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EEE 419 – 01

03.12.2024

EEE 419 Experiment 2 Half-Bridge Isolated DC-DC Converter Experimental Report

Introduction

The circuit schematic of the designed half-bridge isolated DC-DC converter is shown in Figure 1.

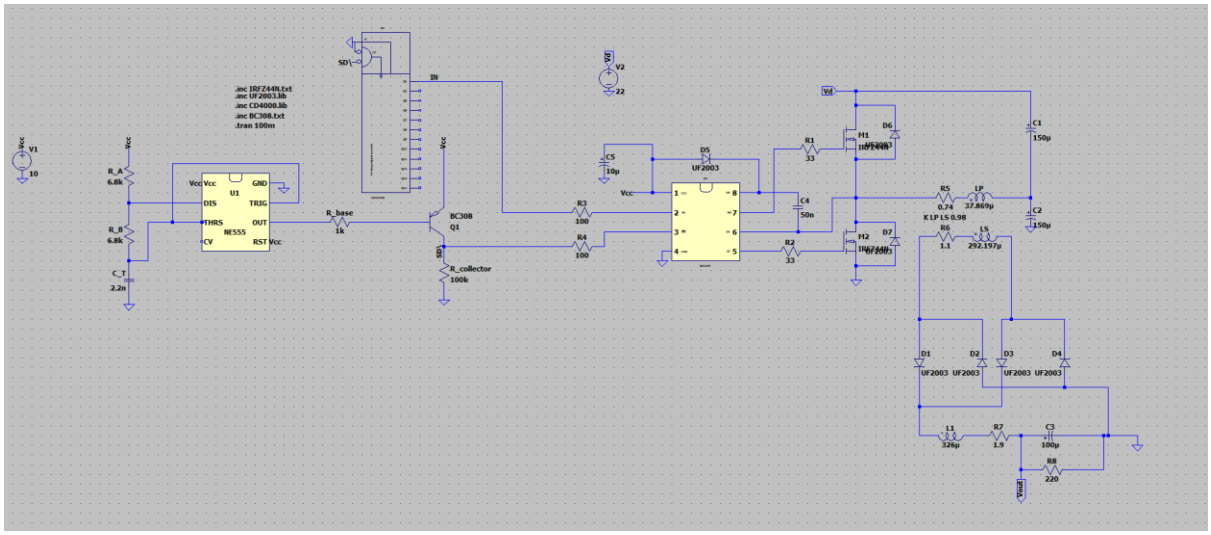

Figure 1: Circuit of the Half-Bridge Isolated DC-DC Converter

According to the designed circuit, the expected output voltage is 21V with 22V input voltage. For this purpose, the circuit is implemented on breadboard and the related measurements and observations are made. The implemented circuit is shown in Figure 2.

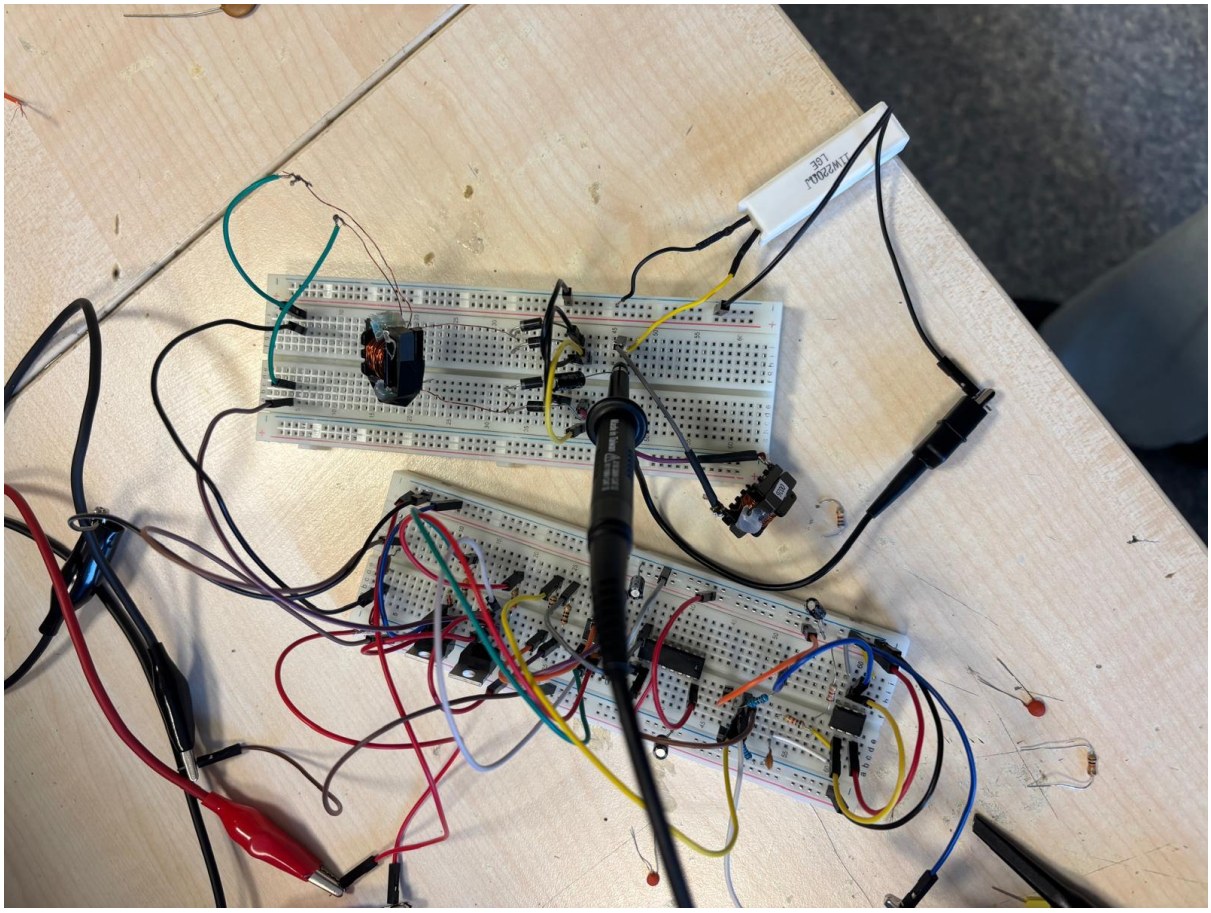

Figure 2: Implemented Half-Bridge Isolated DC-DC Converter

Results and Measurements

At the beginning of the implementation, NE555 is connected, and the output pulse is observed as shown in Figure 3. As expected from the simulation results, the output is 10V peak-to-peak pulse.

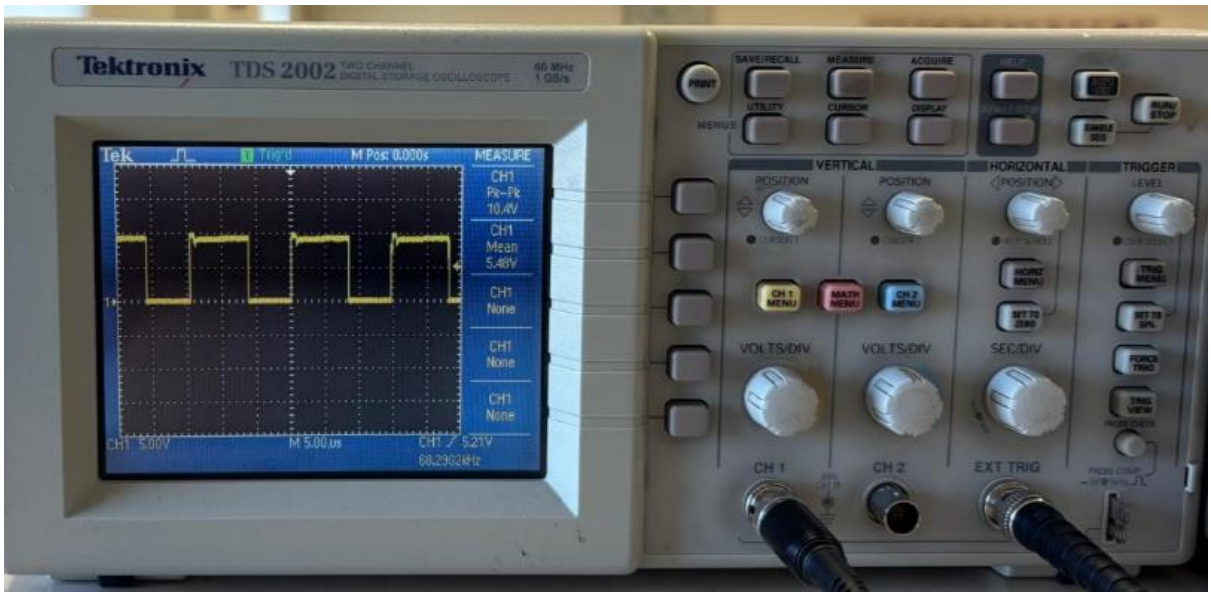

Figure 3: Output of NE555

t_{on} and T_s values of NE555 output are shown in Figures 4 and 5, respectively.

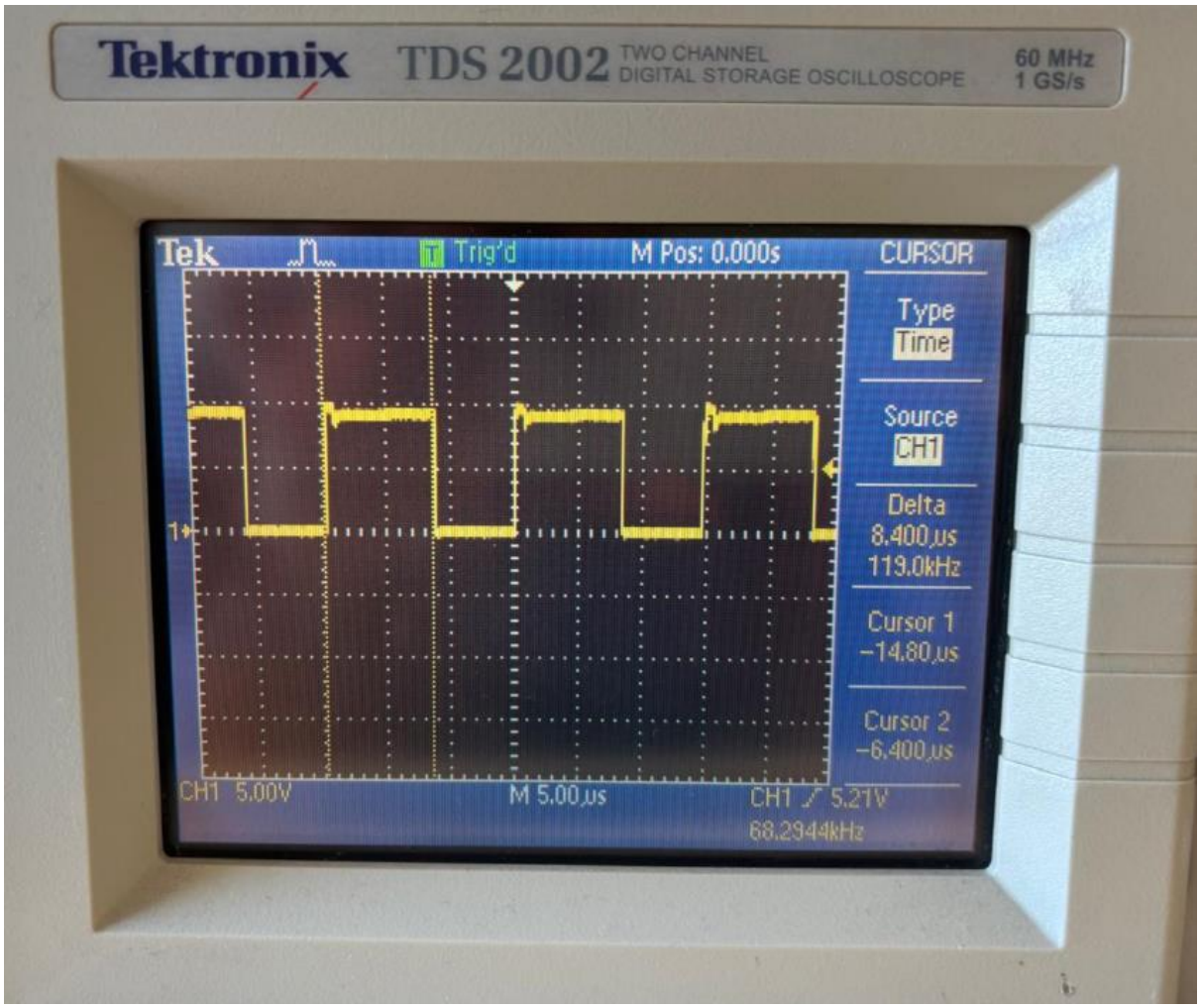

Figure 4: t_{on} value of NE555

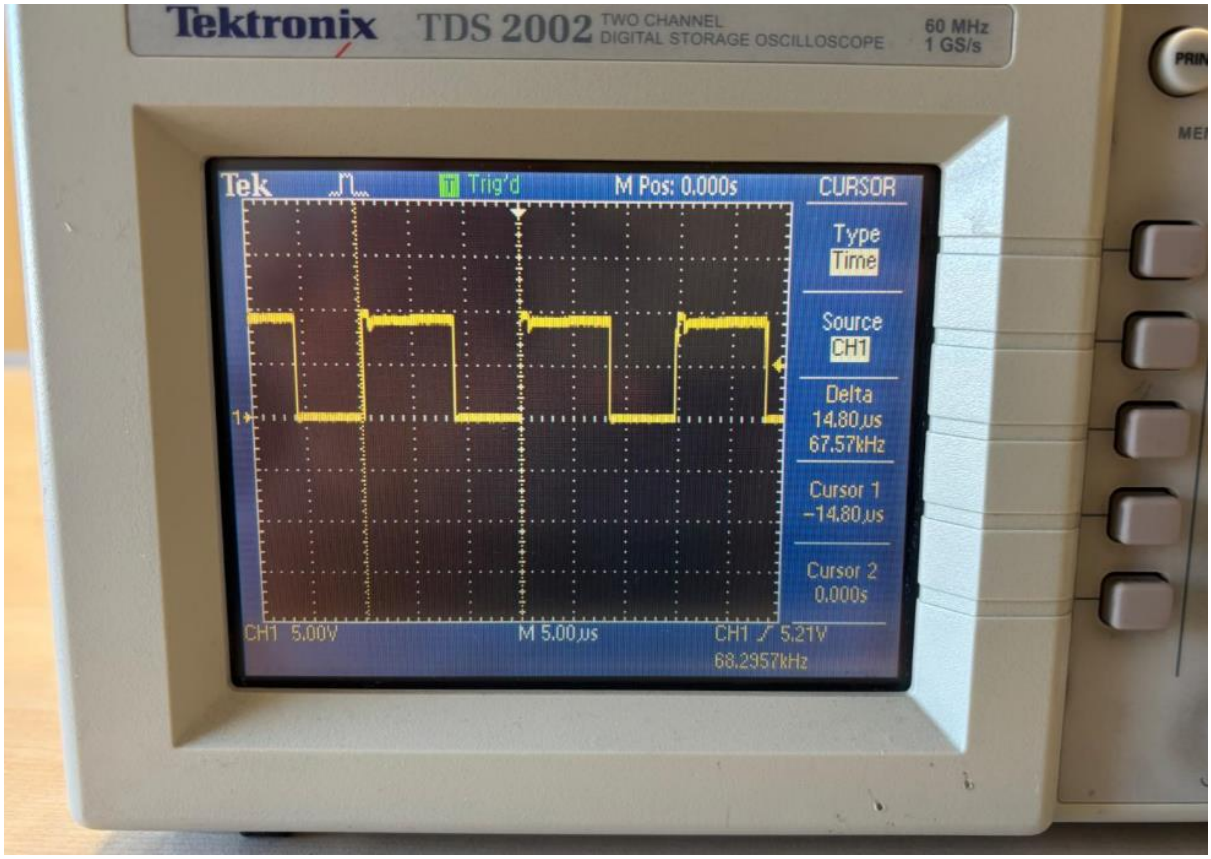

Figure 5: T_s value of NE555

From the results, the duty cycle is found to be 0.58. Hence the duty cycle of SD\ is 0.42.

SD\ output is connected to the input of CD4020BE counter's input. T_s and ton of the counter output are shown in Figures 6 and 7, respectively.

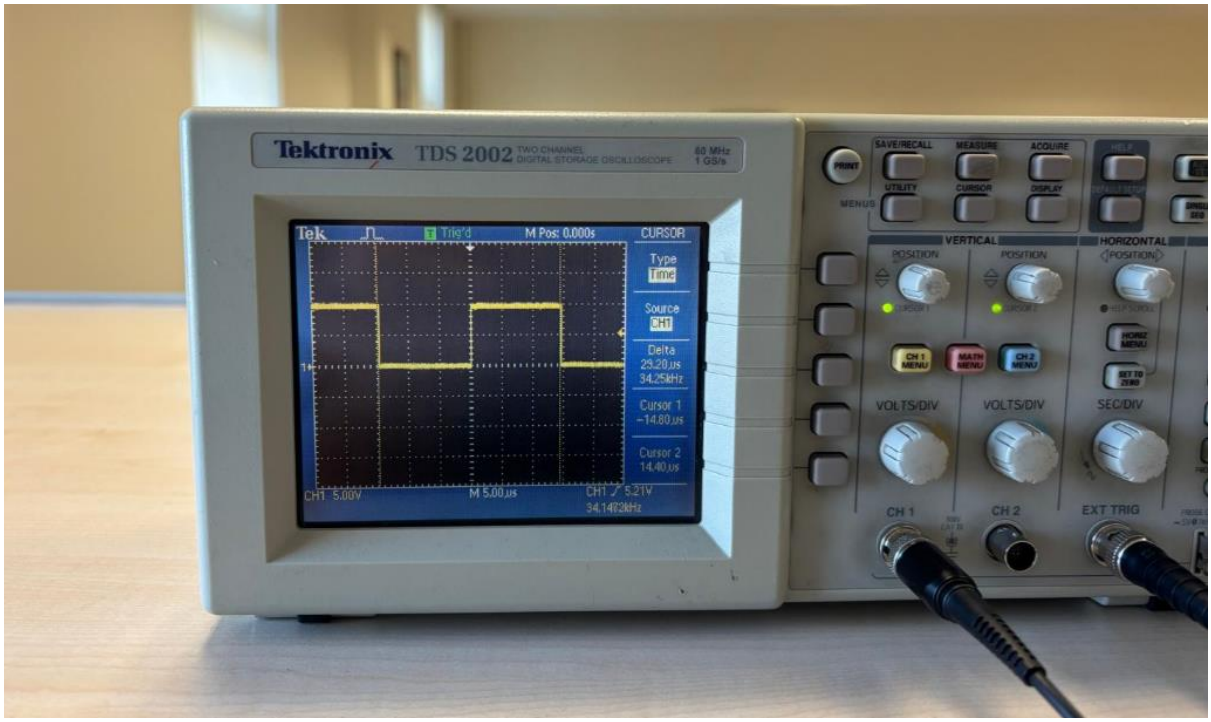

Figure 6: T_s of Counter

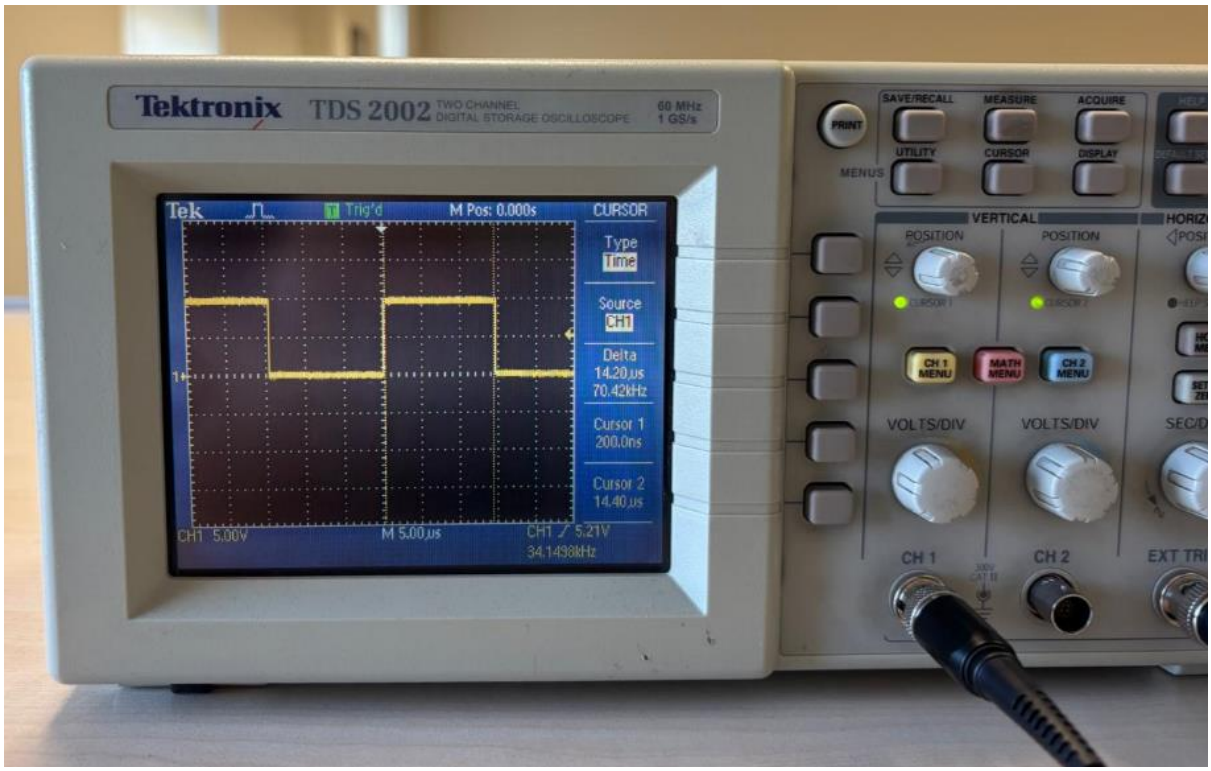

Figure 7: t_{on} of the Counter

Hence the duty cycle of the counter output IN is found to be 0.47.

IR2109 and MOSFET's are connected to the circuit. The gate voltage of the first MOSFET is shown in Figure 8.

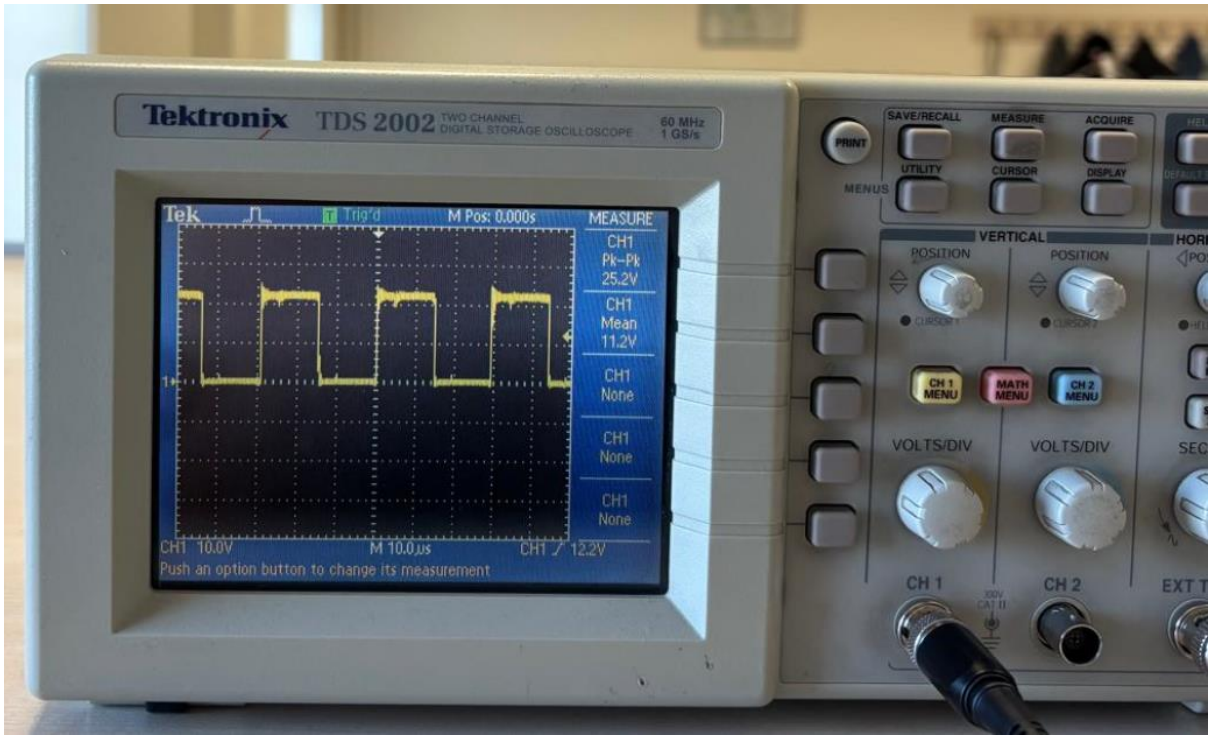

Figure 8: Gate Voltage of M1

The gate voltage of the second MOSFET is shown in Figure 9.

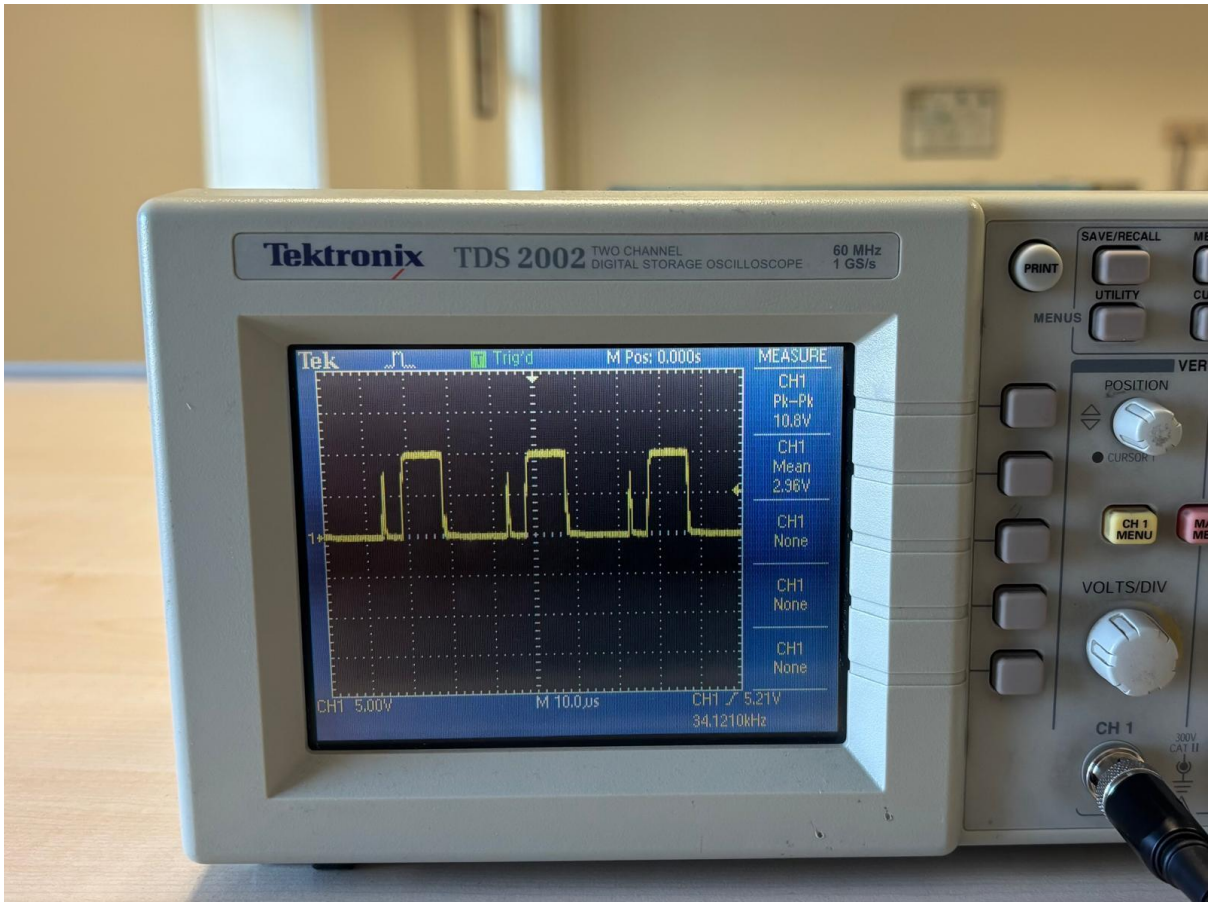

Figure 9: The Gate Voltage of M2

These results are compatible with simulation results.

As a next step, transformer and the capacitors are implemented, and the output voltage of the seconder is shown in Figure 10.

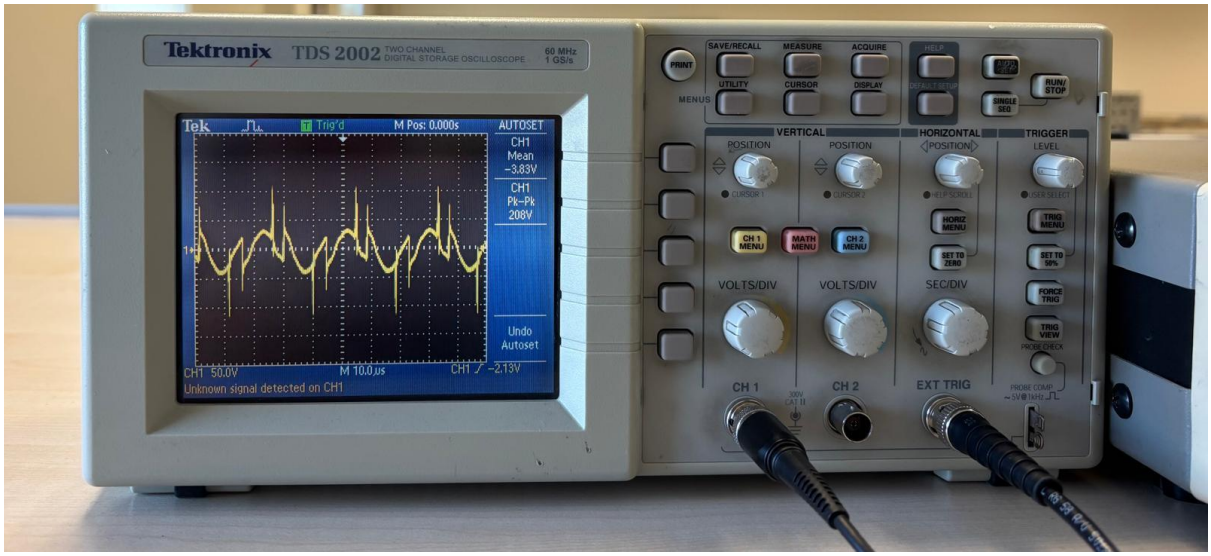

Figure 10: Voltage of the Seconder

Since this value is expected, the remaining part of the circuit is implemented and the output voltage of the converter with 22V input are shown in Figure 11 and 12.

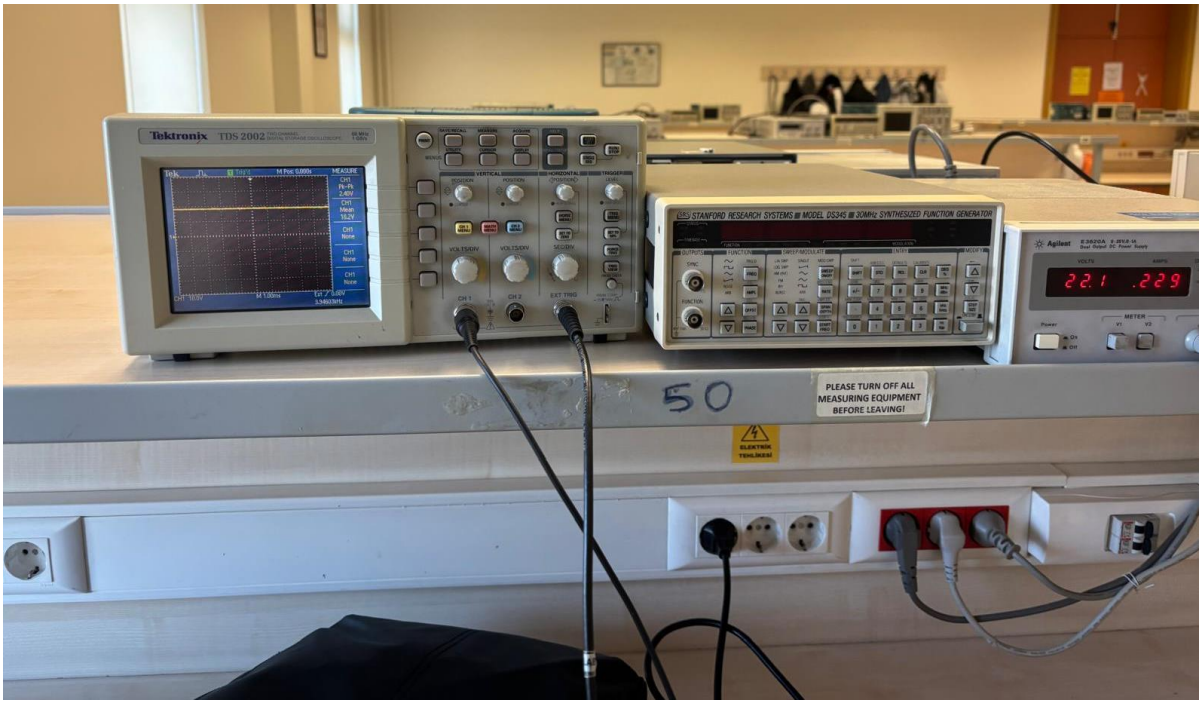

Figure 11: Output Voltage of the Converter with 22V Input Voltage

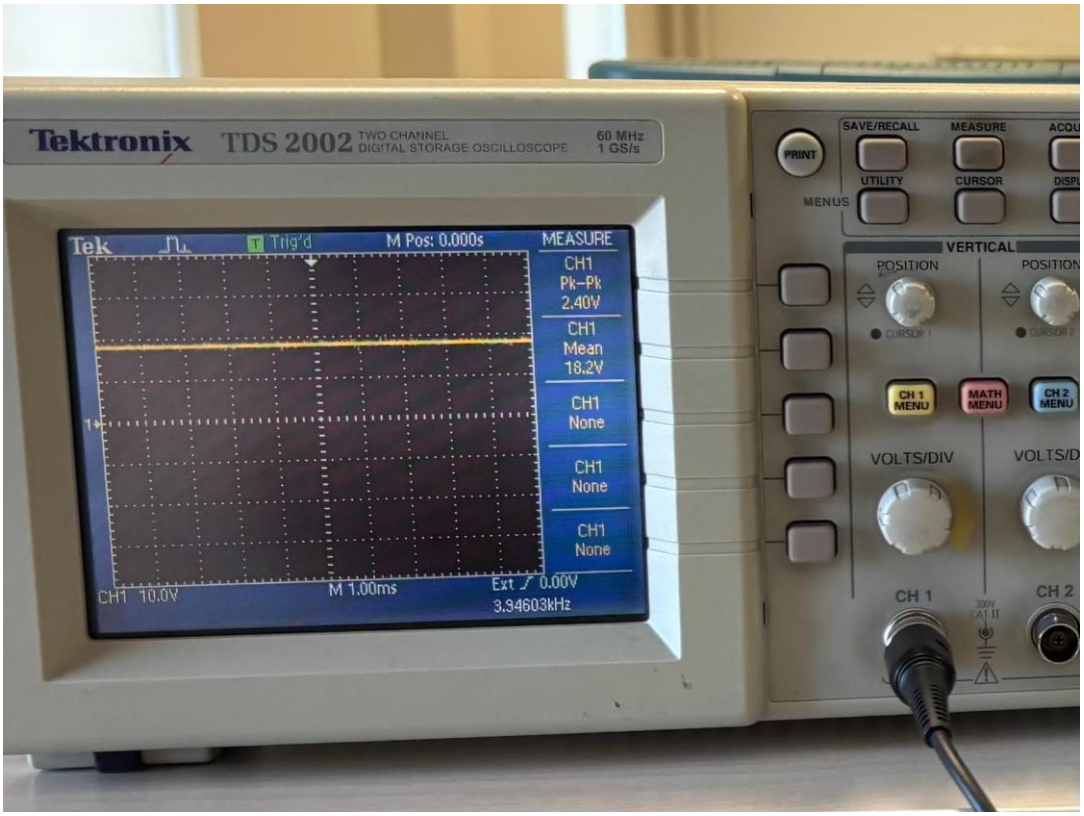

Figure 12: The Output Voltage of Converter with 22V Input Voltage

Since the output voltage is lower than the expected voltage, the input voltage is increased to 26 and the timing capacitor value of NE555 is decreased.

The output voltage of the converter is shown in Figures 13 and 14.

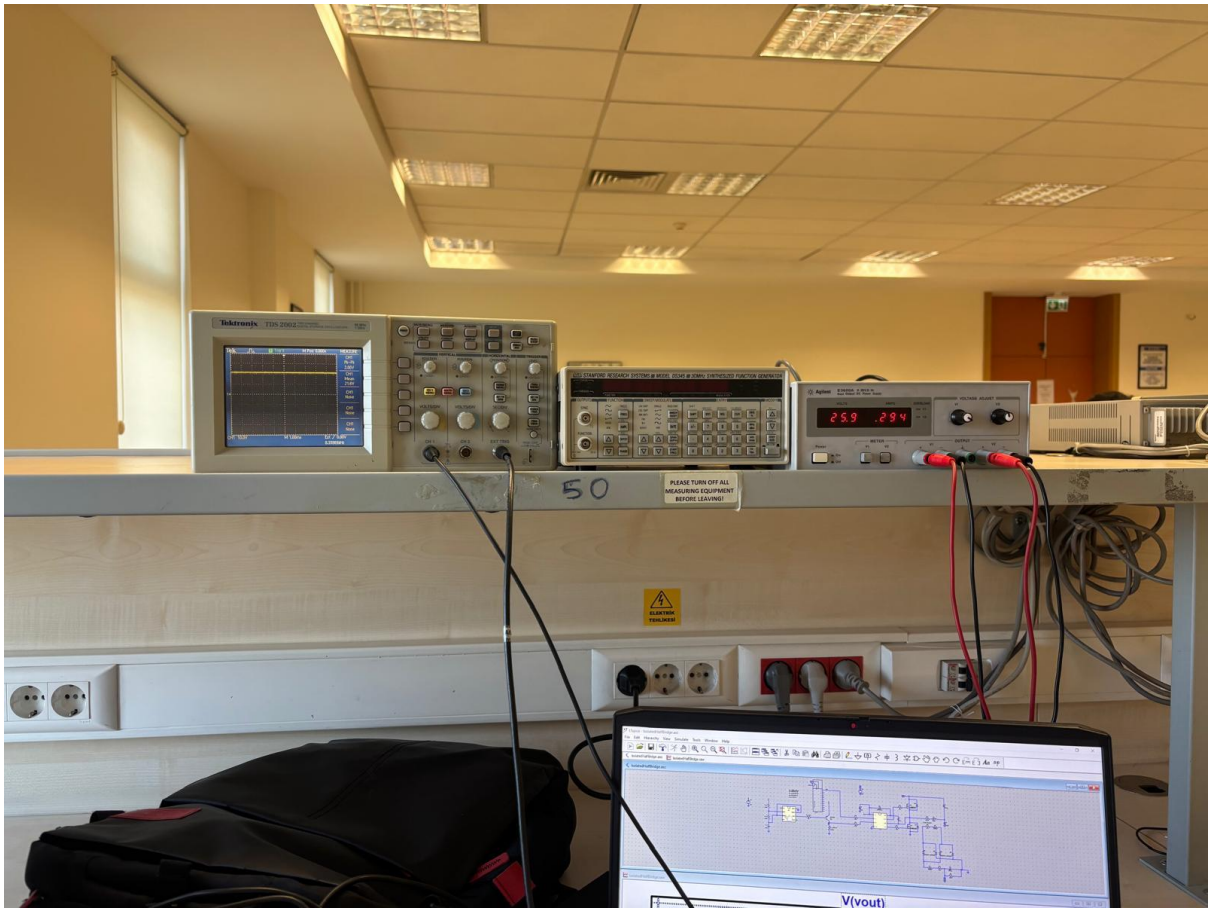

Figure 13: Calibrated Output of the Converter with 26V Input

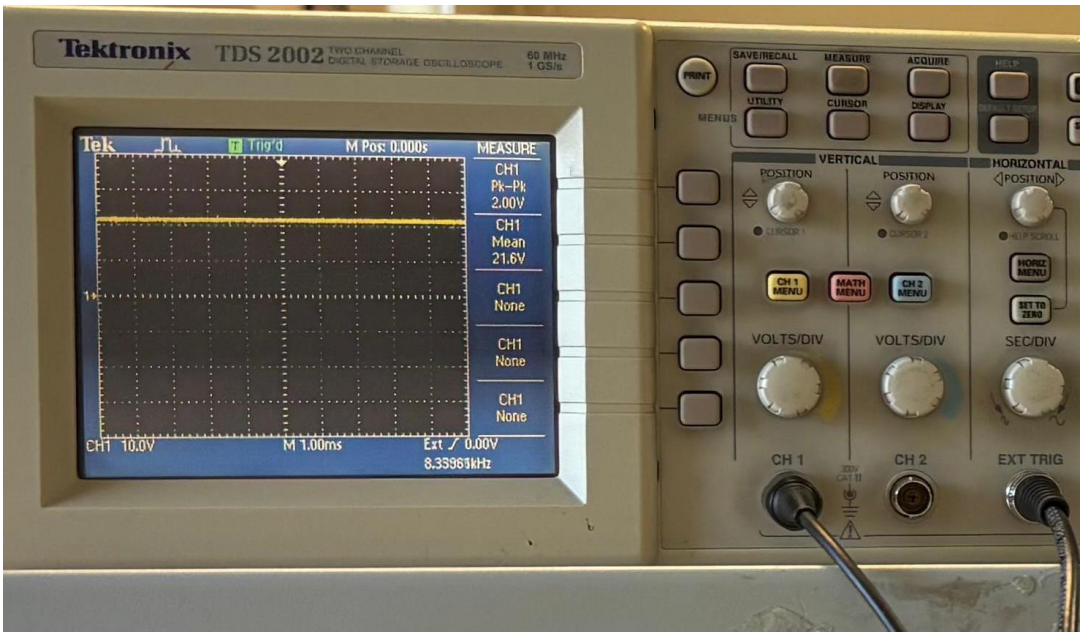

Figure 14: Calibrated Output of the Converter with 26V Input

Hence, the desired output from the converter is obtained. With 220Ω load resistance, the efficiency of the converter is found to be 26.33% which is lower than the simulation result.

Conclusion

The experiment successfully demonstrated the operation of a half-bridge isolated DC-DC converter. The desired output voltage was achieved by carefully setting the duty cycle, input voltage, and component values. Key observations include the critical role of proper signal generation for driving the IR2109 and ensuring reliable switching of the MOSFETs. The experiment also highlighted the importance of accurate transformer winding and circuit layout to minimize losses and maintain efficiency. Overall, the design performed as expected, providing valuable insights into isolated DC-DC converter operation.