World Academy of Science, Engineering and Technology
International Journal of Electronics and Communication Engineering
Vol:9, No:10, 2015

A Novel PWM/PFM Controller for PSR Fly-Back Converter Using a New Peak Sensing Technique

Authors : Sanguk Nam, Van Ha Nguyen, Hanjung Song

Abstract : For low-power applications such as adapters for portable devices and USB chargers, the primary side regulation (PSR) fly-back converter is widely used in lieu of the conventional fly-back converter using opto-coupler because of its simpler structure and lower cost. In the literature, there has been studies focusing on the design of PSR circuit; however, the conventional sensing method in PSR circuit using RC delay has a lower accuracy as compared to the conventional fly-back converter using opto-coupler. In this paper, we propose a novel PWM/PFM controller using new sensing technique for the PSR fly-back converter which can control an accurate output voltage. The conventional PSR circuit can sense the output voltage information from the auxiliary winding to regulate the duty cycle of the clock that control the output voltage. In the sensing signal waveform, there has two transient points at time the voltage equals to Vout+VD and Vout, respectively. In other to sense the output voltage, the PSR circuit must detect the time at which the current of the diode at the output equals to zero. In the conventional PSR flyback-converter, the sensing signal at this time has a non-sharp-negative slope that might cause a difficulty in detecting the output voltage information since a delay of sensing signal or switching clock may exist which brings out an unstable operation of PSR fly-back converter. In this paper instead of detecting output voltage at a non-sharp-negative slope, a sharp-positive slope is used to sense the proper information of the output voltage. The proposed PRS circuit consists of a saw-tooth generator, a summing circuit, a sample and hold circuit and a peak detector. Besides, there is also the start-up circuit which protects the chip from high surge current when the converter is turned on. Additionally, to reduce the standby power loss, a second mode which operates in a low frequency is designed beside the main mode at high frequency. In general, the operation of the proposed PSR circuit can be summarized as following: At the time the output information is sensed from the auxiliary winding, a saw-tooth signal from the saw-tooth generator is generated. Then, both of these signals are summed using a summing circuit. After this process, the slope of the peak of the sensing signal at the time diode current is zero becomes positive and sharp that make the peak easy to detect. The output of the summing circuit then is fed into a peak detector and the sample and hold circuit; hence, the output voltage can be properly sensed. By this way, we can sense more accurate output voltage information and extend margin even circuit is delayed or even there is the existence of noise by using only a simple circuit structure as compared with conventional circuits while the performance can be sufficiently enhanced. Circuit verification was carried out using 0.35μm 700V Magnachip process. The simulation result of sensing signal shows a maximum error of 5mV under various load and line conditions which means the operation of the converter is stable. As compared to the conventional circuit, we achieved very small error only used analog circuits compare with conventional circuits. In this paper, a PWM/PFM controller using a simple and effective sensing method for PSR fly-back converter has been presented in this paper. The circuit structure is simple as compared with the conventional designs. The gained results from simulation confirmed the idea of the design

Keywords : primary side regulation, PSR, sensing technique, peak detector, PWM/PFM control, fly-back converter
Conference Title : ICECS 2015 : International Conference on Electronics, Circuits and Systems
Conference Location : Osaka, Japan
Conference Dates : October 08-09, 2015