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Simulation of Push-Pull Buck Converter

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ABSTRACT
A push–pull converter is a type of DC-to-DC converter, a switching converter that uses a transformer to change the voltage of a DC power supply. The distinguishing feature of a push-pull converter is that the transformer primary is supplied with current from the input line by pairs of switches (MOSFET, Transistors etc.) in a symmetrical push-pull circuit

Keywords: Dc-Dc converter,Push-Pull topology,PWM Technique,Step down,PSIM.

I. INTRODUCTION

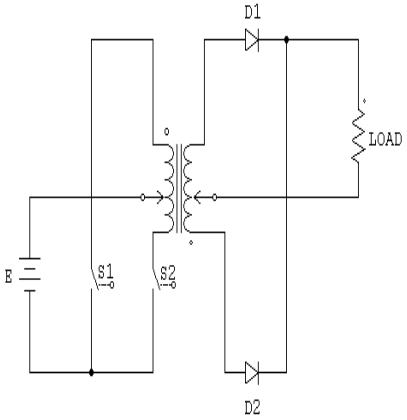
The world has become a slave of the electronic gadgets and electronic equipments without which it is very difficult for the mankind to keep going. So it is very important to design the devices with maximum accuracy and fast response.But todays most vital requirement is the conservation of energy,so energy efficient devices is the call for the time. Of the research field is dc-dc converters. The dc-dc converters mean the input is dc and the output is also dc which can be said as acting like a dc transformer.
DC-to-DC converter is a device that accepts a DC input voltage and produces a DC output voltage. Typically the output produced is at a different voltage level than the input. Conversion operation takes place by turning on and turning off of the switches like mosfet, thyristors, diodes etc. This type of conversion is called switch mode conversion. But this results in non isolated conversion whereas in ac link conversion an isolation is provided between the low voltage and high voltage side thus allowing different input output ground potentials and better personal security.
The functions of dc-dc converters are:

[1] To convert a dc input voltage into a dc output voltage .
[2] To regulate the dc output voltage against load and line variations.
[3] .To reduce the ac voltage ripple on the dc output voltage below the required level.
[4] .To provide isolation between the input source and the load (isolation is not always required);
[5] To protect the supplied system and the input source from electromagnetic interference.

The dc-dc converters can be divided into two main types:
i.Hard-switching pulse-width modulated (PWM) converters and ,
ii.Resonant and soft-switching converters.
In push pull topology switches are alternately switched on and off, periodically reversing the current in the transformer. Therefore current is drawn from the line during both halves of the switching cycle. This contrasts with buck-boost converters, in which the input current is supplied by a single switch which is switched on and off, so current is only drawn from the line during half the switching cycle. During the other half the output power is supplied by energy stored in inductors or capacitors in the power supply. Push–pull converters have steadier input current, create less noise on the input line, and are more efficient in higher power applications.

II. PUSH-PULL CONVERTER

Let us first see a brief sketch of circuit waveforms in the push-pull circuit. Here the primary as well as secondary winding is center-tapped. The switch voltage stress is nearly 2 V_{source} and the switches alternatively conduct the current to the twop ortions of the center tapped primary winding. When one switch is on the other is off.



Fig(1)Basic circuit of push-pull topology

The switches S1 and S2 operate shifted in phase by T/2 with the same duty ratio D,however, the duty ratio must be smaller than 0.5. When switch S1 is on, diode D1 conducts and diode D2 is off; the diode states are reversed when switch S2 is on. When both controllable switches are off, the diodes are on and share equally the filter inductor current. The dc voltage transfer function of the push-pull converter is

$$M_v = 2 * D/n$$

where
Mv = DC Voltage Transfer Function
D = Dity Ratio
n = N2/N1

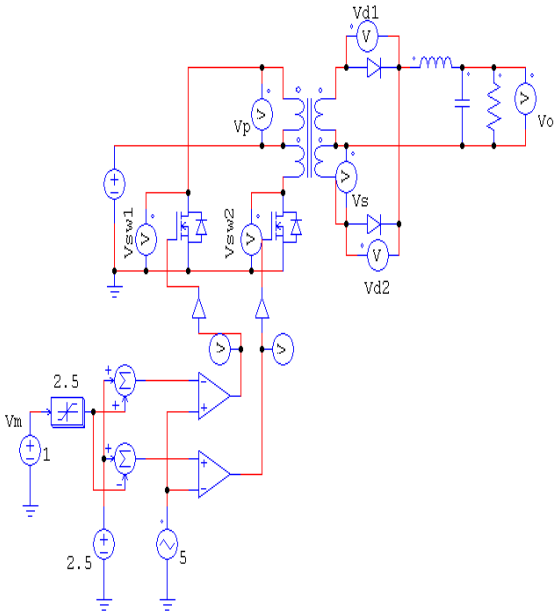
III. SIMULATION MODEL

A. Parameters

In this paper, single phase 3wirecentre tapped transformer is being used to step down the voltage.
The parameters for transformer is given in table 1

B. Model.

In this PSIM simulation model the gating pulses fpr the two MOSFETS are generated by PWM echnique.The triangular carrier wave of frequency 10kHz is compared with the reference dc voltage using two comparators to obtain alternate triggering pulses for the MOSFETs.



IV. SIMULATION RESULTS

Below waveforms shows the output of the control circuit which is fed to the two switches. The switching frequency is 10kHz with a constant duty ratio of 50%.

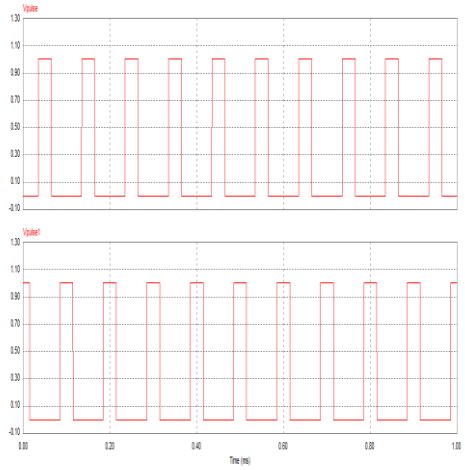


Fig2(a).Pulses to the MOSFET

The switch voltage stress is nearly 2 V_{source} and the switches alternatively conduct the current to the two portions of the center tapped primary winding.This can be verified by the output waveform of the simulation .

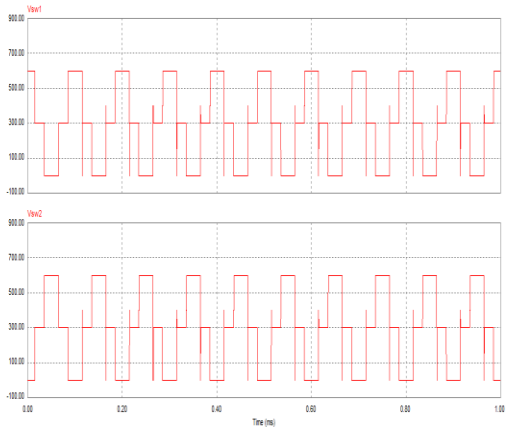


Fig2(b).Voltage across the two switches(MOSFETS)

Also the voltages across the two rectifying diodes are shown as under:

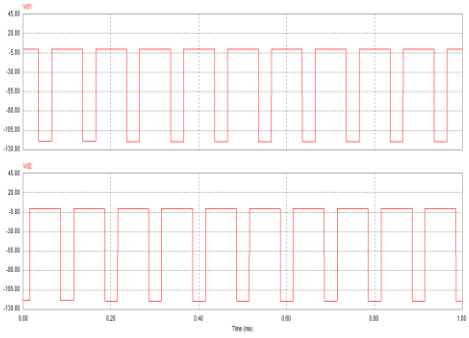


Fig2(c).Voltages across diodes

Since the step down transformer is used of the turns ratio 1:5,the voltageof the transformer secondary will be 60V. The output voltages of the primary and secondary sides are shown in fig2(b).

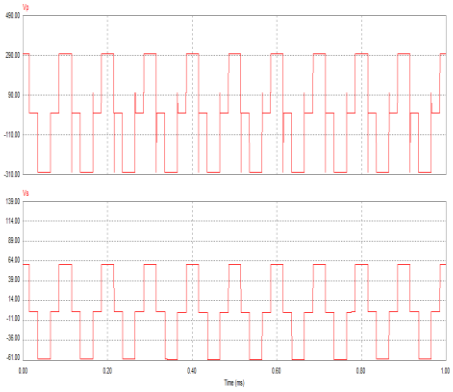


Fig2(d).Output voltage of Primary and secondary sides of transformer

Thus ,the final output voltage across the load obtained after the simulation of the push-pull converter is as shown in fig.below.

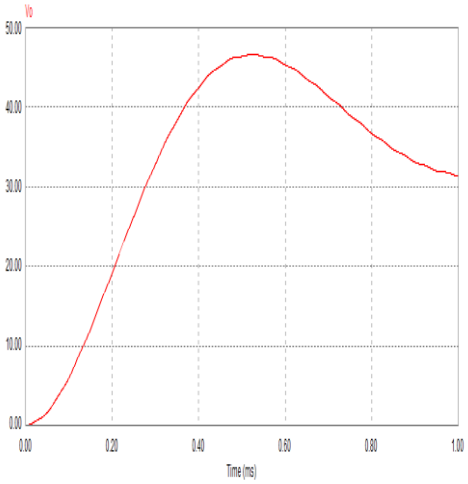


Fig2(e). Voltages across load

V. CONCLUSION

Thus in this paper, the push-pull DC –DC converter topology is modeled and simulated using PSIM Software. From the simulation results, it is clear that the input dc voltage (300 V) is stepped down to obtain the final dc output voltage (30 V).

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