PassThru of a Voltage Using Buck-Boost Regulators

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This article will illustrate how special converters equipped with PassThru™ mode can be useful when the circuit's input voltage is too high or too low to power a load. It will give examples of how PassThru mode is used with buck-boost regulators and boost regulators to increase power supply efficiency and improve EMC behavior.

In some applications, an existing supply voltage can drive a load directly without the use of an additional voltage converter. At certain times, when unusual operating states occur, the supply voltage may be too high or too low to supply a load directly. In these cases, special voltage converters that have been optimized for this type of operation can be used. An example of an application is an industrial 24 V system. Let's assume a load requires a 24 V supply voltage, but the available 24 V voltage rail can sometimes go up to 38 V or drop to 15 V. These voltages fall outside of the permissible supply voltage range of the load. For these applications, classic boost regulators or buck-boost regulators can be used.

Figure 1 shows a system diagram of such an application. A portable radio device is supplied with voltage by a battery. The load can handle between 10 V and 14 V, but the voltage source has a possible output range of 8 V to 16 V. An interposed buck-boost regulator can thus convert the voltage to 12 V at the output. If the supply voltage is somewhat lower than 12 V, the converter works in boost mode, and if it is above 12 V, it works in buck mode.

Figure 1. A system in which the permissible voltage range of a load is narrower than the possible voltage range of the energy source.

Achieve Improvement with PassThru Mode

A system such as the one shown in Figure 1 works well—however, improvements can be made. If the voltage source is at a voltage that can directly supply the load for most of the time, a buck-boost regulator can be used in PassThru mode. Here, the circuit designer defines an input voltage range within which the input voltage is passed directly to the output of the buck-boost regulator. The advantages of this are that there are no switching losses whatsoever and the circuit efficiency is very high. In addition, the circuit is operated with extremely low electromagnetic emissions because there is no pulsing of currents in this operating mode.

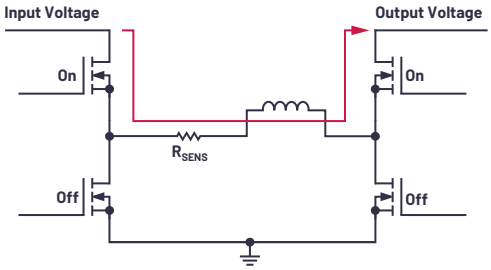

Figure 2. An LT8210 buck-boost regulator with PassThru mode for passing a voltage in standard operation.

Figure 2 shows the power stage of a new LT8210 buck-boost controller circuit with PassThru mode. In this mode, the two high-side switches of the H-bridge are permanently on and the two low-side switches are permanently off. Through this, depending on the currents and voltages, efficiencies of just below 100% are possible.

Besides a buck-boost solution (LT8210), boost regulators are also available with PassThru mode. The new LT8337 Silent Switcher® boost regulator from Analog Devices has an integrated PassThru mode. Figure 3 illustrates the concept behind the LT8337 boost converter. When PassThru mode is active, the high-side switch is permanently on and the low-side switch is permanently off.

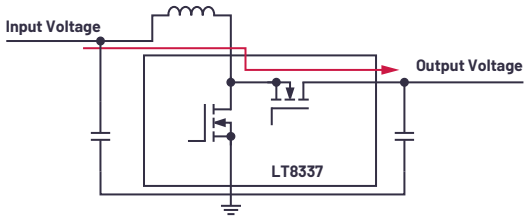

Figure 3. An LT8337 boost regulator with Silent Switcher technology that also offers PassThru mode.

In boost regulators, the high-side switch is usually executed with a flyback diode. Through this, an increased regulator supply voltage lying above the set output voltage is automatically passed through the inductor and the flyback diode. A dedicated PassThru mode, however, helps strongly reduce the voltage drop losses of the diode by actively switching on a high-side MOSFET. The PassThru mode also takes care of switching off all unnecessary functions of the LT8337. As a result, the IC itself can reach a current consumption of just 15 µA. This is very useful, especially for battery-operated applications.

Summary

PassThru mode increases the efficiency of a power supply and improves the EMC behavior. These advantages especially come into play in applications in which the available supply voltage is usually within the permissible voltage range of the load. However, it must also be clear to users that in PassThru mode, regulation of the output voltage does not take place within the defined voltage thresholds. In many applications, though, this is not necessary.

About the Authors

Frederik Dostal studied microelectronics at the University of Erlangen in Germany. Starting work in the power management business in 2001, he has been active in various applications positions including four years in Phoenix, Arizona, where he worked on switch-mode power supplies. He joined Analog Devices in 2009 and works as a field applications engineer for power management at Analog Devices in München. He can be reached at frederik.dostal@analog.com.