Spread Spectrum Technology with Automatic Notch Generation Used for Switching Converter

Yifei Sun, Yasunori Kobori, Haruo Kobayashi
Division of Electronics and Informatics, Faculty of Engineering and Science, Gunma University
1-5-1 Tenjin-cho, Kiryu 376-8515, Japan
t172d004@gunma-u.ac.jp

This paper proposes an EMI spread spectrum technology with automatic setting the notch frequency using the pulse coding controlled method of the DC-DC switching converter for the communication equipment. This proposed EMI spread spectrum technique does not distribute the switching noise into some specified frequency bands. The notch in the spectrum of the switching pulses is represented by the Pulse Width Coding (PWC) method. Notch frequency F_n is automatically set to the frequency of the received signal by adjusting the clock frequency F_{ck} using the equation $F_n = (N + 0.5)F_{ck}$. Here *N* is an integer. We have confirmed with simulation that the proposed technique is effective for EMI reduction and notch generation.

In order to reduce the EMI noise, modulation of the clock pulse is used by shaking the phase or frequency of the clock. Although the peak noise is decreased, the bottom level of clock spectrum is increased[1].

In the proposed PWC method, the analog output voltage error is converted to a digital signal. By appropriately switching and controlling the pulse width of this signal, the output voltage of the switching power supply is stabilized. Fig. 1 shows the control circuit for the PWC method switching converter and Fig. 2 shows the waveform of PWM signal. In the simulation, the PWC pulses are used to generate the notch frequency in the spectrum of the modulate clock. When tuning the communication channels, automatic adjustment to the input frequency change is necessary. Hence we consider about automatic generation of Pulse-H and Pulse-L to realize automatic PWC control. Fig. 3 is automatic PWC method pulse coding circuit. Waveforms of Pulse-H and Pulse-L can be generated if we just set F_{in}. The period of saw-tooth is T_{ck}, and comparison between V_L and V_H can produce Pulse-L and Pulse-H automatically. The simulated spectrum of the direct method is shown in Fig. 4. The notch characteristics can be clearly reflected at 750kHz if we set F_{in} equal to 750kHz. Automatic notch generation in noise spectrum of switching converters with PWC method can be good for radio receivers to receive frequency signal without other communication device interferences.

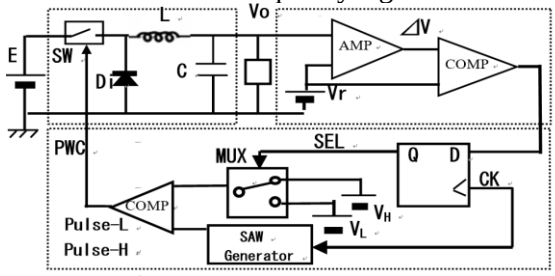

Fig. 1 Converter with PWC control.

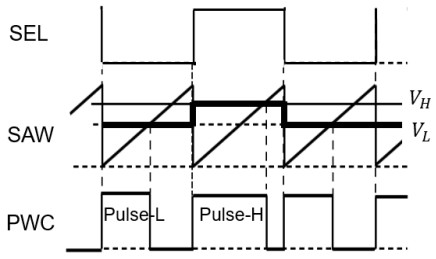

Fig. 2 Waveforms of PWC control.

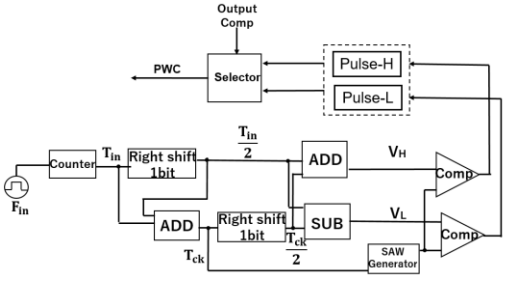

Fig. 3 Automatic PWC method circuit

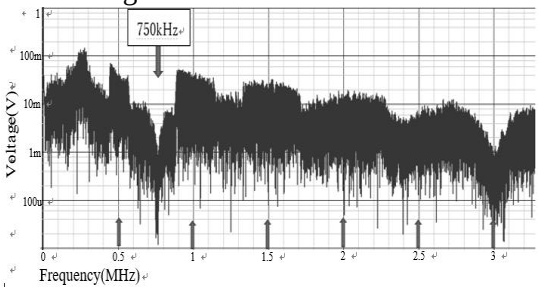

Fig. 4 Simulated spectrum with EMI reduction

[1] Yi-Fei Sun, Yasunori Kobori, Haruo Kobayashi, "Full Automatic Notch Generation in Noise Spectrum of Pulse Coding Controlled Switching Converter", ICSICT2018, S0357, Qingdao, China. (Nov 2018)