COMPARISON OF VARIOUS TOPOLOGIES FOR THE DESIGN OF SWITCHED MODE POWER SUPPLIES

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Abstract— Every Switched Mode Power Supply (SMPS) for PCs typically portrays considerably low amount of power quality, for example, the power factor of a value below 0.5 and output voltage regulation happening to be extremely poor. The SMPS is generally the most preferred option for converting the DC to DC power. Here a couple of topologies are studied and likewise one amongst them can be chosen for the hardware implementation which gives proper output voltage and power factor. In this paper, a general MATLAB/SIMULINK modeling method is shown where the topologies are simulated and the results are verified.

Index Terms— Switched Mode Power Supply, SMPS Topologies, MATLAB-SIMULINK.

I. INTRODUCTION

The SMPS is a power converter which uses the switching components like the MOSFET which enables the continuous turning on and off of the switch at higher frequencies. This type of power supply having high efficiency of about 90 %, are smaller in size and are broadly utilized in PC applications and other sensitive electronic equipments. The design of a Switched Mode Power Supply is compact and it utilizes small transformers [6]. The capacity to minimize the size and fit all the components together is a small amount of space is the main necessity for a large number of the electronic gadgets nowadays.

The supply having the isolation provided by a transformer have stable outputs regardless the input supply. It will also have higher efficiencies, up to 90%. It will have more efficiency compared to the other linear power supplies because the switching action helps in the dissipation of the small amount of power while the switching takes place, also they are compact in size and light weight.

All the DC to DC voltage converting topology are divided in two essential segments, which depends on the fact that do they possess any kind of galvanic isolation present in between the input supply and the output. Mostly the topology consists of a power transformer which is used to give out voltage scaling depending upon the turns ratio, multiple outputs dependent on the number of winding and the isolation available. Topologies such as the buck and boost do not use a transformer, and therefore are non-isolated. The non-isolated topology will possess restricted usage and will be commonly utilized in the dc-dc regulators. The selection of the particular topology to implement is predisposed by cost, efficiency, size and few other necessities.

There are various techniques and topologies utilized for the designing of the switched mode power supplies [6] some basic topologies used are:

[1]Buck – It is the most commonly used, simple and cheap non-isolated topology as the DC to DC voltage step-down applications.
[2]Boost - step-up non isolated.
[3]Buck and Boost - step up and down, non isolated.
[4]Flyback – isolated step-up and step down.
[5]Forward isolated.
[6]Push-Pull forward converter with two primary windings.
[7]Zeta Converter.

Few of the topologies are simulated in the MATLAB/SIMULINK [7] program and then the results are just compared so as to see the difference between the results and accordingly chose the required topology for the implementation of hardware based on the output power requirement.

II. FLYBACK CONVERTER

The Fly-back converter which is regularly utilized as a topology for the SMPS circuit for such application which require a low output voltage also that it should be in isolation with the input voltage. The general circuit of this converter is impressively less complex compared to other SMPS circuits[6].

The circuit input which is in general the non-regulated dc supply which is gained by the rectification of the input ac voltage, following by a basic capacitor filter. This circuit is capable of offering singular or multi output voltage and can work over different input voltage ranges.

$$E_{dc} = L_{pri} \times \frac{d}{dt} i_{pri} \qquad (1)$$

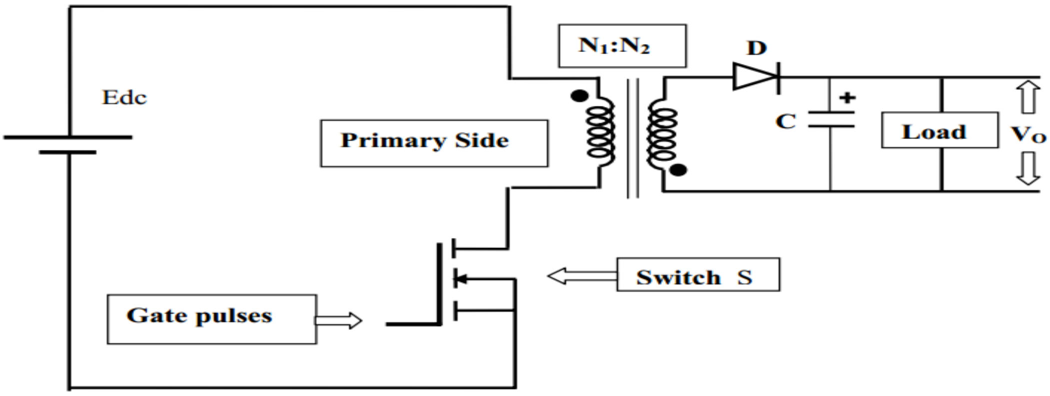

Figure 1. Basic Flyback Topology

The generally utilized fly-back converter needs a single controlled switch like, the MOSFET and the standard switching frequencies ranging from 50 kHz to 100 kHz. A dual-switch topology [3] also can be used which can offer comparatively superior efficiencies and lesser voltage stress over the switches, but again it will be costing higher and the circuit will become a little more complex.

III. SINGLE SWITCH VERSUS DOUBLE SWITCH FLYBACK

In a double switch flyback, the leakage inductance of the power transformer is much less critical (figure 2). The two demagnetization diodes (D1 and D2) provide a single non-dissipative way to systematically clamp the voltage across the switches to the input DC voltage Vin. This energy recovery system allows us to work at higher switching frequencies and with a better efficiency than that of the single switch structure. However, the double switch structure requires driving a high side switch. This double switch flyback is also known as asymmetrical half bridge flyback as shown in Figure 2.

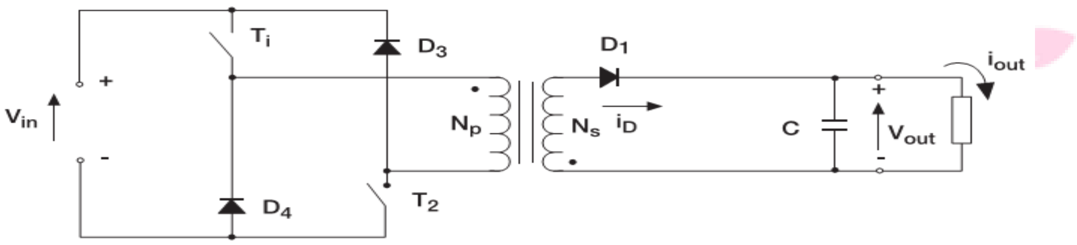

Figure 2. Isolated Double Switch Flyback

Power Switch:

$$V_{CEV} \text{ or } V_{DSS} \geq V_{inmax} \quad (2)$$

Primary Rectifiers:

$$V_{RRM} \geq V_{inmax} \quad (3)$$

IV. SIMULATION AND RESULTS

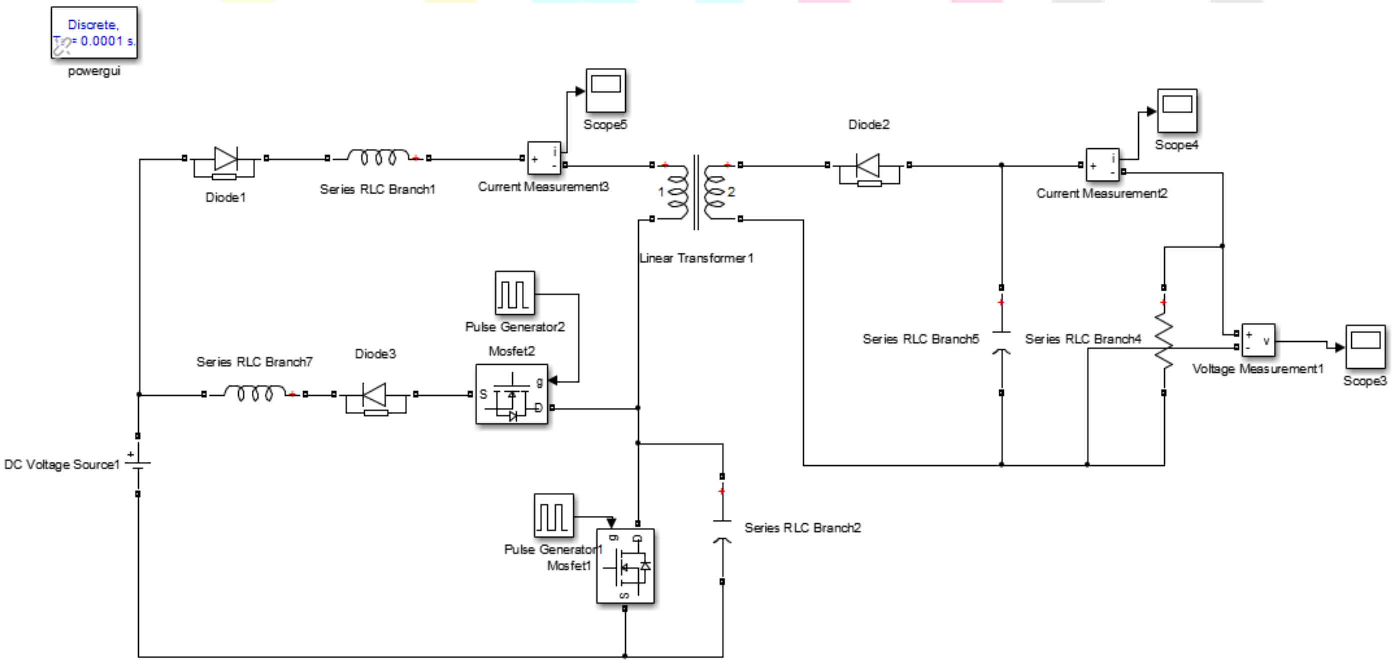

Figure 3. Flyback Topology Simulation

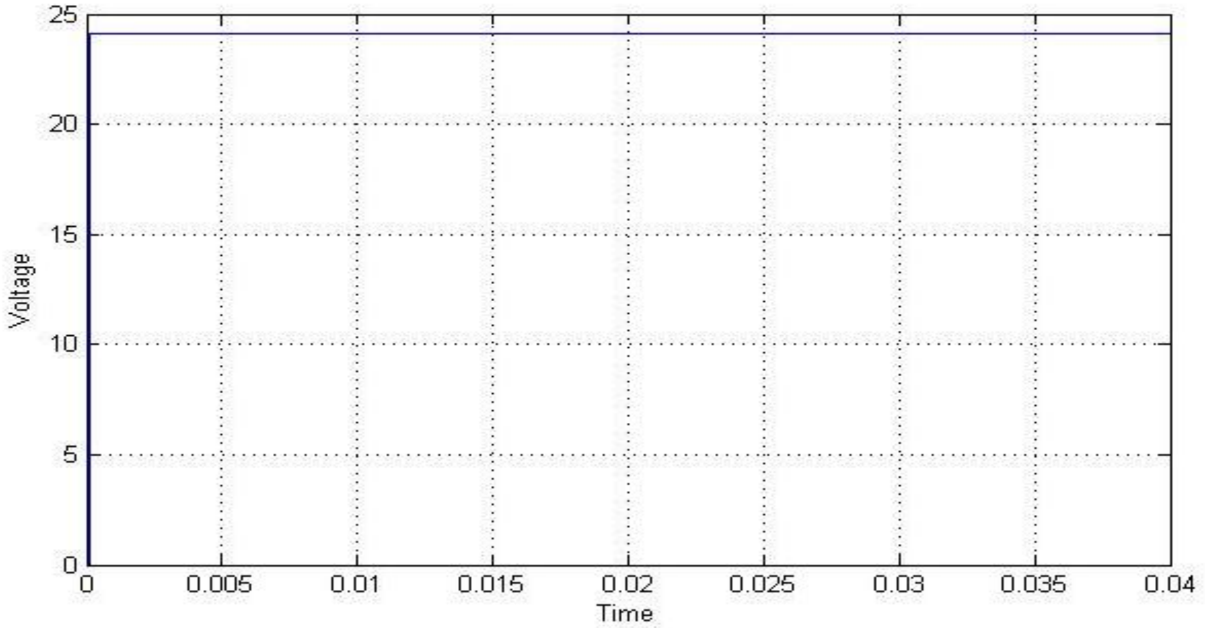

Figure 4. Output Waveform of Flyback Topology

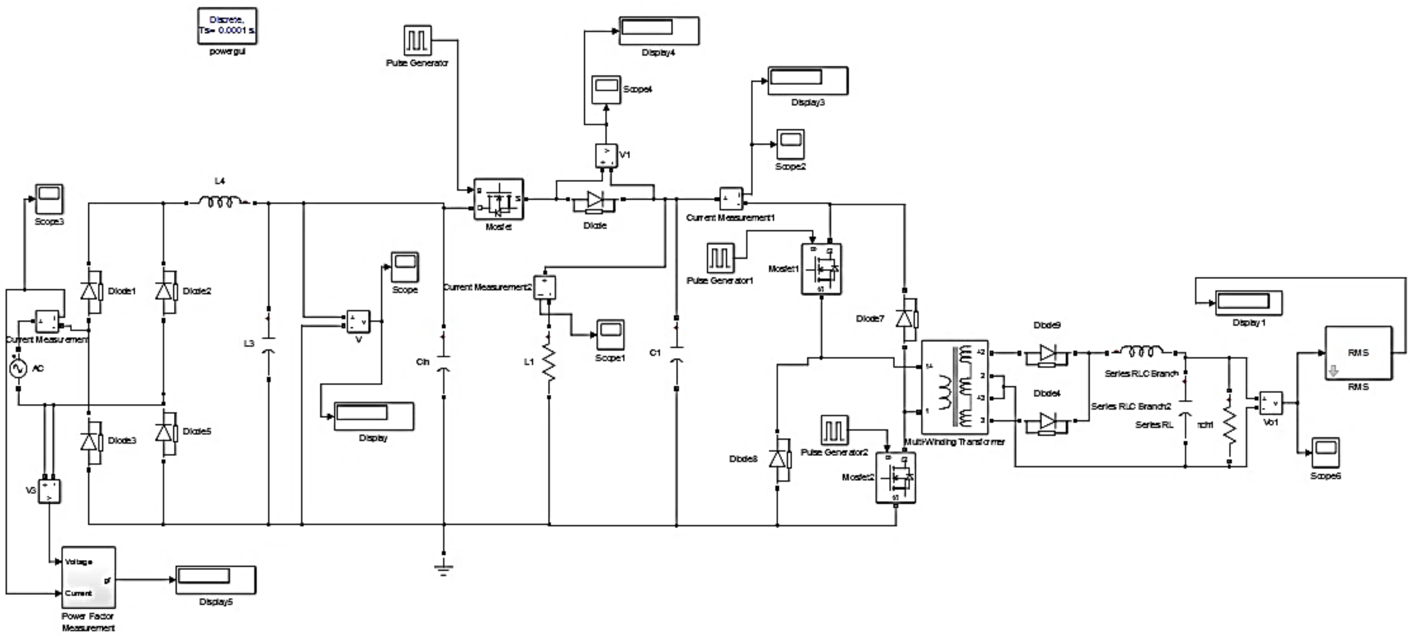

Figure 5. With Push Pull Topology

Waveform of the push pull topology which are generated in MATLAB-SIMULINK software for the analysis purpose.

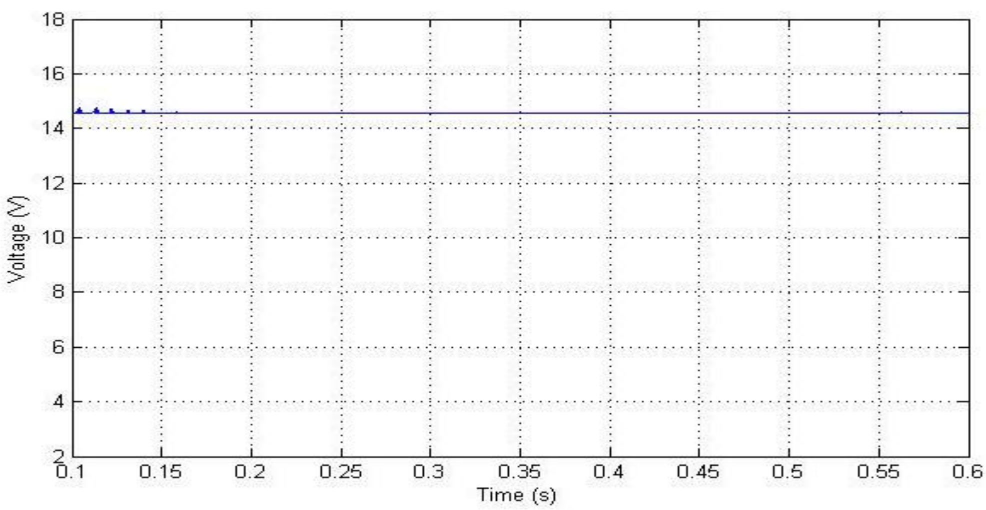

Figure 6. Output Waveform

Table 1 Specifications of Various Topologies

Topology	Double Switch Flyback	Half Bridge Forward	Push-Pull
Input AC	230 V	230 V	230 V
Output DC	19.8 V	10.5 V	14.8 V
Inductor	0.0133	0.0133	0.0133
Capacitor	20 mF	20 mF	20 mF

CONCLUSION

The considered converters work under hard and delicate exchanging conditions and are furnished with normal and also the synchronous output rectification. The examination depends on general effectiveness, controlled component stress, electromagnetic discharges and converter sizes. All the topologies are capable enough to provide the desired output now in the end it depends on the customer which to choose from. Rules are given to help choosing the SMPS with the best topology as per the particular outline.

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