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A 12-2kV Secondary Side Controlled Flyback Converter SIMULINK MODEL

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ABSTRACT: In many applications, conversion of a low voltage to a high voltage plays a crucial role. This can be done using a Flyback Converter which has many advantages. The primary being isolated from the output, the ability to cooperate on a wide range of input voltages and the usage of very few components as compared to other SMPSs are some of the advantages. The Flyback Converter is mainly used in television sets which consume small amount of power upto about 250W, standby power supplies for computers, cell phone and mobile device chargers and high voltage supplies in TVs and monitor CRTS, Lasers etc. In this paper, a Flyback Converter is presented which can step-up a 12 V DC input to a 2000 V DC output. This paper discusses the simulation of a secondary side controlled flyback converter simulated in SIMULINK. It is an efficient method for the conversion of low voltages to high voltages.

KEYWORDS: Flyback Converter, High Voltage, Secondary-Side controlled flyback converter

I. INTRODUCTION

The secondary side controlled flyback converter is a modified version of a flyback converter (modified boost converter), by adding a mutually coupled inductor to power the basic boost converter module. It works similar to a boost converter. The flyback converter is very similar to the booster converter in terms of its performance and architecture. A transformer is used as it is basically a mutually coupled inductor. Both the windings of the transformer serve as two separate mutually coupled inductors. The input is fed to the primary side of the mutually coupled inductor, which stores the energy when the circuit is closed. When the MOSFET that controls the energising of boost converter inductor switches, a change in electric field occurs in secondary winding, and by Faraday's Law of Electromagnetic Induction, the switching of the MOSFET couples the two inductors to produce a stepped up output. This output is then fed to the boost converter basic module that boosts the Voltage obtained to a High Voltage of 2000V DC.

II. RELATED WORK

The paper [1] presents a study of the winding strategies in flyback converter transformers. The paper [2] explains the accurate modelling and controller design for an isolated converter which is quantitative with optocoupler isolation in its feedback loop. In paper [3], the methodology of designing flyback converters using the MAX17595/MAX17596 peak current mode controllers is described. The paper [4] reviews the common methods to tighten the output regulation of Flyback switched-mode converters and summarizes the measurements of performances of each. The paper [5] gives a practical example of power supply in offline switching mode.

III. METHODOLOGY

The proposed topology has a constant DC Voltage Source supplying 12V DC input to the primary side of the mutual inductor (transformer) and, the winding ratio of the transformer is $N_1/N_2 = 22$. The secondary side voltage gets coupled due to the switching of MOSFET and voltage of 264 V (Fluctuating) occurs across the secondary of the mutual inductor. This stepped up voltage is fed to the inductor of a generic boost converter module with an inductor value of 50mH, and the MOSFET switches rapidly at a rate of 2500 Hz, this rapid switching energises the inductor and builds up the voltage to 2000V DC and it is passed through a diode so that no back energising occurs and the filter capacitor filters out the alternating ripples of the transformer output and a ripple free stable output is obtained at the load. Here the resistor is modelled as a Load for obtaining the output voltage and to measure the current. The output current is measured in the SIMULINK model as 14 Ampere peak.

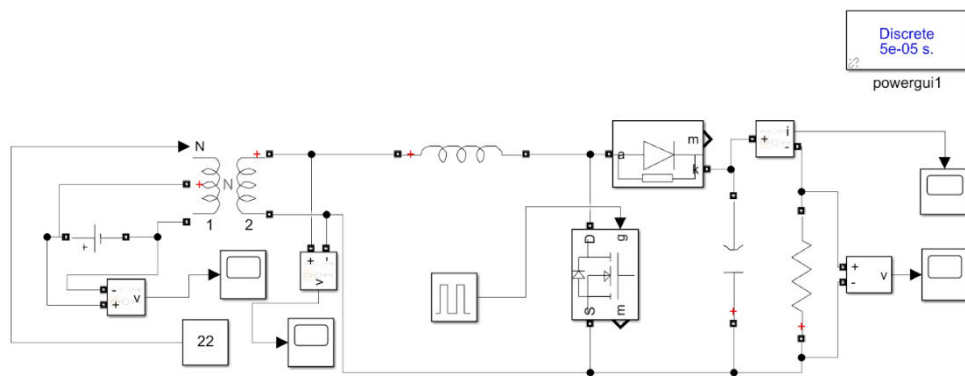


Figure1 : Topology of proposed Flyback Converter

IV. EXPERIMENTAL RESULTS

Figure 2(a,b,c,d,e,f,g,h) shows the simulation results of the flyback converter and the table given below shows the accurate values of the simulation analysis.

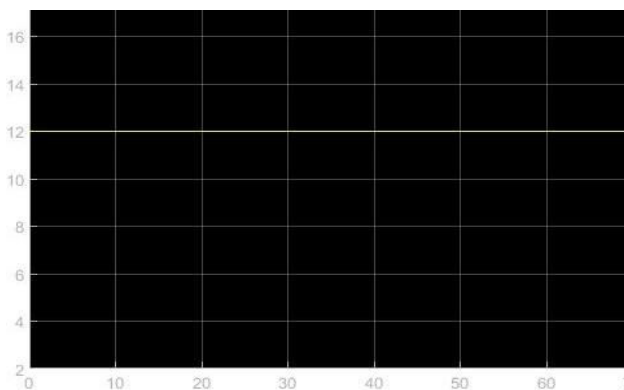


Figure 2(a): Input Voltage

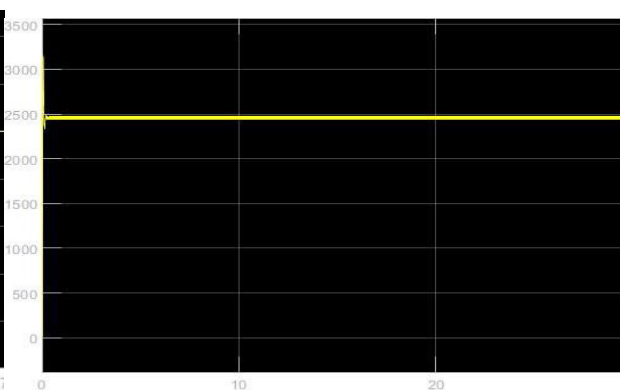


Figure 2(h): Input Current

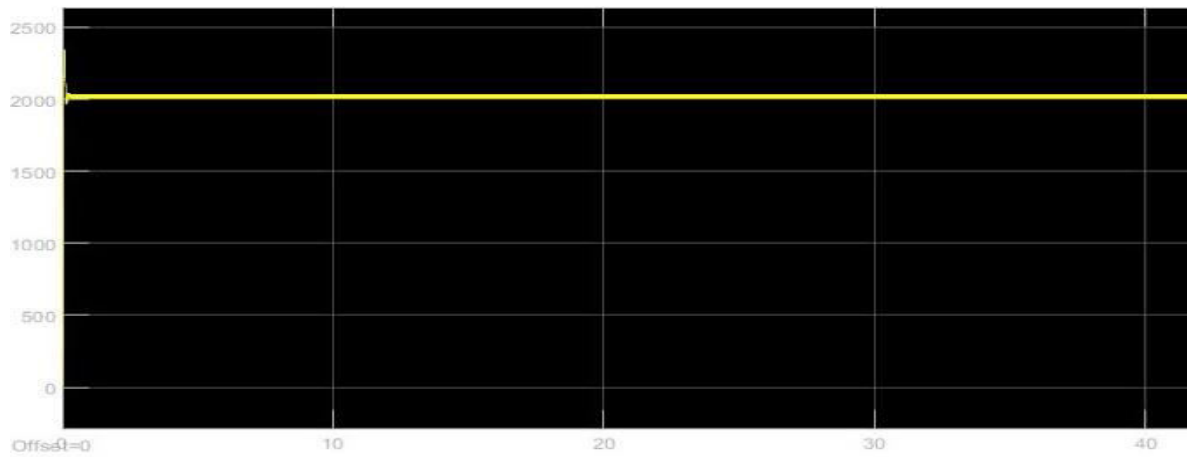


Figure 2(c): Output Voltage of Flyback Converter Secondary Side Controlled.

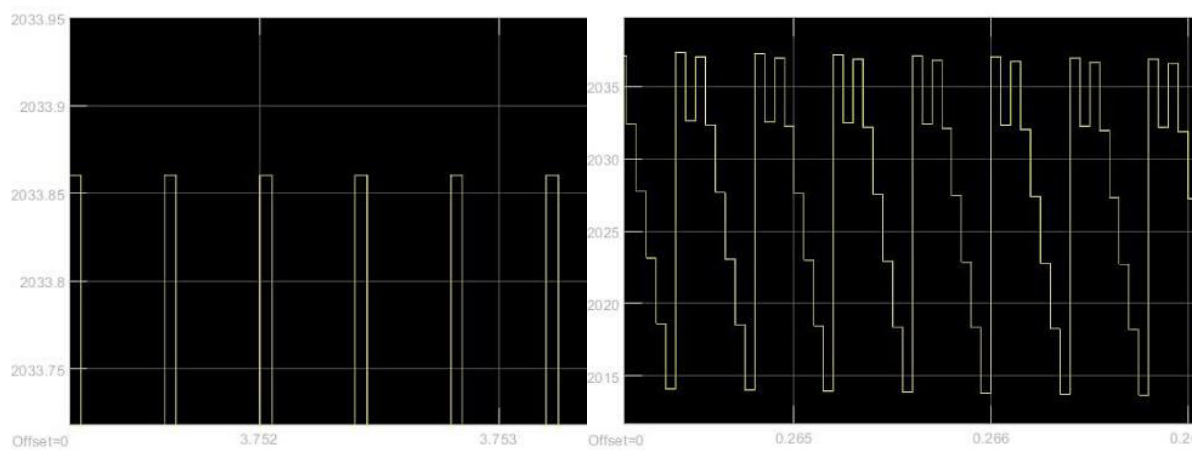


Figure 2(d): Peak Voltage of Output

Figure 2(e): Ripple Voltage of Output

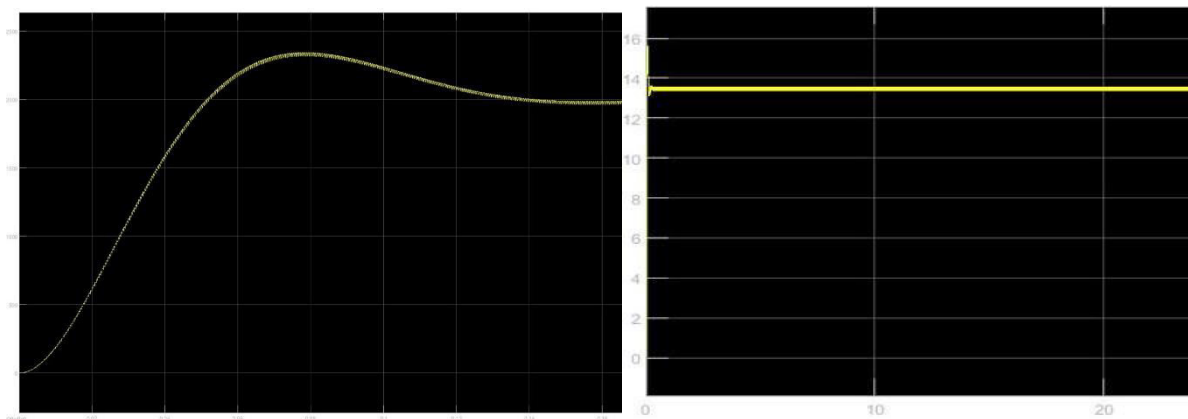


Figure 2(f): Overshoot

Figure 2(g): Output Current

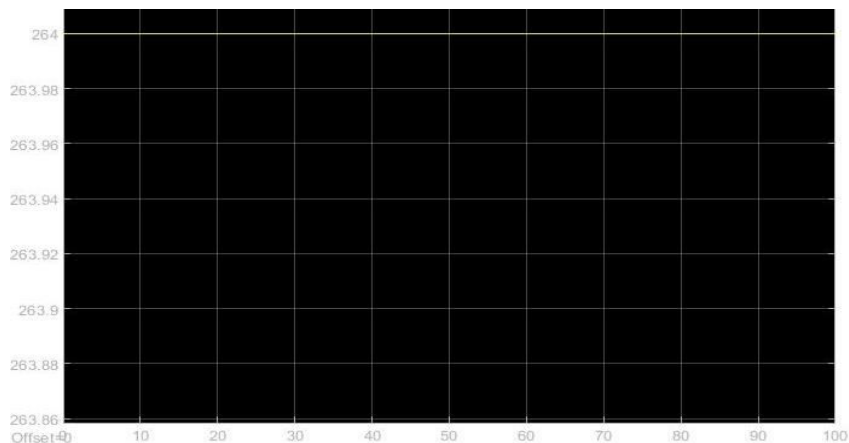


Figure 2(g): Voltageat Secondary Side of transformer

RESULT	VALUES
INPUT VOLTAGE	12V
OUTPUT VOLTAGE	2000 V
PEAK VOLTAGE	2033.85 V
RIPPLE	2015 V - 2035 V
OVERSHOOT	2344.6 V
OUTPUT CURRENT	14 A
SECONDARY SIDE VOLTAGE	264 V

Table 1: Analysis and Results

The current measurement units are connected in series and voltage measurement units are connected in parallel to the proposed SIMULINK topology and the results and input parameter analysis are obtained from the scopes connected to the respective measurement units. A peak output voltage of 2033.85 V DC is obtained as the output of the Flyback Converter, with a ripple voltage ranging from 2015 V to 2035 V. The initial overshoot of the output is obtained to be 2344.6 V and then a steady output of around 2000 V is obtained as the final filtered output. The output current is measured and found to be 14 A for an input current of 2500 A. The transformer secondary side stepped up voltage is found to be 264 V. Thus a constant output voltage of 2000V is observed as the output for a load resistance of 150 Ω .

V. CONCLUSION

We have simulated a secondary side controlled flyback converter with an output voltage of 2000V by supplying a 12V input. The proposed model uses a 2.5kHz frequency switched MOSFET to control the boost converter setup and an additional 50mH inductor and a 2000V, 150 microF filter capacitor. Applications of this converter include, Defibrillators, input for generating further High Voltages, and other High Voltage Testing apparatus.



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