metin içeren bir resim

Açıklama otomatik olarak oluşturuldu

****

**EE463 STATIC POWER CONVERSION I**

**Homework 2: DC/DC CONVERTERS**

**Team Members:** İrem Bayın 2304145 ; Nilsu Bora 2304186

**Deadline:** 18/01/2023 23:59

**Lecturer:** Assoc. Prof. Ozan Keysan

**Assistant:** Ogün Altun

# INTRODUCTION

In this homework, Buck and Boost converters which are DC/DC converters, will be examined. The continuous current mode, power in the ideal case, and nonidealities in the real world will be examined for both converter types.

# SOLUTIONS

1. **Buck Converter**

**a)**

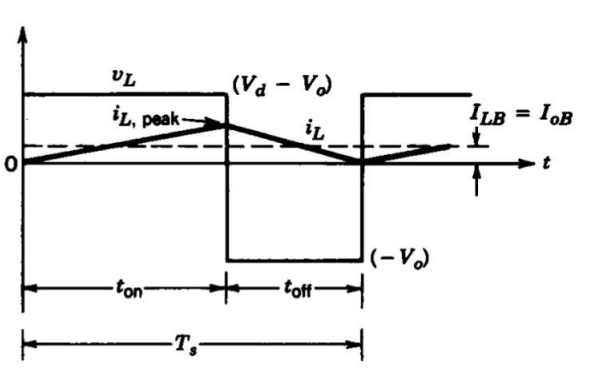


Figure 1: VL and IL graph for transition to the discontinuous current mode

In Figure 1, the boundary output current graph for DCM can be seen.

Since this boundary means the minimum current, we need to find the lower value. So the input voltage is chosen as 12V for the calculation.

**b)**

The output voltage is fixed and 5V. So



saat, kol saati, ölçü aleti içeren bir resim

Açıklama otomatik olarak oluşturuldu

To find maximum ripple, the maximum input voltage must be chosen.







**c)**

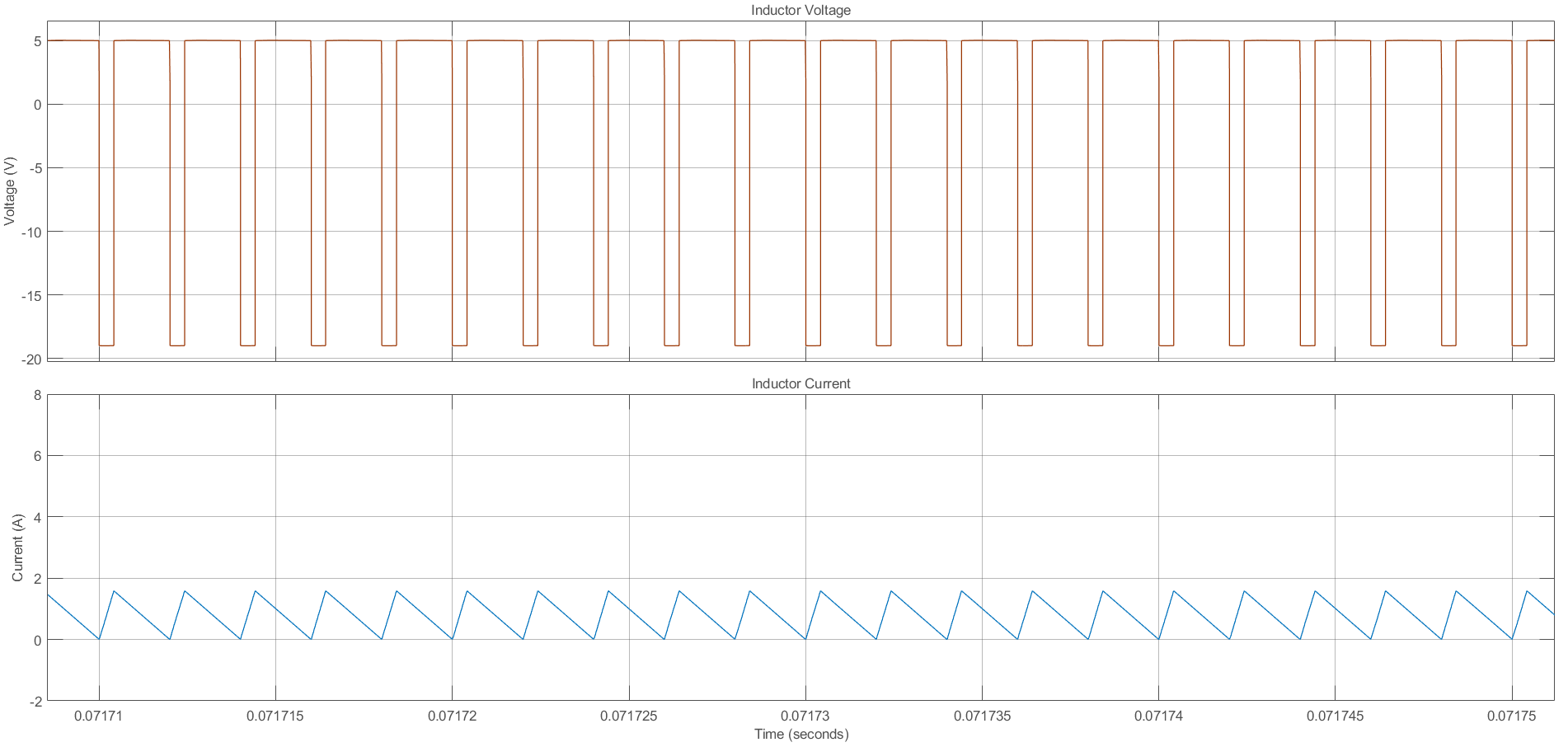


Figure 2: Inductor Voltage and Current Graph

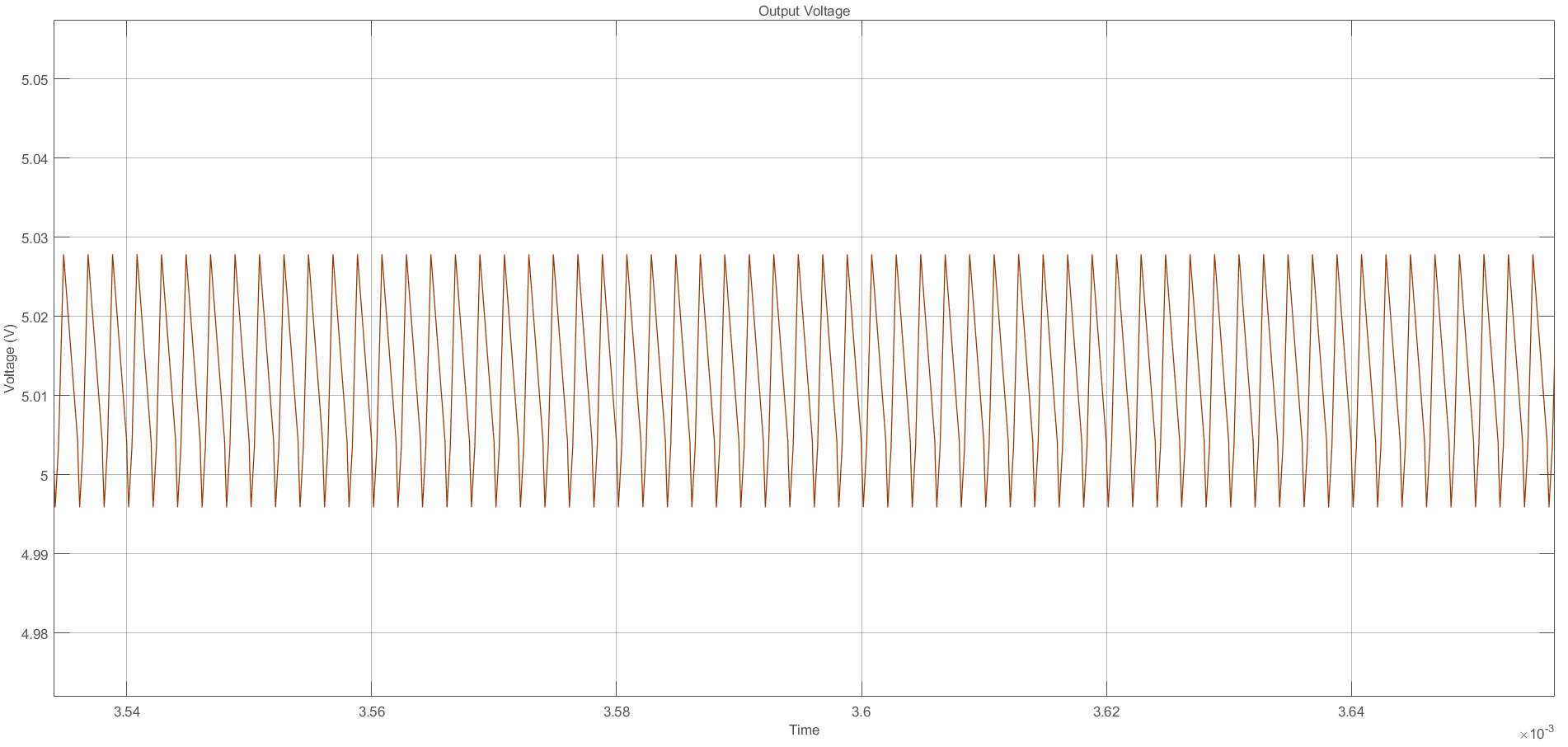


Figure 3: Output Voltage Graph

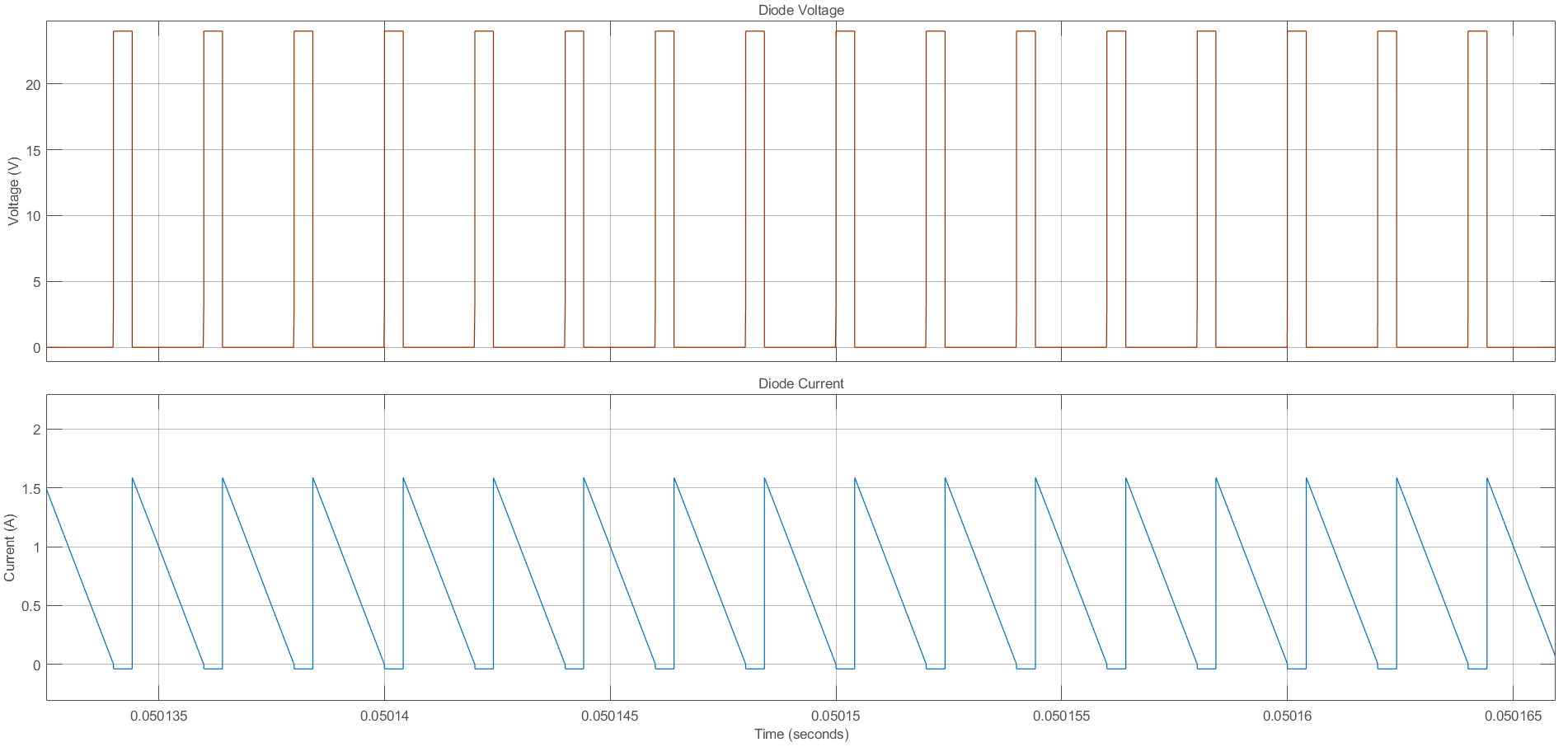


Figure 4: Diode Voltage and Current Graph

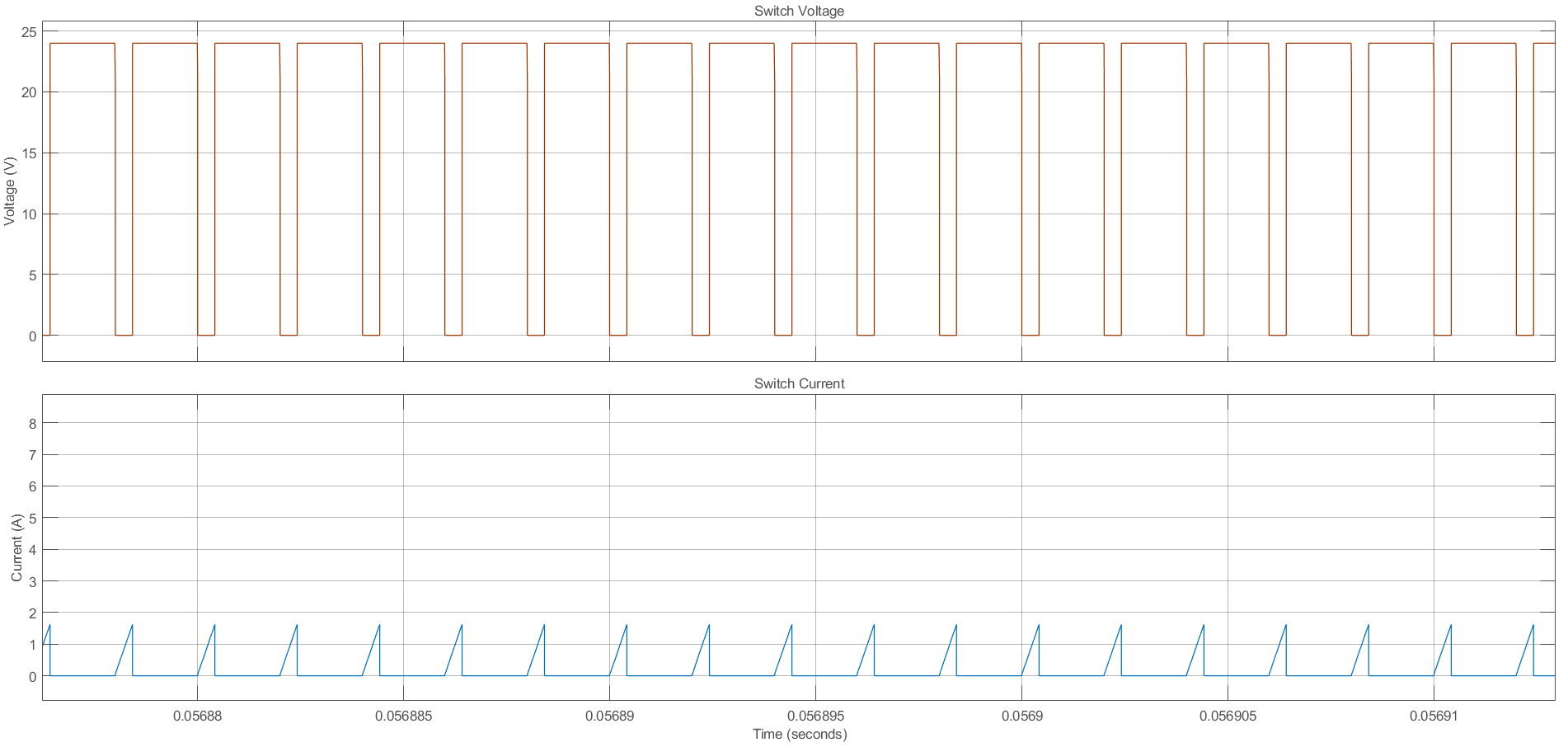


Figure 5: Switch Voltage and Current Graph

In this part, the continuous current mode of the buck converter was observed. When the inductor current graph was examined, it can be seen that the current does not remain zero; it goes down to zero and goes up.

In addition, the peak current value that guarantees CCM operation was 1.6A in part a. In this part, it can be seen that peak was 1.6A, and this is suitable for part a.

**d)**

In the simulation, the output voltage was 7.2V with a 41.67% duty cycle. As a result, D was decreased to 24.4% to obtain a 5V output voltage.

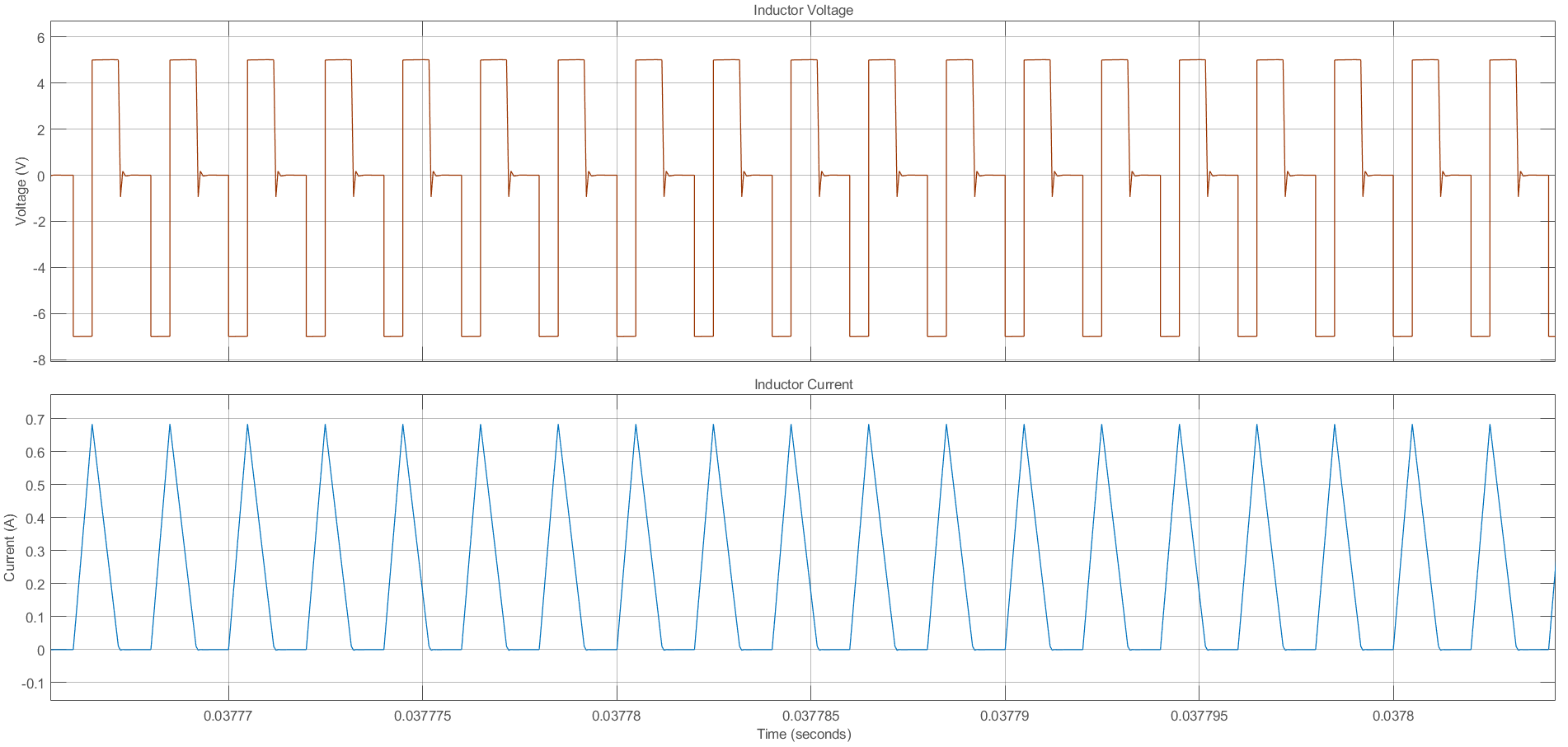


Figure 6: Inductor Voltage and Current Graph

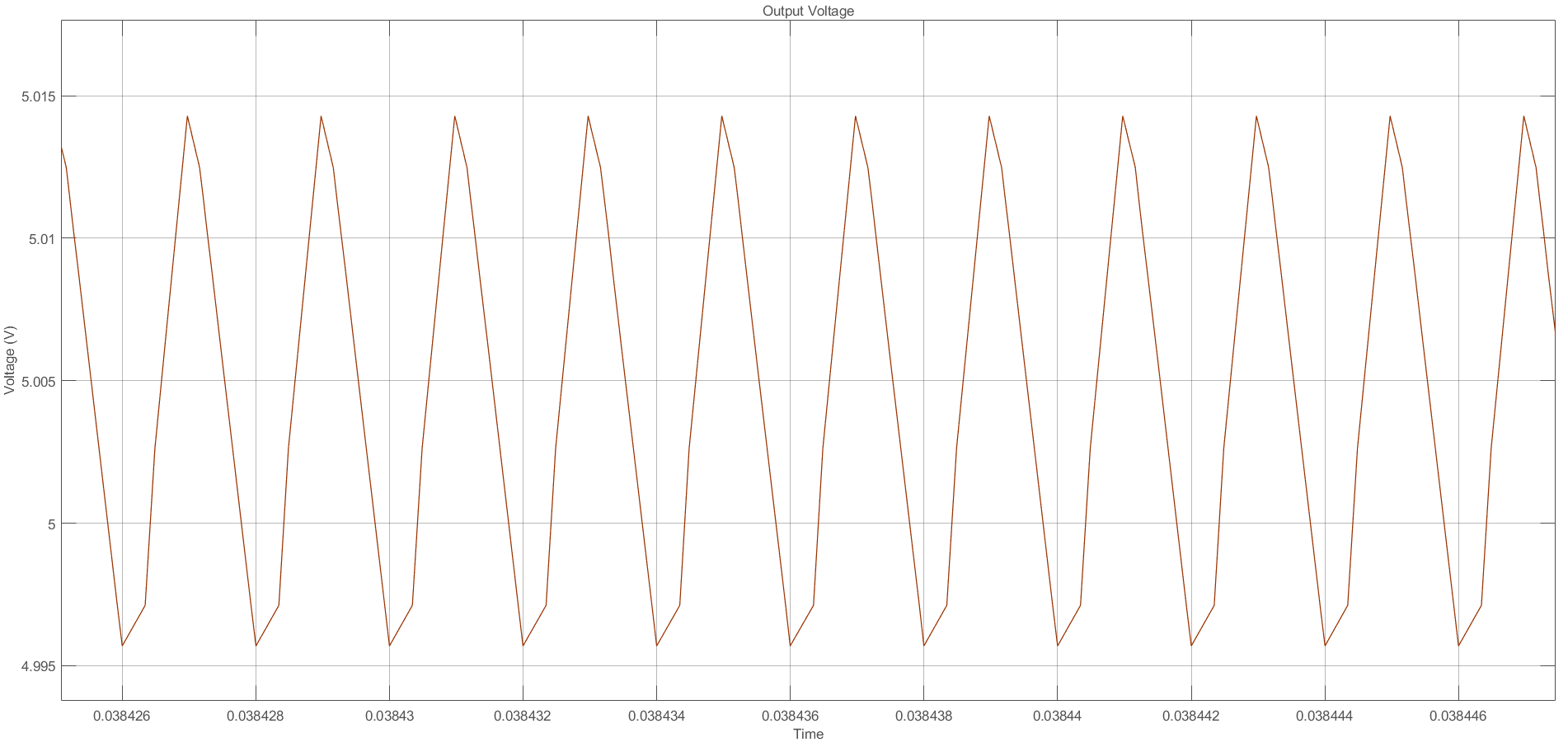


Figure 7: Output Voltage Graph

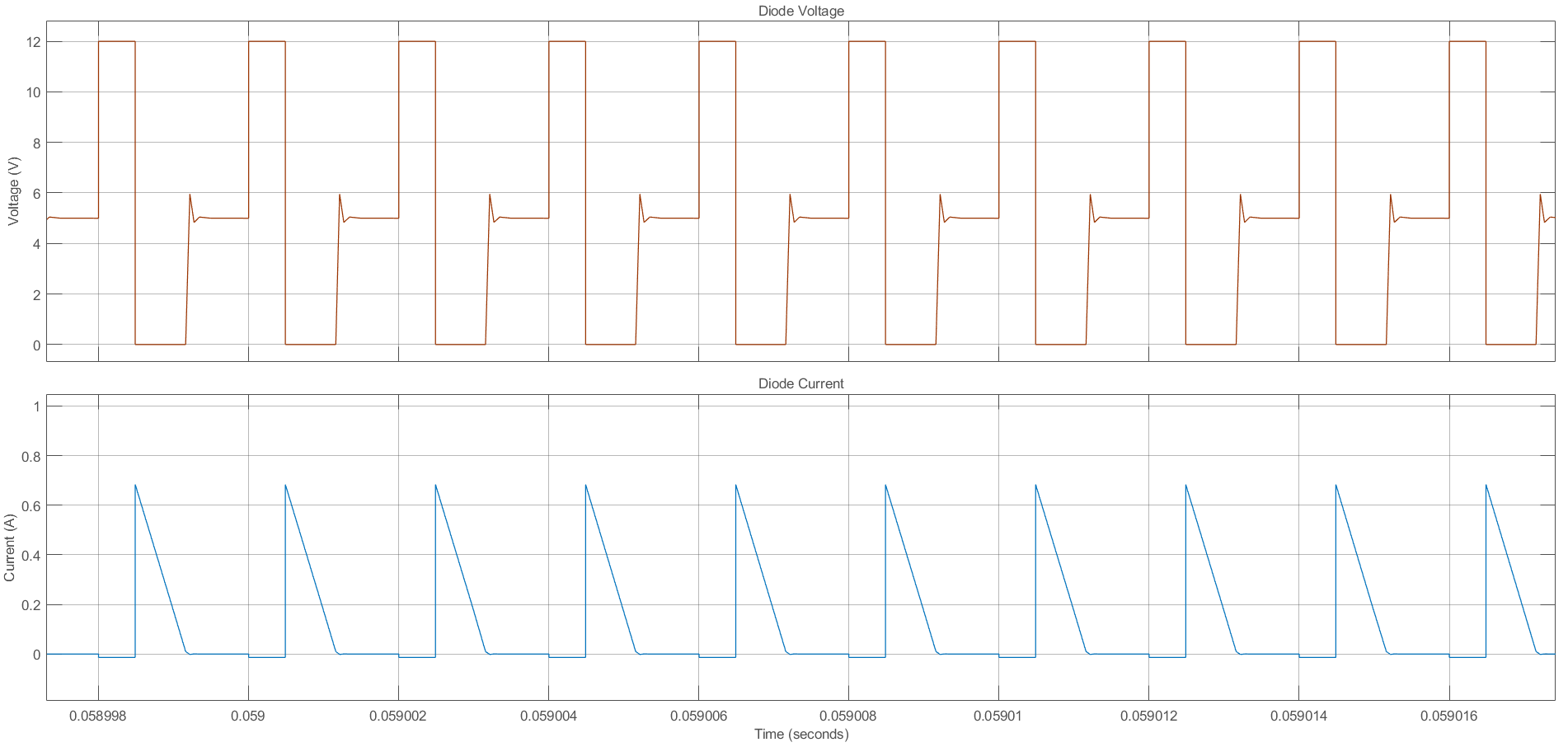


Figure 8: Diode Voltage and Current Graph

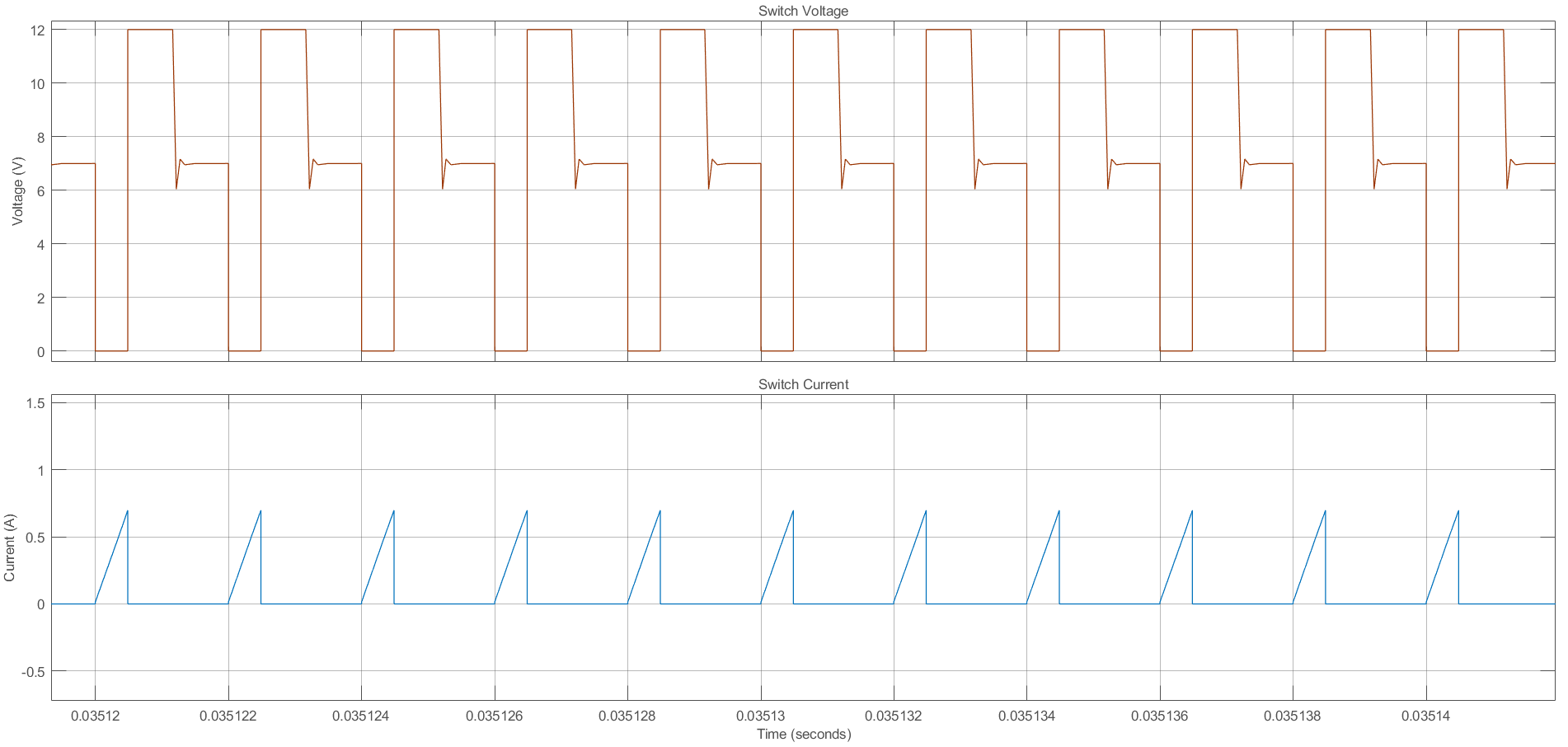


Figure 9: Switch Voltage and Current Graph

In this part, the discontinuous current mode was observed. When the inductor current graph was examined, the inductor peak current was 0.68A which is smaller than the boundary current value found in part a.

When compared with part c, it can be seen that the output voltage ripple and inductor current ripple decreased.

**e)**

The inrush current is the spike in the current when the supply is turned on. It can be higher than the rated current of the component so the components may be damaged.

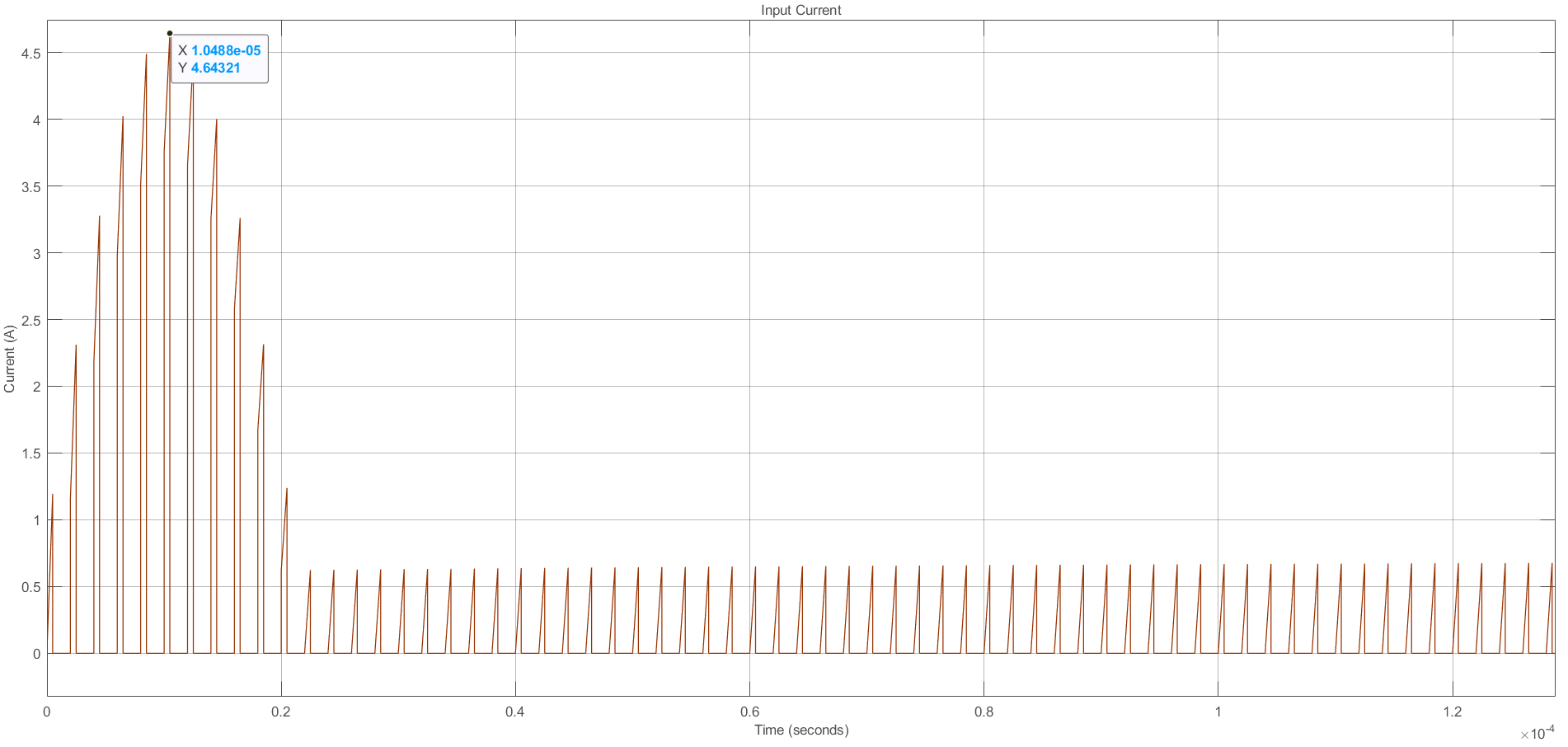


Figure 10: Input Current Graph without Applying Any Methods

It can be seen that the input current reached 4.64 A, which was approximately 6.5 times higher than the operating current.

Having a larger inductor will decrease the inrush current. However, it also affected the output voltage. The other method is using the soft starter. With a soft starter, the duty cycle increased slowly. As a result, the current cannot reach high values.

**f)**

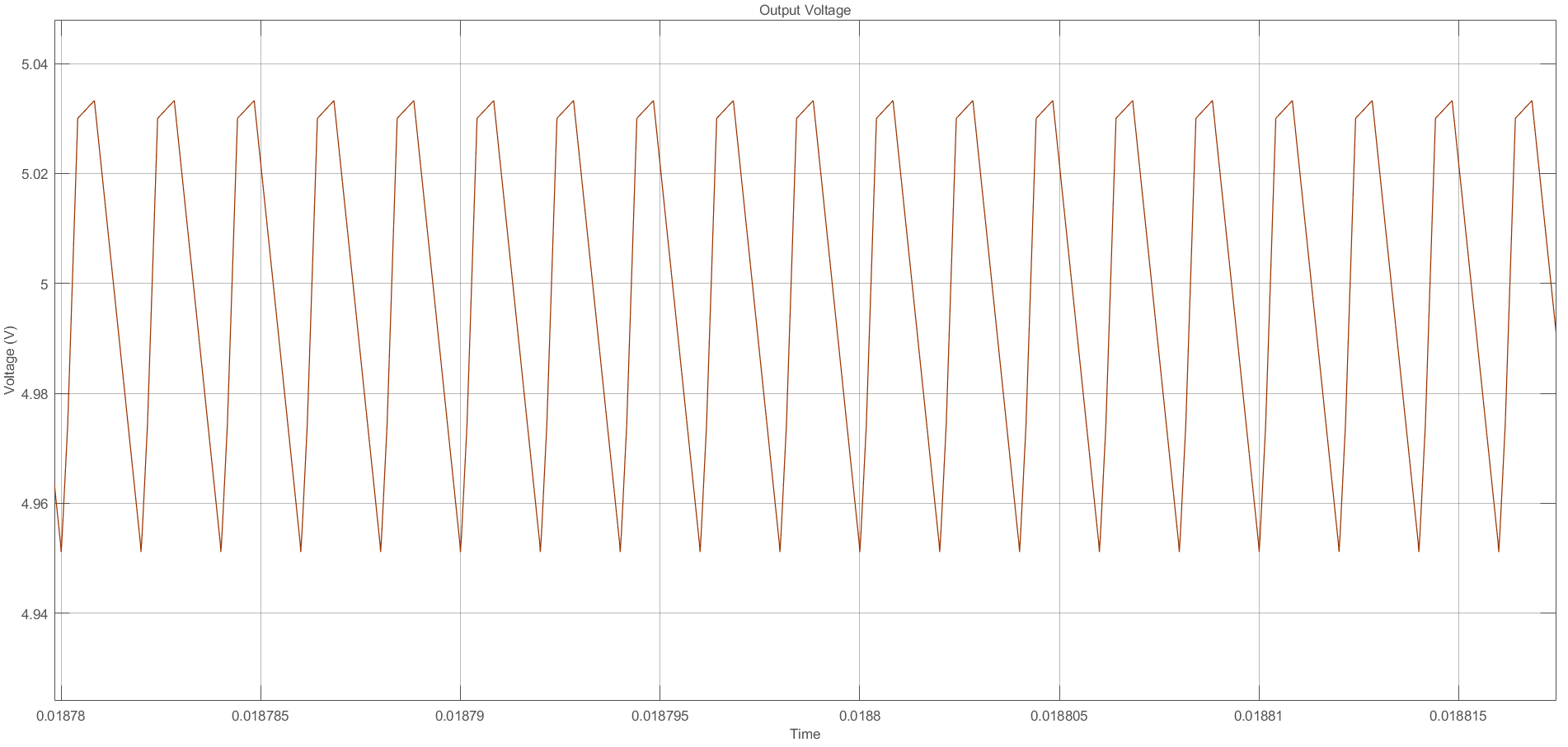
****

Figure 11: Output Voltage Graph When the Input is 24V, and there is ESR

ESR affected output voltage ripple. The output ripple voltage was 82.24 mV which was 1.64% of the average output voltage in this case. In part c, it was 31.98 mV which was 0.64% of the average output voltage. To decrease ripple voltage, a smaller ESR is needed. To do that, capacitors can be connected in parallel.

1. **Boost Converter**

**a)**

**b)**

**c)**

**d)**

**e)**

**f)**

**g)**

# CONCLUSION

# APPENDIX