Smart Switching Buck Converter Status

In the following report, the waveform was observed using a Tektronix TDS 2024B oscilloscope. The efficiency measurements were done using a laboratory voltmeter (HP 34401A) and the amperemeter. The equipment is presented in Figure 1.

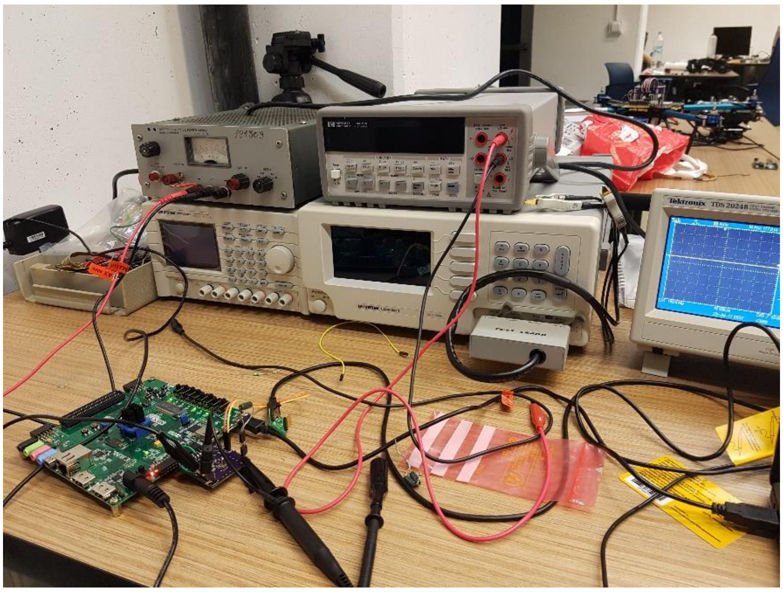


Figure 1

First iteration of converter had a 2.2uH inductor and a hysteresis width equal to 200mV. After successive tests, the optimum switching frequency was found to be somewhere around 800kHz – this value provided the best efficiency and the smallest ripple. However, the ripple values were very inappropriate for high loads, reaching values over 250mV, presenting some high amplitude narrow spikes (See Figure 2)

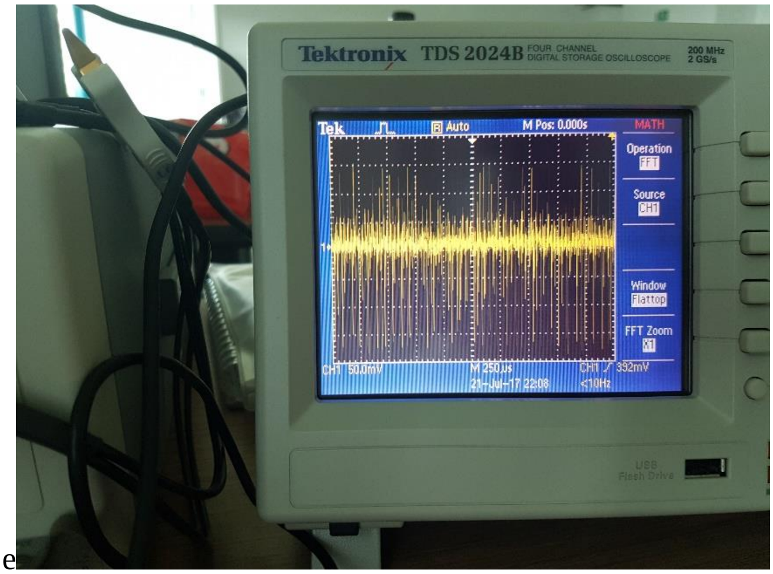
e 

Figure 2

In order to solve this, I firstly decreased the hysteresis width to 80mV, which improved the results, but just a bit. For this, I added another resistance in parallel with the existing one.

The next improvement was obtained by replacing the inductor with a 10uH one. In this way, the converter can operate at lower switching frequencies. For the 10uH based circuit, the optimal switching frequency was found to be somewhere around 200kHz. The output voltage ripple for 1A is highlighted in Figure 3.

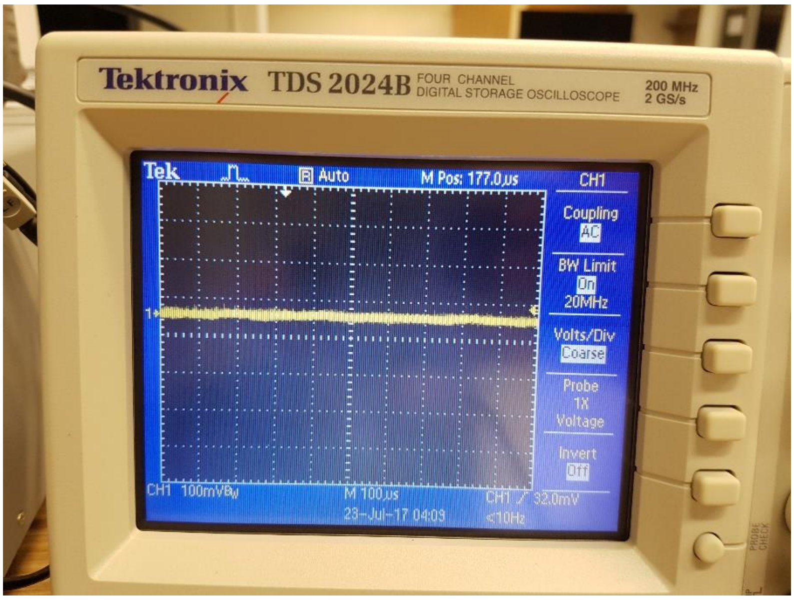


Figure 3

However, the ripple value is not perfect, as it looks worse for higher load currents, like in Figure 4.

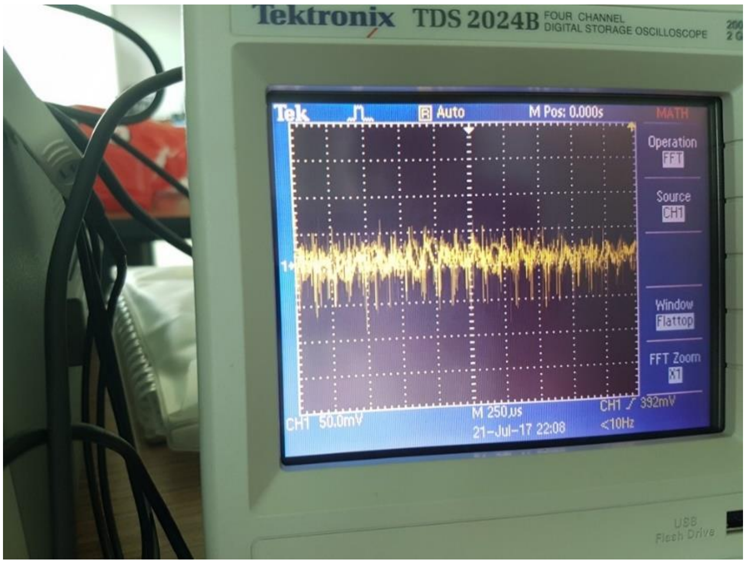


Figure 4

The used control algorithm was a variable duty cycle one (with fixed frequency). The duty cycle variation is made according to a proportional term, which is experimentally determined as the value which generates the lowest ripple.

Now, I have to extend the low ripple range to 0 – 2A, and try to figure out from where those oscillations come from. The efficiency now is between 80% and 90% for most currents, so this is not the problem. The main aim now is to improve the ripple to be lower than 50mV and then adjust the accuracy.

The efficiency chart for the latest setup is presented in Figure 5

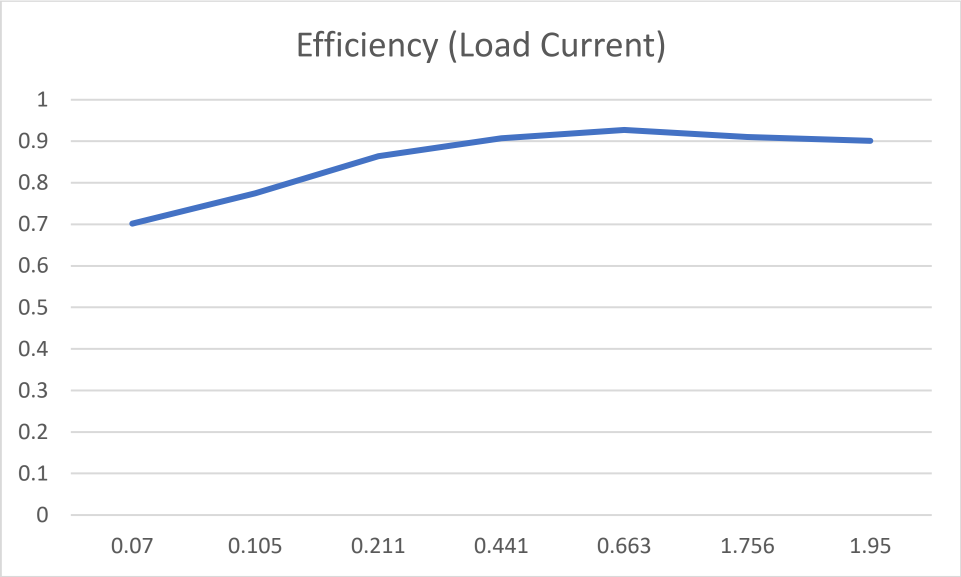


Figure 5