficiency, which can easily surpass 95% when compared to ordinary voltage regulators.

Applications:

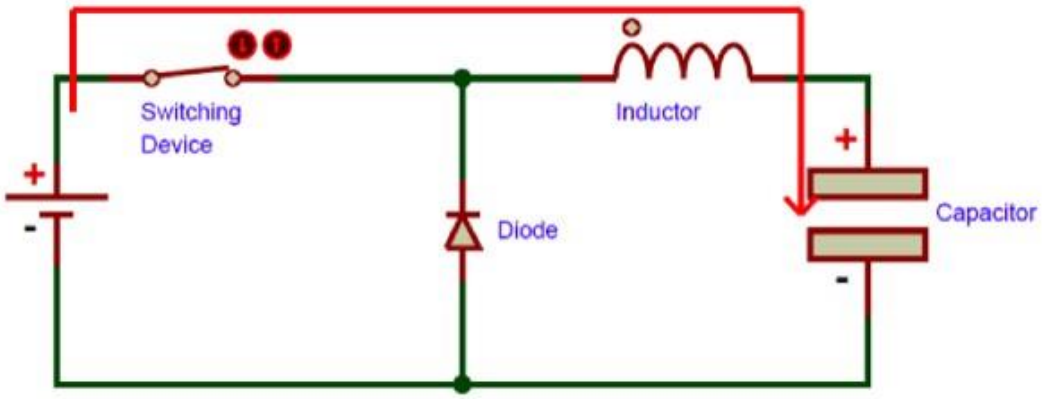
1) Keyboards, mouse, and other peripherals can be linked to a smartphone using USB On-The-Go. The USB port on the phone provides electricity to the auxiliary device. A synchronous buck converter that can transmit power in both directions is used for power regulation.
2) A Point-Of-Load Converter, or POL, is a non-isolated buck converter that's capable of efficiently driving power to high current loads. This is especially helpful in PC and laptop motherboards.
3) Everyone wants their smartphone, tablet, or portable battery pack to charge quickly and without overheating. The best way to do this is via a synchronous buck converter. A micro USB connector is the most common type of charging port for mobile devices. It accepts a 5V supply that is regulated.
4) Buck converters are used in quadcopters. Quadcopters often are powered from a multi-cell lithium battery pack. typical pack configurations are 26 cells in series. These battery packs produce a voltage in the range of 6V-25V. A buck converter drops the battery voltage down to 5V or 3.3V for the flight controller (the brain of the quadcopter) to use.
5) A brushed motor can be driven using a configuration called high side motor control. It's basically a synchronous buck converter without an output capacitor.

Principle of working:



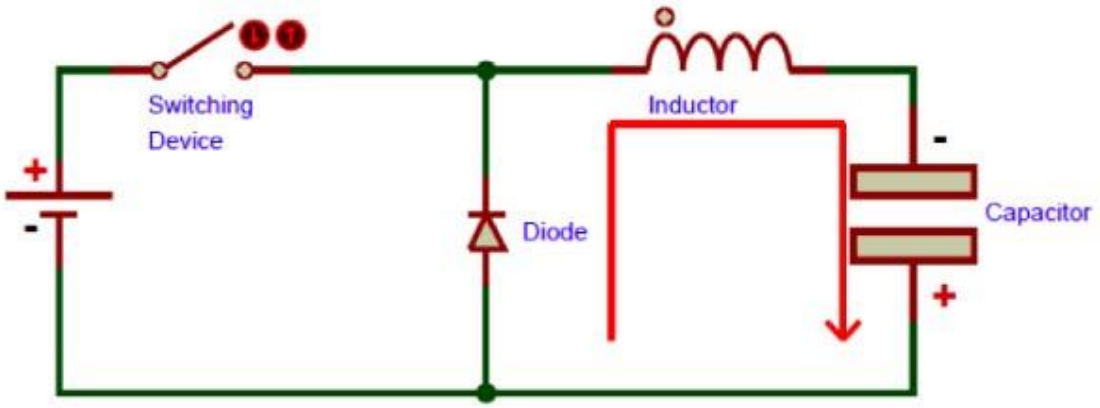
This is the whole circuit. The circuit operation depends on the conduction state of the switch.

Step1: Switch is ON



The switch turns on and lets current flow to the output capacitor, charging it up. Since the voltage across the capacitor cannot rise instantly, and since the inductor limits the charging current, the voltage across the cap during the switching cycle is not the full voltage of the power source.

Step2: Switch is OFF



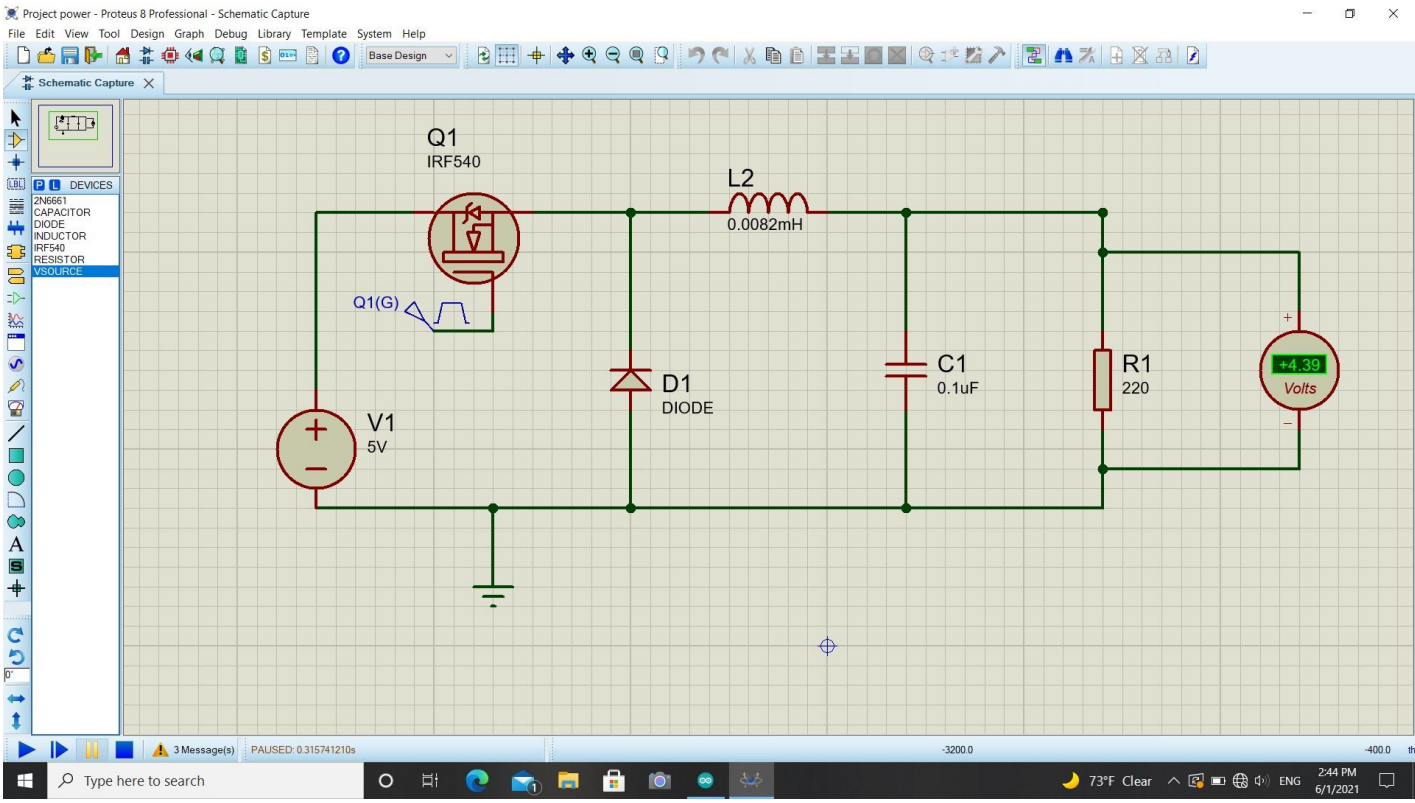
The switch now turns off. Since the current in an inductor cannot change suddenly, the inductor creates a voltage across it. This voltage is allowed to charge the capacitor and power the load through the diode when the switch is turned off, maintaining current output current throughout the switching cycle.

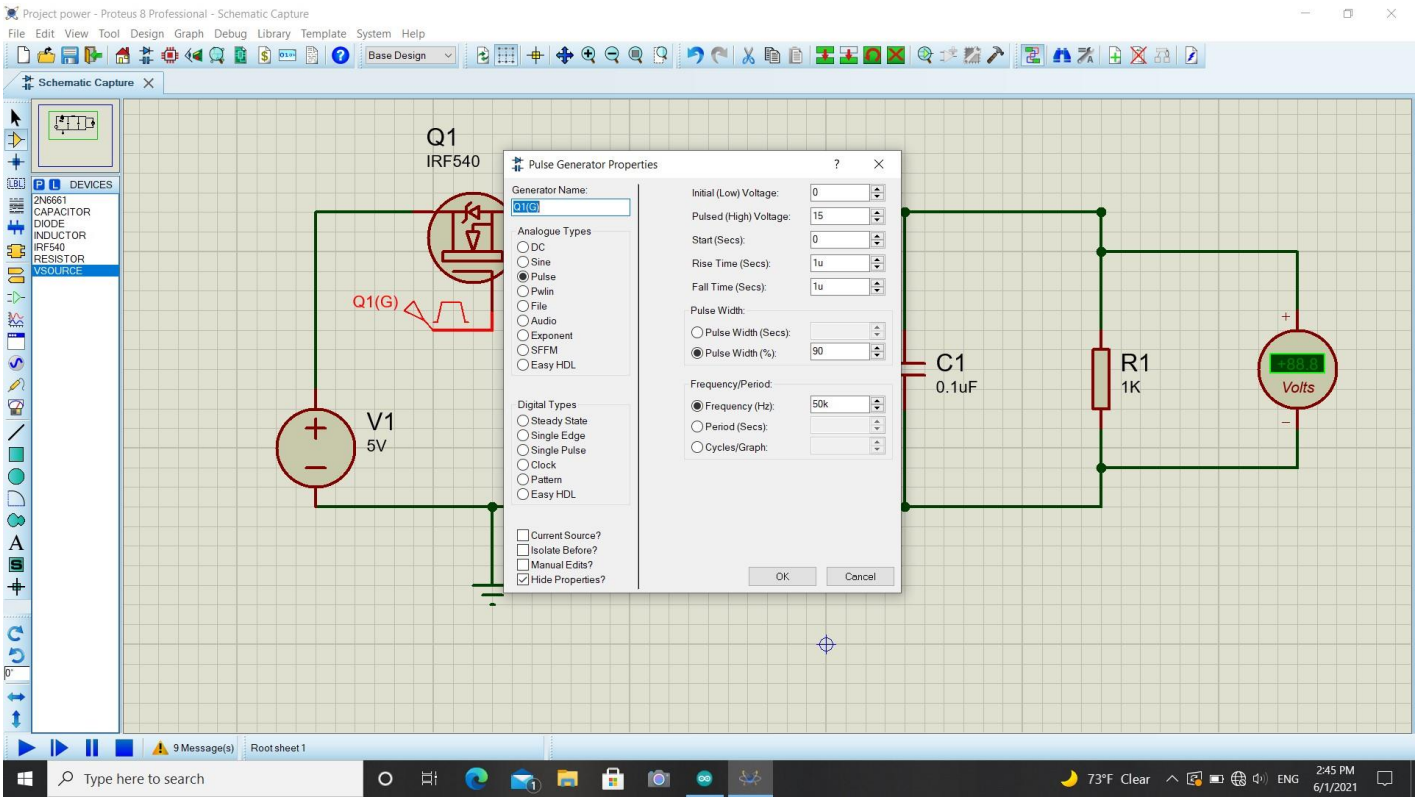
These two steps keep repeating many thousands of times a second, resulting in continuous output.

Components used:

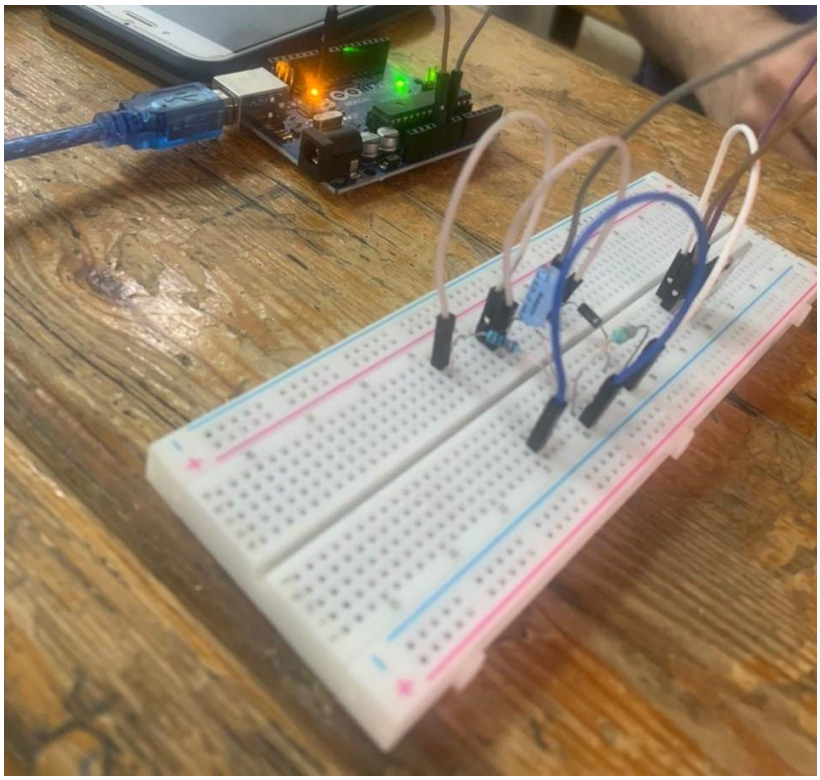
1) Breadboard
2) Resistance
3) Capacitor
4) Inductor
5) Diode
6) MOSFET
7) Arduino Uno

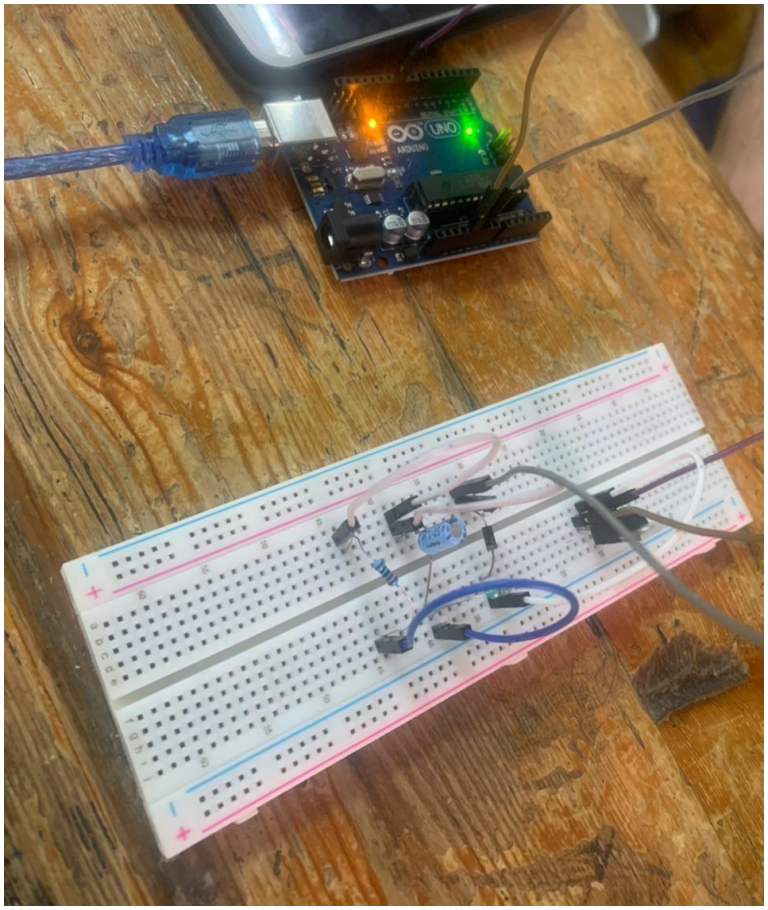
Circuit on Proteus:





Real connections:





Output: