Photovoltaic Based Advanced Active Clamping technique for Current-fed Push-Pull Converter

***K.Abarna,S.Divya,M.Sasi kumar**

Department of power electronics and drives,Jeppiaar engineering college,Chennai

***Corresponding author:E.mail:lkabarna28@gmail.com**

ABSTRACT

In this paper, a Zero current based single-inductor push-pull converter is discussed. A push-pull converter is compatible for low voltage photovoltaic applications, because high frequency transformer has high step-up ratio. Photovoltaic is considered to be a popular source of renewable energy due to several advantages, specifically low operational cost, and maintenance free and environmental friendly. In the conventional converter, primary switches are operated with hard switching strategy where in the proposed converter the switches are operated with soft-switching condition. This is the main reason that the proposed push-pull converter has reduced switching losses. The advanced active clamping circuit is added in the proposed circuit to protect the primary side switches from the overload and other transient conditions. Moreover the boost rectifier added in the secondary side reduces the turn's ratio of the transformer further when compared to the voltage doubler.

Key words: Current-fed push pull converter, soft switching, boost rectifier.

INTRODUCTION

The distribution generation a system being designed with Photovoltaic Panels has drawn the attention of wide number of analysts. The use of PV energy has been widely increased due to its renewable energy concept is another remarkable thing.

Advantages of PV system

1. Renewable
2. Pollution free
3. Less maintenance cost
4. Noise free

The Push-Pull converter is widely utilized in PV systems because of the fact that it can be either fed to a grid connected system or standalone system and moreover because of its ability to operate in the absence or in the presence of a battery bank. The active clamp circuit is used across the switches to protect them from transient over voltages. The boost rectifier added at the output side rectifies the output from the transformer.

Conventional Push-Pull converter: The Push-Pull converter which is a combination of two primary switches and a high-frequency transformer is proposed for PV modules since it need not provide a separate isolation circuit where the transformer itself provides the isolation. Using a voltage-fed source in the primary side of the transformer in the circuit is not a good idea which should have high step-up ratio due to low input voltage and the high output voltage. Therefore, the push-pull converter is used with a current source which can decrease the turn ratio of the transformer.

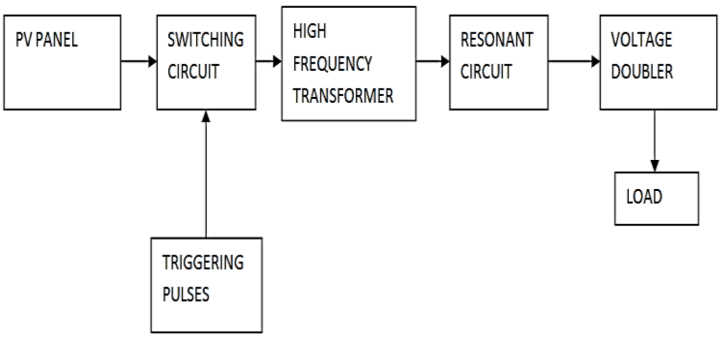
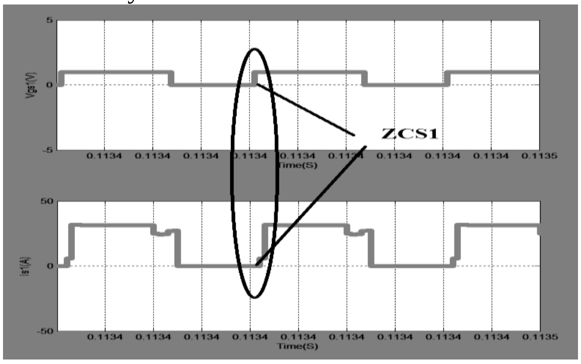


Figure.1.Block diagram of the Conventional Push-Pull converter

The conventional push-pull converter is composed of switching devices (S_1,S_2), a boost inductor (L_{bst}), a high frequency transformer. The primary-side voltage (v_{T1}, v_{T2}) of the transformer is the sum of the input voltage v_{in} and L_{bst} voltage v_{Lbst}.

A.ZCS for Switch S_1: At first, the current flow through S1.The flow of the resonant current at the resonant tank is reversed. i_{Lk} decreases linearly.



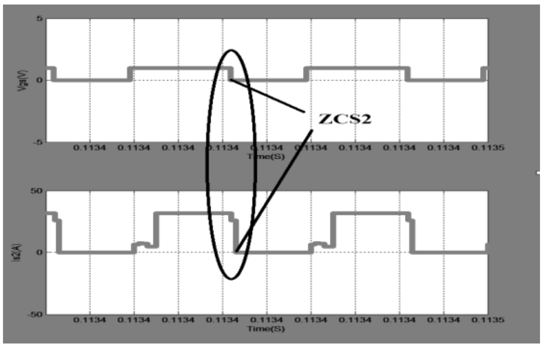


Fig.2 ZCS for S_1

Fig. 3 ZCS for switch S_2

B.ZCS for switch S_2:

C.Parameters of Simulation:

PARAMETERS	VALUE	UNIT
Input voltage	20-40	V
Output voltage	400	V
Output Power	250	W
Boost Inductor	127	µH
Secondary side magnetic inductance	950	µH
Secondary leakage inductance	34	µH
Resonant capacitor	4.7	nF
Switching frequency	50-100	KHz
Transformer turn-ratio	5.5	

Proposed Push-Pull converter: The conventional push-pull converter has the transformer turns ratio of 5.5. Inorder to reduce this turns ratio to a greater value the voltage doubler which was designed in theconventional circuit is replaced with a Boost rectifier. On replacing, a high output voltage is obtained for the same turns ratio of the transformer. In other words , reduced transformer turns ratio is obtained.

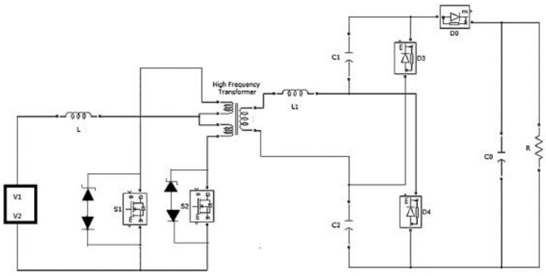


Fig.4.Main circuit of proposed push pull converter with boost rectifier

Advanced Active Clamping Protection: Active clamp circuits for the transistors are achieved when the power is shunt from a transistor drain to the transistor gate when a drain to source voltage of the transistor exceeds a particular threshold voltage. When power is made to flow through the transistor gate, the transistor is turned on, therefore power is allowed to flow across the transistor and prevents excess drain to source voltages. A simple active clamp circuit provides protection to the transistors at the time of overload but eventually creates losses and additional voltage drops.

To overcome the shortcomings of the simple active clamp an advanced active clamp circuit is proposed which includes either a Zener diode or a unidirectional TVS (Transient Voltage Suppressors) diode in series with a forward blocking rectifier diode. The Zener diode or TVS diode and the forward blocking rectifier diode are connected between the gate and drain of the transistor. In such a circuit, the Zener diode allows current to pass through when the voltage exceeds the Zener breakdown voltage, and the reverse current flow is prevented by the forward blocking diode when the transistor is turned on.

Active clamp circuit provides benefits like lowering the switching losses, exact voltage limitation independent of the operating point of the converter and provides reliable protection to the transistors.

B.Simulation results: The implementation of proposed system is simulated using the tool MATLAB.

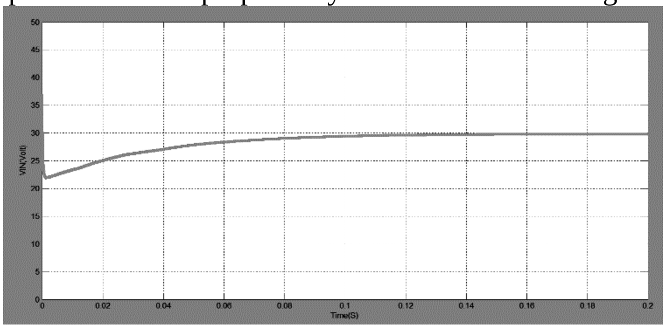


Fig.9 Input voltage of the proposed system

In the above figure the input voltage of proposed system is shown where the input is given as 25V

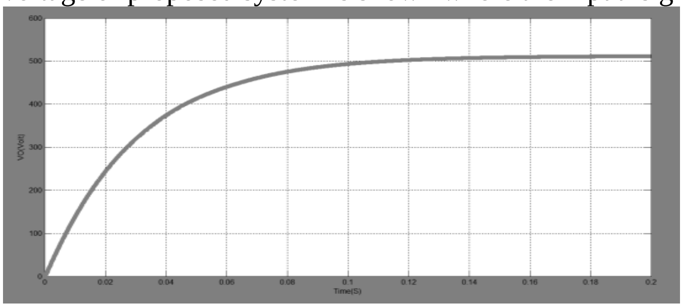


Fig.10 output voltage of the proposed system

The voltage obtained here is the output voltage where we get a voltage of 500V which is higher than the conventional system and the above result is implemented for R load. The following results which are simulated for the proposed system are for the ***motor load .***

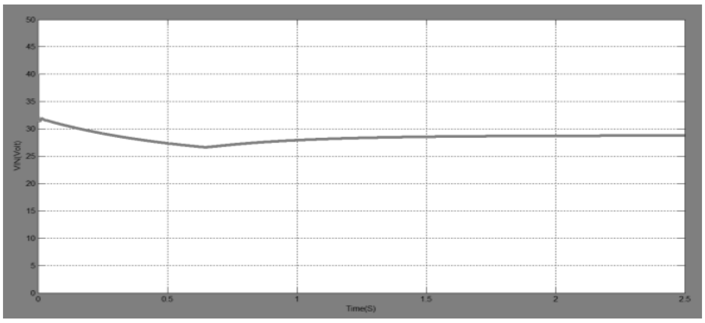


Fig .11 Input voltage of Proposed system

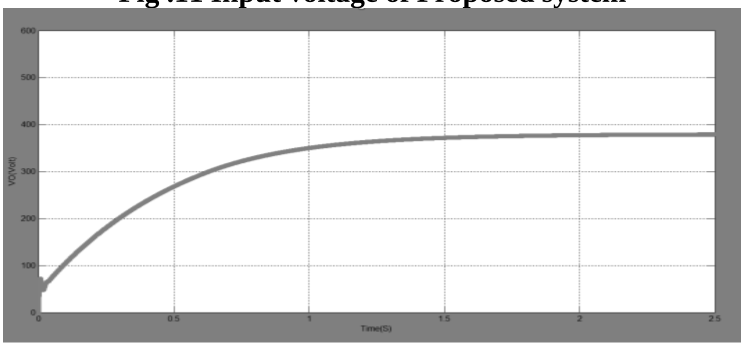


Fig. 12 Output voltage of proposed system

CONCLUSION

Thus in this paper, zero current transition technique has been used inorder to reduce the switching losses. The active clamp protection is used for the overvoltage protection of the switches. The boost rectifier added on the secondary side of the transformer reduces the transformer ratio to a greater value.In future advanced protection which protect the whole setup for overload could be proposed.

Journal of Chemical and Pharmaceutical Sciences ISSN: 0974-2115

REFERENCES

D.Meneses, F.Blaabjerg, O.Garcia, and J.A. Cobos, Review and comparison of step-up transformless topologies photovoltaic AC-module application, IEEE Trans. Power Electronics., 28(6), 2013, 2649-2663.
A.C. Nanakos, E.C.Tatakis, and N.P.Papani kolaou, A weighted efficiency oriented design methodology of flyback inverter for AC photovoltaic modules, IEEE Trans. Power Electronics, 27(7), 2012, 3221-3233.
T.C.Lim, B.W.Williams, S.J.Finney, H.B. Zhang ,and C.Croser, Energy recovery snubber circuit for a dc-dc push-pull converter, IET Trans.Power Electron., 5(6), 6, 2012, 863-872.
S.M.Mukhtar, A.R.M.Saad, and N.H.Hanafi, A high efficiency microcontroller-based step-up push-pull DC-DC converter for PV inverter, in proc. IEEE. Power Energy Eng. Conf. Dec. 2010, 141-145.
Shin Ju Chen, Huang Chang Chang, Analysis and implementation of low side active clamp forward converter with synchronous rectification, in IECON, 2007, 1506-1511.