Technical Article

# Reducing Noise by Synchronizing Switching Regulators

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The majority of today's electronic circuits require multiple supply voltages. 20 years ago, a general-purpose 5 V supply voltage was sufficient for TTL logic and everything else in a system. Today, for example, 2.5 V is needed for the input/output (I/O) of a microcontroller, 0.9 V for the core, and 3.3 V for a sensor. Different voltages are also required for interfaces; for example, 5 V for USB. For maximum energy efficiency, switching regulators are the means by which the individual DC-to-DC conversion stages are operated today.

Figure 1 shows a typical power conversion architecture.

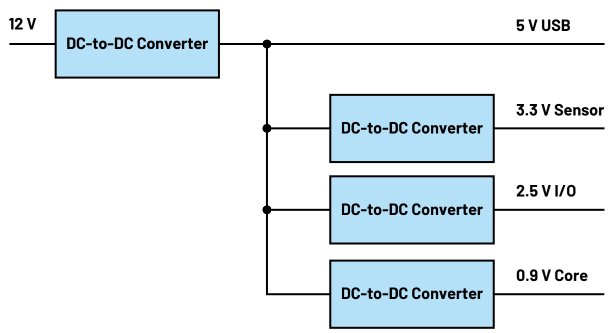


*Figure 1. Various switching regulators on a 12 V supply rail.*

If various switching regulators with different switching frequencies are operating in a system, you will see not only each respective fundamental frequency and its harmonics in the frequency spectrum but also the beat frequencies that correspond to the differences between the frequencies of the various switching regulators.

This problem of generated radiated emissions as well as conducted emissions at the inputs of the switching regulators can be alleviated through the synchronization of the various switching regulators in the system. Many DC-to-DC converter ICs have SYNC pins to which a clock signal can be applied. With an internal phase-locked loop (PLL), the switching frequency of each DC-to-DC converter sets itself to this supplied frequency.

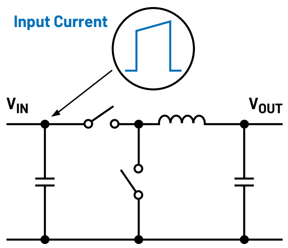


*Figure 2. Buck converters generate input-side pulsed currents.*

This is an elegant solution, but how is this clock signal generated? Because buck converters cause input-side pulsed currents, it makes sense to ensure that they do not all draw current from the input source at the same time. A phase-shifted external SYNC clock signal provides a remedy here. This greatly reduces the conducted emissions at the input side of the switching regulators.

The LTC6902 is a small additional clock generator device for controlling the SYNC pins of multiple switching regulators in a system. It is one of the useful tools in a power supply developer's toolbox. This clocking device can provide a clock signal between 100 kHz and 20 MHz, drive the SYNC pins of up to four switching regulators separately with a certain phase shift, and, if required, even use the optional spread spectrum frequency modulation (SSFM) to lower individual peaks in the frequency domain. In some applications, this trick allows to reach different EMC specifications.

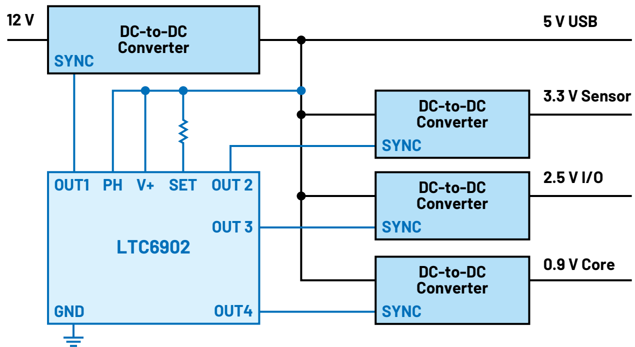


*Figure 3. A solution to the clock problem using an external clock generator module such as the LTC6902.*

Figure 3 shows the power supply architecture from Figure 1 with the LTC6902 multiphase oscillator. It is supplied with a voltage of 5 V. This voltage is generated by a buck converter that converts 12 V to 5 V. It is normally not a problem for switching regulators if they first independently start up with their own internal oscillators and are then supplied with an external clock. Details can be found in the data sheets for the respective switching regulators.

In addition to the LTC6902 4-phase part, there is also the LTC6908, a 2-phase device, and LTC6909, an 8-phase device.

A low noise system design is also possible if there are multiple switching regulators on one board. Apart from the usual optimizations—for example, selection of appropriate switching regulator ICs, optimization of the board layout, and addition of various filters—the use of an additional clocking module can also be beneficial.

## About the Author

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 4 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 ADI in München. He can be reached at frederik.dostal@analog.com.





TA23725-3/22