Center for Electromagnetic Compatibility (CEMC)

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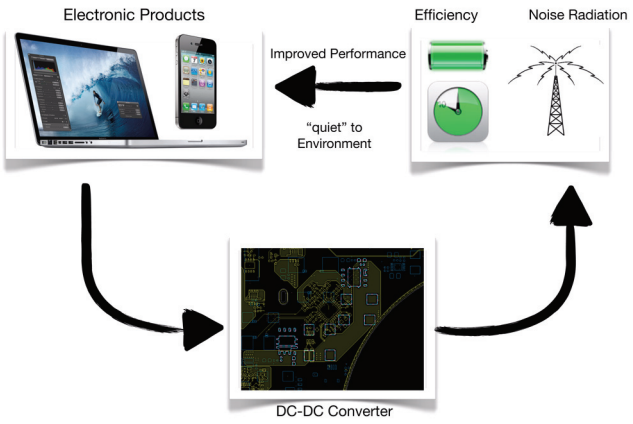
Reducing Emissions From DC-DC Converters Without Sacrificing Efficiency



High speed digital electronic devices such as computers and cell phones, for example, utilize signals that change rapidly, often on the order of nanoseconds or even picoseconds. These rapidly changing signals are generally transmitted from one integrated circuit to another or to one or more peripheral devices through a network of electrical conductors. The conductors in turn can exist in various forms including cables, wires, circuit board traces and circuit board planes. However, as the signal transitions become more rapid and occur more frequently the voltages and currents associated with the transitions can create a weak electromagnetic field in the proximity of the device. The electromagnetic field produced by the device then adds to the ambient electromagnetic fields produced by both natural events (e.g., lightning) and man-made events (e.g., radio and television transmissions). In this way each device contributes to the electromagnetic environment. While the electromagnetic environment is generally imperceptible to the senses, it can be detected with suitable electronic equipment. More importantly, excessive noise introduced into the electromagnetic environment by one device can cause interference to other devices located in proximity. The need is to determine how to design reliable electronic equipment that meets or exceeds regulatory constraints without significantly compromising other important design objectives.

Researchers at the Center for Electromagnetic Compatibility (CEMC) have made a significant technological contribution with their work on reducing emissions from DC-DC converters without sacrificing efficiency. Conventional solutions to reduce noise often affect the efficiency of the circuit. This breakthrough work conducted at CEMC provides a more thorough understanding of the noise radiation mechanisms in the circuit, and proposes innovative solutions to eliminate noise while maintaining circuit performance.

Economic Impact: The outcome of this study has been completed as a set of design guidelines. The design guideline is used during the product design stage to optimize the design of DC-DC converters for minimal radio emissions. The design guidelines allow designers to quickly optimize the EMC performance of the DC-DC converters in various products and thus can reduce the number of development cycles which can substantially reduce the cost of development. The outcome of this work has been implemented at Apple, Inc. in a number of its products. It is helping to deliver better products at reduced cost to the consumer. This will help industry realize reduced electromagnetic emissions from DC-DC converters that are often used multiple times in each product. Since DC-DC converters are used in almost all kinds of electronic devices, the breakthrough has a profound impact to the electronic industry. Implications of this work for end-users include reduced cost, fast-to-market product development, and a product that is "quiet" to environment while offering improved functionality and performance.

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