Abstract

Most electronic systems have switching power converters located on the same board. However, it is known that such power converters are prominent sources of electromagnetic interference (EMI), which may be both conducted and radiated in nature. Radiated EMI from these converters couple with nearby printed circuit board (PCB) traces and communication circuits located on the same PCB, and thus adversely affect the system performance. Conducted EMI degrades the input power quality. There are regulatory limits on the maximum amount of EMI that may be allowed to be generated from any circuit and hence various methods are adapted to reduce the EMI generated from these converters. Conventional methods to reduce EMI include conducted EMI filters, radiation screens, and various PCB layout techniques. Other methods involving the use of modulation signals having wide spectrum, like chaotic signals have also been proposed to improve performance. These methods claim to have certain benefits like reduced filter size and reduced cost and weight, but are yet to find wide acceptance in industry. In the present research, we have analysed these methods and have proposed some modifications to the existing chaos based EMI reduction techniques. We have also proposed novel methods for reducing the effect of radiated EMI in digital communication systems.

In Chapter 1, we have outlined the motivation for this work and thereafter in Chapter 2, we have presented a pulse position modulation based scheme for EMI reduction from DC-DC converters. The said scheme modulates the PWM saw-tooth suitably so that the EMI at the switching harmonics comes down. It has several features like wide operating frequency range, complete analog realization and peaky shape of power spectrum (which allows one to design appropriate filters). In Chapter 3, we have described how EMI reduction based on spectral shaping has adverse effects on some power quality parameters which are to be monitored closely according to limits set in the power quality standards like MIL-STD 704. We have pointed out that this kind of modulation has some cost factors associated with it which were not previously described in literature. Thereafter, in Chapters 4 and 5, we have designed new modulation schemes for reducing bit error rate in digital communication systems with minimum jitter and also for reducing conducted EMI without causing unwanted increase in radiated EMI in adjacent communication circuits.