

Adaptive Efficiency Optimization for the High-Step-Up Boost Converter Based on the Loss Analysis Model

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Abstract - An adaptive-step-size frequency optimization algorithm (ASSFO) is used for tracking the maximum efficiency point of the high-step-up boost converter under variable conditions. Based on the analysis of losses of the converter, the desired switching frequency is selected depend upon input current value. The ASSFO function results in improved adaptive controller convergence speed, convergences error and stability.

Adaptive-Step-Size Frequency Optimization Algorithm

- The Gradient Descent Method is used for optimization

High-Step-Up Boost Converter and Control system

- The high boosting capability is because the discharging process of the magnetic element.
- The voltage loop collects the output voltage to compensate the output voltage when the switching frequency is changed to keep the output voltage constant.
- Collecting the input current, which can be used as a characterization of the input power when the input voltage is constant, and the input power is minimized when the converter loss is minimized, that is, when the input current is minimized.

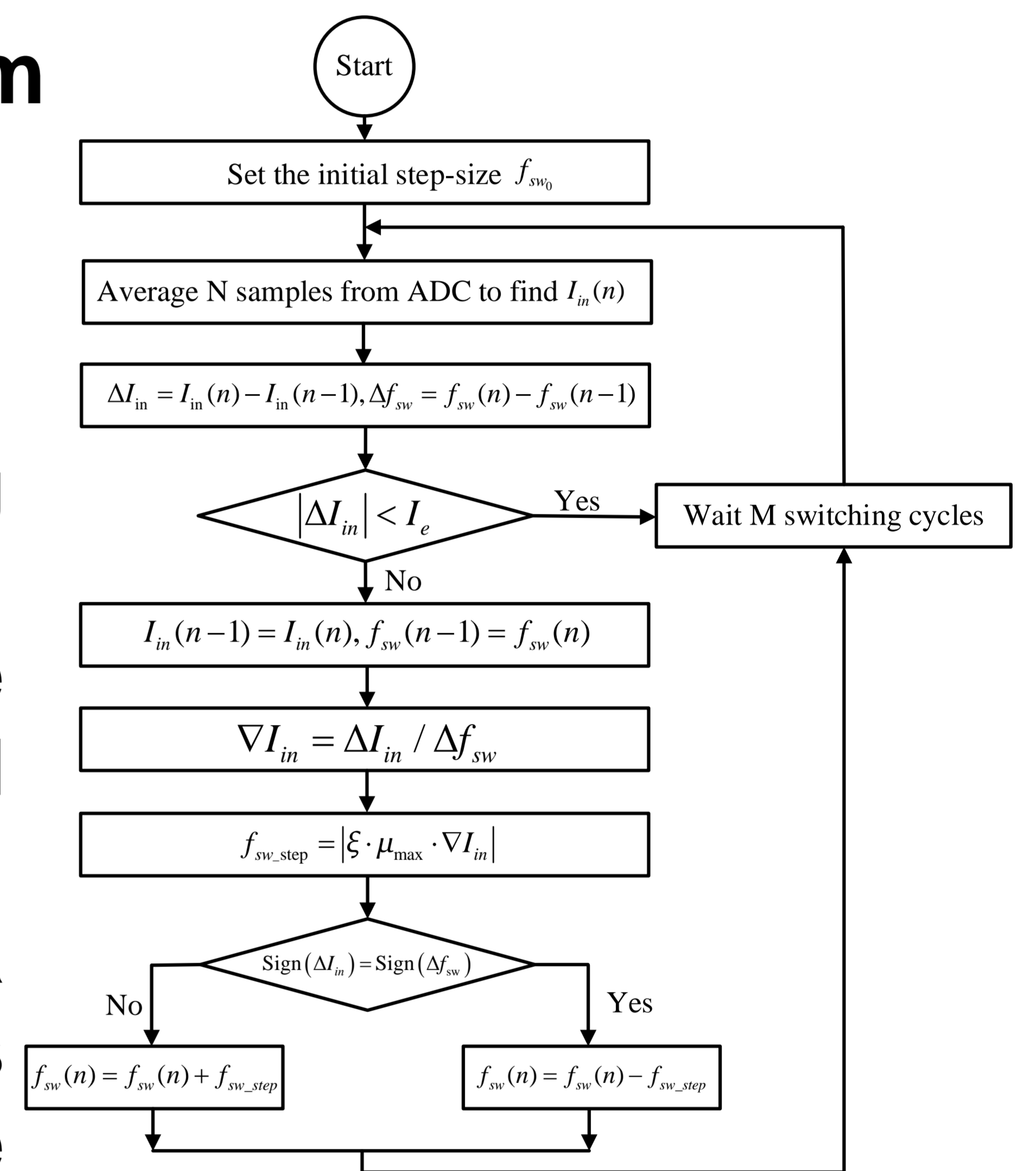


Fig.1 ASSFO controller flowchart

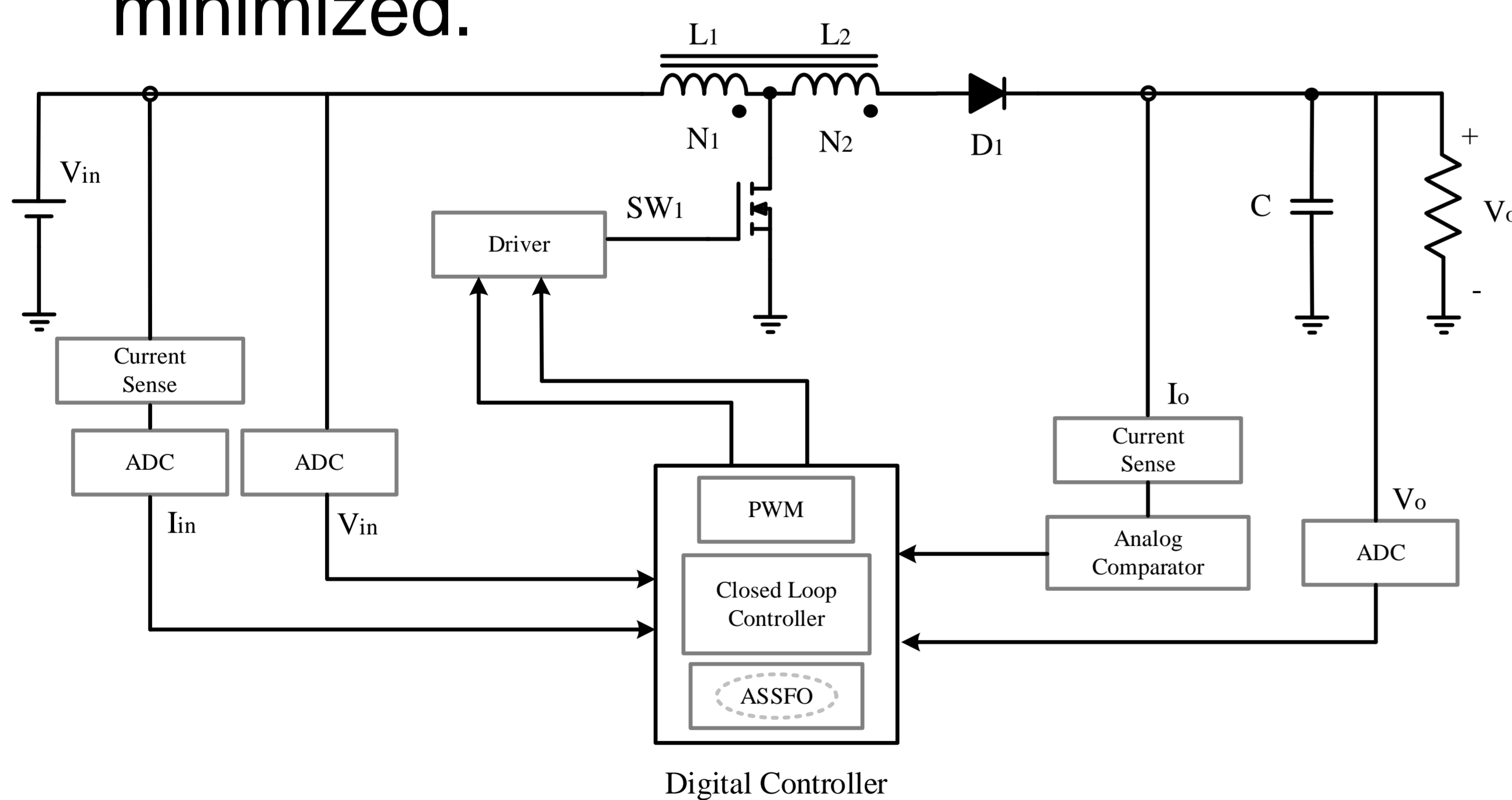


Fig.2 The tapped-inductor boost converter with control system.

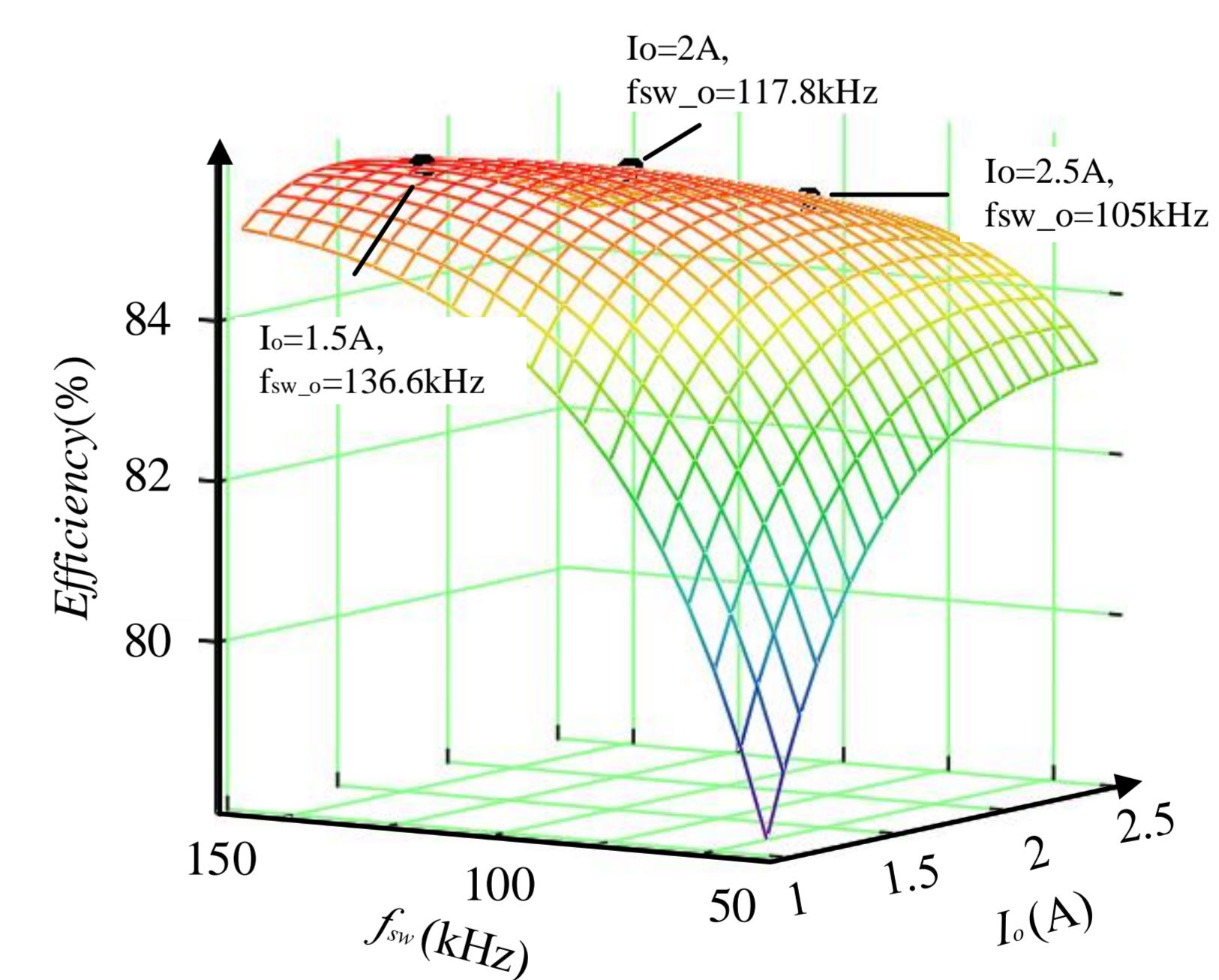


Fig.3 Converter efficiency versus switching frequency and load current.

Experimental Result

A 1-kW prototype is implemented to verify the proposed controller performance and proposed algorithm is verified successfully.

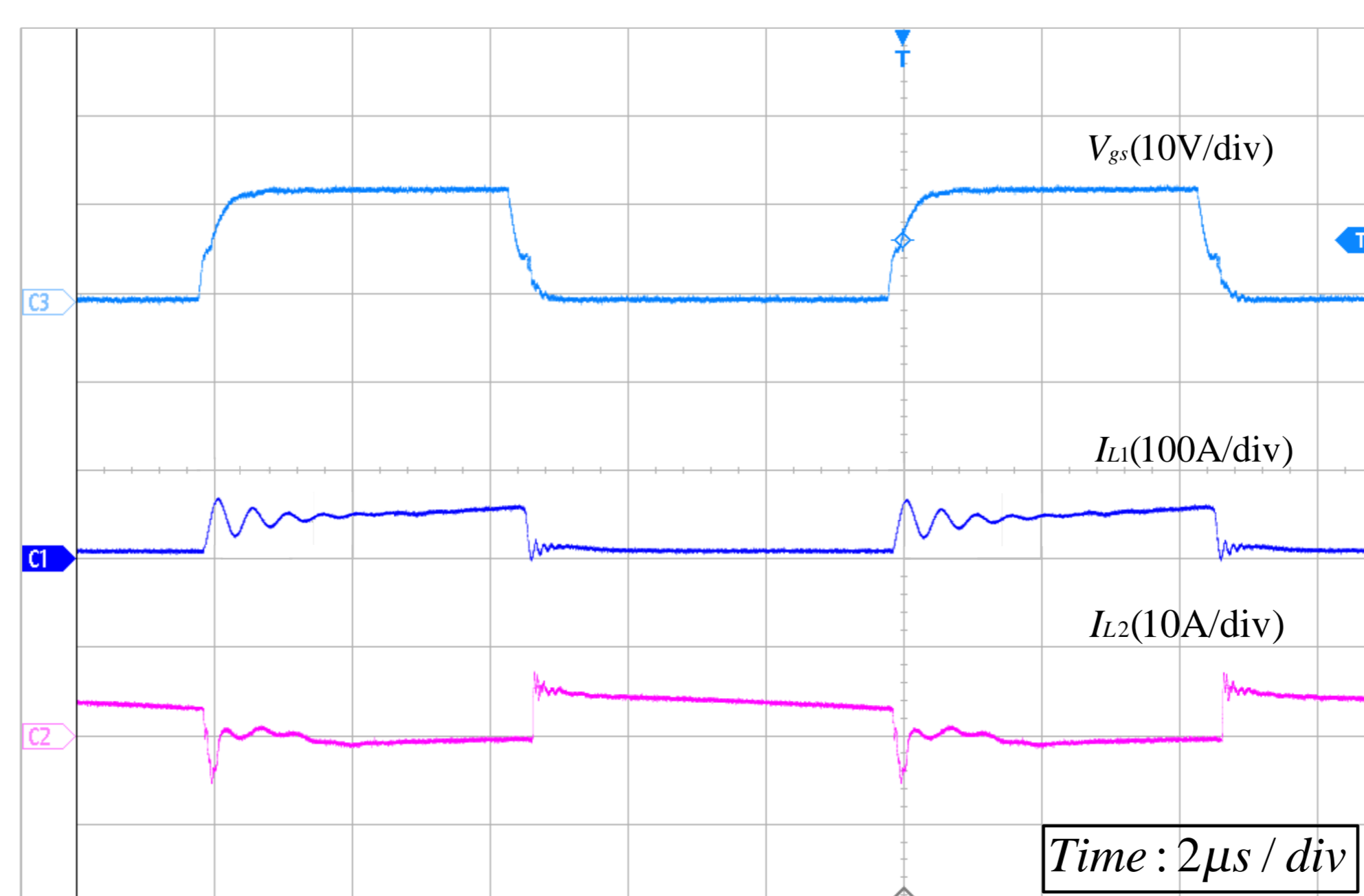


Fig.4 Current waveforms.

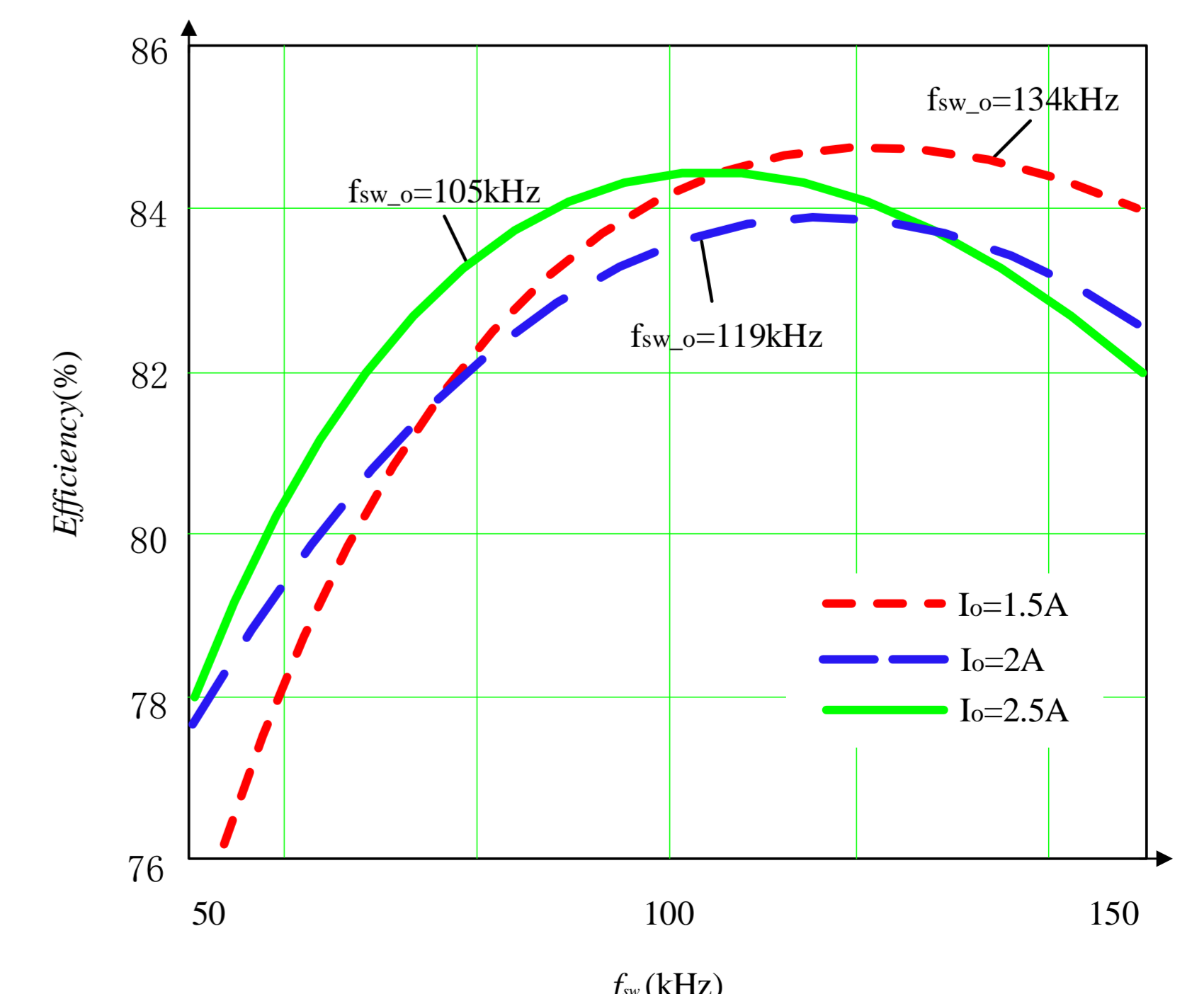


Fig.5 Optimal switching frequency for different loads.