

ABSTRACT

A power supply is an essential part of almost every electronic device. The current trend is towards the miniaturization of these devices. It is thus desirable to reduce the size of the power supply by decreasing the size of the passive components such as inductors, capacitors and transformer, which can be achieved by increasing the switching frequency and power density. Switch Mode Power Supplies (SMPS) operating at higher switching frequencies offer significant size and weight reduction by replacing bulky line frequency magnetics with smaller high frequency magnetics. With the availability of modern and efficient power devices such as the CoolMOS and GaN power MOSFETs, it is possible to switch SMPS from several kHz to MHz range. The development of energy efficient multilayer PCB and hybrid core planner transformers is also a motivating factor in designing SMPS operating in MHz frequency range.

This research work is an innovative step towards designing, implementation and analysis of emerging high frequency SMPS. The design, implementation and evaluation of energy efficient AC-DC and DC-DC isolated converter topologies switching in MHz frequency range are described in this dissertation. The auxiliary voltage feedback technique which is better alternate to the commonly used opto-coupler feedback is proposed for half bridge converter topology.

The consequence of increased switching frequency is the production of undesirable electromagnetic emissions (EMI) which affects the Electromagnetic Compatibility (EMC) of the SMPS. The EMC is as important as the energy efficiency of a power converter and has become a compulsory requirement because of stringent EMC regulations such as International Special Committee on Radio Interference (CISPR) and Federal Communication Commission (FCC) etc. In order to comply with EMC standards, most power converters use input and output filters. It is a common perception that the EMI has worst effect on filter design in the converters switching in MHz frequency range than the converters operating below 150 kHz. When switching frequency of a converter is increased above 150 kHz, the fundamental frequency component also needs to be filtered. As a result of this the line filter size can get increased. Therefore in order to study the effects of increased switching frequency on filters design, the EMC analysis is performed by EMI measurements of different high frequency power converters. Different techniques are

studied and implemented to suppress the conducted emission from these converters.

In order to analyze the radiated emission from the power converter as well power cables, near field emission measurements are performed for a 3 MHz half bridge converter and the frequency spectrum of both E- and H-fields are analyzed. An output filter is proposed to reduce the emission from the secondary side cables. Since these converters are in initial design phase, the practical measurement results analyzed in this dissertation will be helpful in the final design.