

An Introduction to Buck, Boost, and Buck/Boost Converters

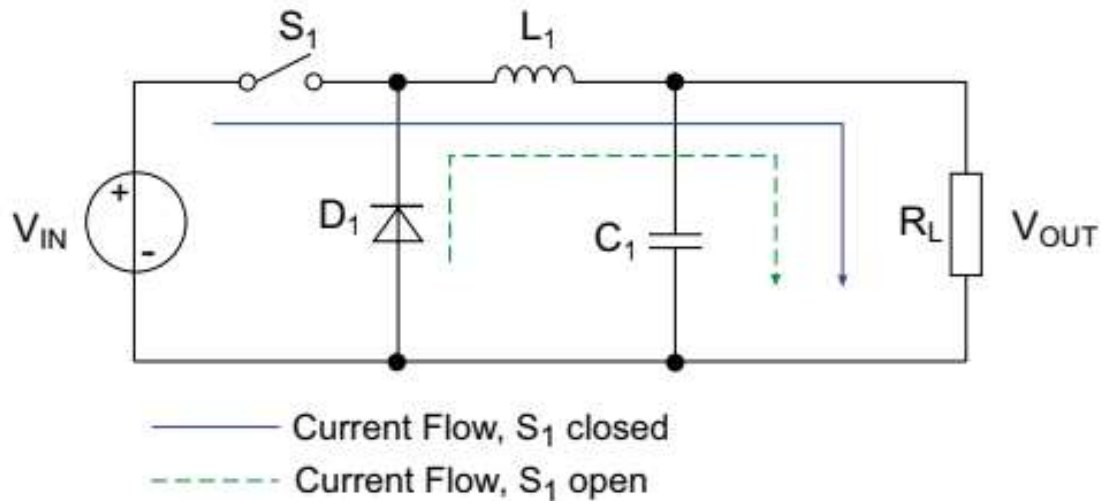
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Switch-mode power conversion has been a pillar of modern electronics technology across many sectors including utility, industrial, commercial, and consumer markets for many years. In low-power DC/DC conversion applications, most modern power conversion is done with three different types of power converters – Buck, Boost, and Buck-Boost Converters. This article examines the fundamentals of each type of converter and looks at where they may be used in the real world.

What is a Buck Converter?

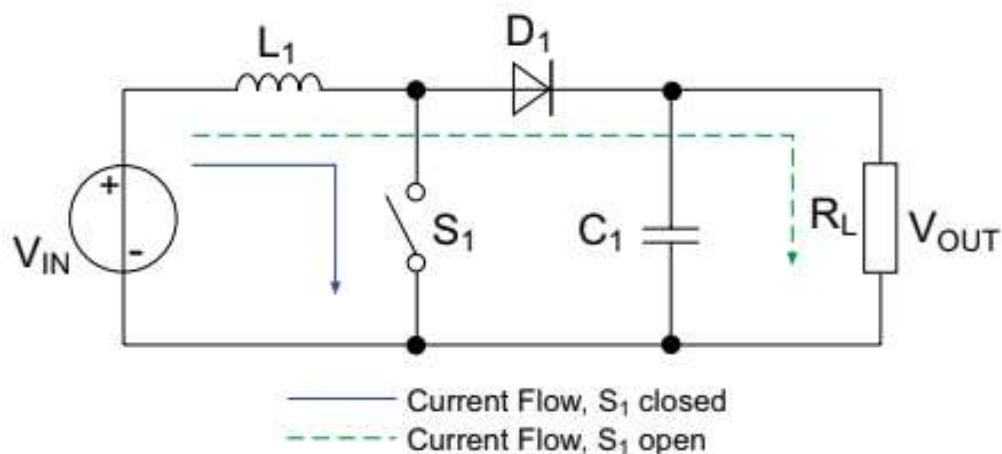
A buck or step-down converter is a DC/DC switch mode power supply that is intended to buck (or lower) the input voltage of an unregulated DC supply to a stabilized lower output voltage. Buck converters are, especially compared to traditional voltage regulators, widely valued for their extremely high efficiencies which can easily exceed 95%. The below simplified circuit diagram shows how current flows through the circuit during a switching event of a buck converter.



Buck converters are often used in lieu of traditional, non-efficient linear regulators to provide low-voltage on-board power in a variety of applications such as microprocessors, communication equipment, control systems, and more.

What is a Boost Converter?

A boost converter is a DC/DC switch mode power supply that is intended to boost (or increase) the input voltage of an unregulated DC supply to a stabilized higher output voltage. Similar to a buck converter, a boost converter relies on an inductor, diode, capacitor, and power switch regulate the output voltage, but they are arranged differently. The below simplified circuit diagram shows how current flows through the circuit during a switching event of a boost converter.

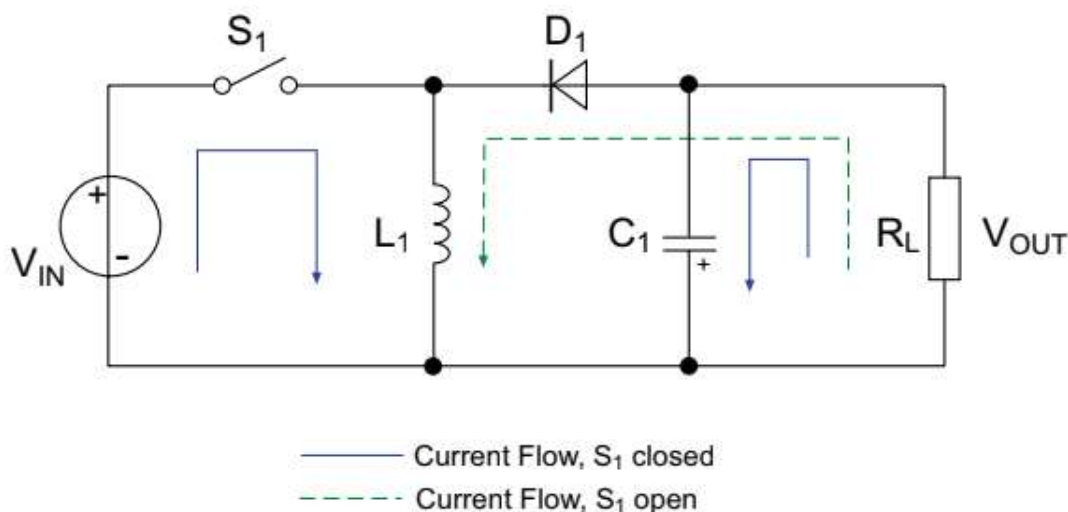


In a boost converter, the output voltage is varied by the mark-space ratio of the PWM signal to be equal to or above V_{IN} . As power is conserved, a boost converter that supplies triple the input voltage will be only be able to supply one third the current that it draws

from the supply. However, boost converters are very popular in battery powered devices, where perhaps a pair of batteries deliver 3V but need to supply a 5V circuit.

What is a Buck-Boost Converter?

A buck-boost converter can supply a regulated DC output from a power source delivering a voltage either below or above the regulated output voltage. A buck-boost converter circuit combines elements of both a buck converter and a boost converter, however they are often larger in footprint than either alternative. The below simplified circuit diagram shows a typical flow of current during a switching event through a buck-boost converter.



As you may have noticed in the circuit diagram, V_{OUT} is actually negative with respect to the supply potential, which can complicate certain designs. Buck-boost converters also require more expensive components as they need to withstand both high V_{IN} max voltage and high input current at V_{IN} min, but they are useful in many applications. A very common use of buck-boost converters are for high power LED lighting where, for example, lead-acid batteries supply a nominal 9-14V to a constant 12V LED load.

Conclusion

The technology of buck, boost, and buck-boost converters are utilized around the world to provide regulated low-voltage DC/DC power in nearly every electronics market. RECOM's buck, boost, and buck-boost converters are an excellent solution for your low-power conversion needs.