Abstract

With the rapid development of power management unit, switching converters are widely used as voltage regulators due to its high power conversion efficiency. In the context of high-speed applications that require different operation modes in the embedded systems, the frequently changing load current in specifications may induce significant undershoot/overshoot variations. This will deteriorate the overall system performance such as data missing, transmission errors, robustness and so forth. As such, it directly poses the design challenge for the switching converters. From the application prospective, fast-transient response becomes one of the key parameters for the design of this specific DC-DC converter. In this thesis, the representative fast-transient circuit techniques for DC-DC converters has been extensively reviewed. To tackle the issue, a new pumping control scheme is proposed to enhance the transient response of a voltage-mode hysteretic DC-DC buck converter in 40nm CMOS technology. Comparing with conventional counterparts, it is able to improve the transient response and reduce the undershoot/overshoot voltage together with the multiple undershoot/overshoot effect during the load current transitions. Besides, a detailed theoretical analysis is conducted to give the in-sight of circuit technique. From the simulation results, the output voltage ripple is obtained at about $36mV_{pp}$ whilst the undershoot/overshoot settling time is obtained as 620ns/550ns in response to a 200mA load current step. The undershoot/overshoot voltage can be maintained within 2%. The peak efficiency is 94% for the entire load current range. It has confirmed that these simulation results correlate well with the theory for validation of transient enhancement. The performance comparison has shown that the proposed circuit technique outperforms that of the reported works.