Comparison of Different Topologies for Transformer-less Inverter – A Review

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Abstract - *From last few years solar power technologies become less costly that have created to an attractive resolution, It is clean and environment friendly as compared to fossil fuel or nuclear. However the energy we are getting from sun is free of cost, offered nearly everyplace and it is renewable. Main benefits of PV technology is that it don't have any moving components, therefore the hardware is very robust, it have long life and no high maintenance is required and most significantly it's one resolution that it gives environment friendly power generation the efficiency of economic PV panel is around 15-20%. The efficiency and reliability of each single phase and three phase PV inverter system is improve using transformer less topologies. In this paper comparison of different topologies for transformer-less inverter is carried out.*

Key Words: **Transformer-less inverter**

1. INTRODUCTION

In recent years the application of Photovoltaic generation system have increased rapidly in industrial and domestic structure. PV generation has attracted the interest of new generation as it is capable of solve problems like global warming. It reduce unnecessary fuel expenses and PV does not cause air pollution and waste. As semiconductors are used in this system so there are no vibration and noises[6]. Another advantage of PV system is it has a life of more than 20 years and it required minimum maintenance which reduce maintenance expenses. The output of solar cell changed by the change in surrounding temperature and irradiation. And its efficiency is also low. But for power conditioning system (PCS) required high efficiency it helps to transmit power from PV array to the load. Basically in single phase PV power conditioning system have two conversion stages , first stage is DC-DC conversion stage and second stage is DC-AC conversion stage. DC-DC performs maximum power-point tracking. The function of MPPT is to maximize the energy during operation as it is connected to solar module array. MPPT circuit monitors the array voltage and current, which helps to harvest highest energy.

When there is no transformer connected in grid connected photovoltaic system (PV), a common-mode resonant circuit is obtained, when common-mode (CM) voltage is varies, it excite resonant circuit which produces common-mode current. Common-mode current flow through the stray capacitance between PV array and ground, which may causes harm to the body and PV system. In order to avoid leakage current different topologies are proposed.

2. Different topologies for transformer less inverter

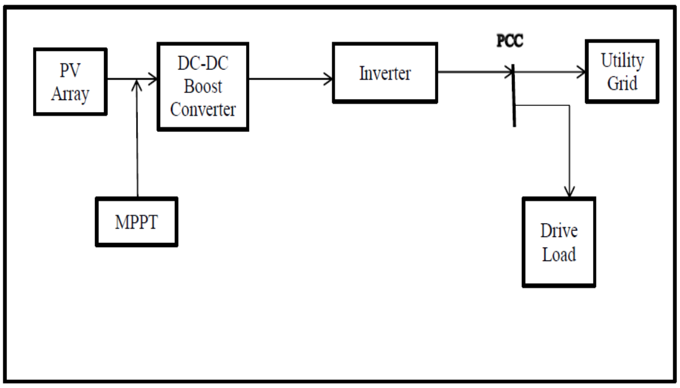

Fig.1 Block diagram of transformer-less inverter system

Fig.1 shows the basic diagram of transformer-less inverter system ,where PV array is connected for generating power, as power generation by solar is less because its output changes easily by changing temperature or irradiation, so to boost output DC-DC boost converter is connected.

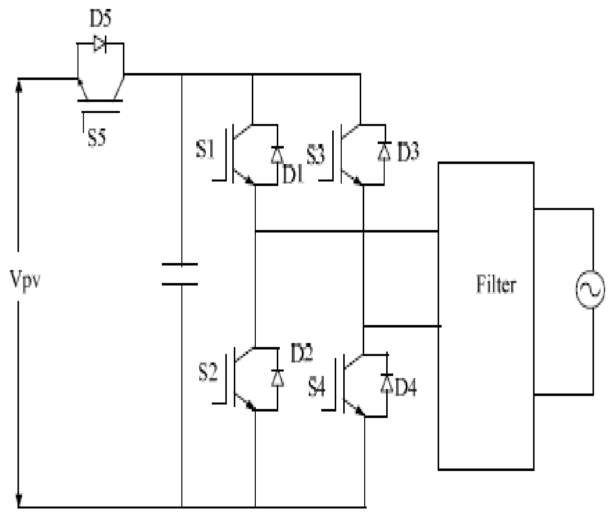

Fig 2. H5 Inverter

Transformer-less H5 inverter topology is shown in fig.2. This inverter have 5 number of switches which helps to reduce cost of a system. The h-bridge is connected to the PV panel by using fifth (S5) switch. Operation of H5 inverter is as follows.

Modes of Operation of H5 inverter

Operation of H5 inverter is divided into four modes:

i. Active state mode: In this mode the current passes through S5, S1 and S4 from PV panel to the grid.

ii. Zero state mode: It named as zero state mode because in this mode there is no energy transfer from PV to the grid. In this mode, the grid current freewheels through S1 and D3, and the PV panel disconnects from the grid.

iii. Active state mode: This mode is also an active state mode because, the current passes through S5, S3 and S2 from PV panel to grid.

iv. Zero state mode: This mode is also called as zero state mode because, the grid current freewheels through S3 and D1, and the PV panel disconnects from the grid.

Transformer-less H6 inverter topology is shown in fig 3. This inverter have 6 number of switches.

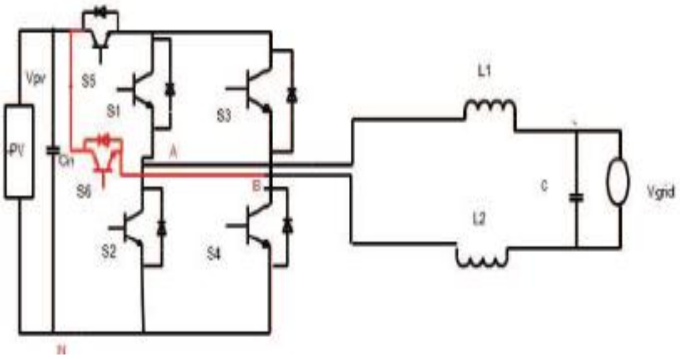

Fig 3. H6 Inverter

Modes of operation of H6 inverter

i. Active Mode : In active mode current passes through Switch S1, S4 and S5 and switches S3 and S6 remains OFF as shown in fig 3(a).

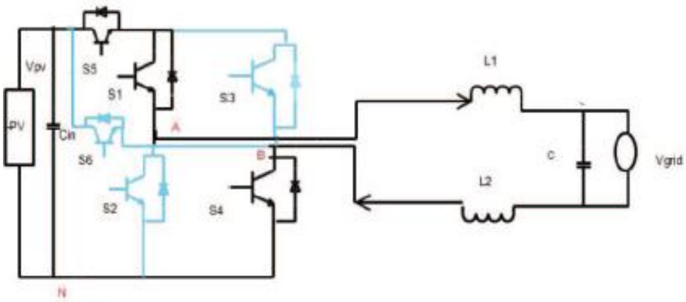

Fig. 3(a)

ii. Freewheeling mode : In this current passes through S1 and S3 and other all switches remains in OFF position as shown in fig 3(b).

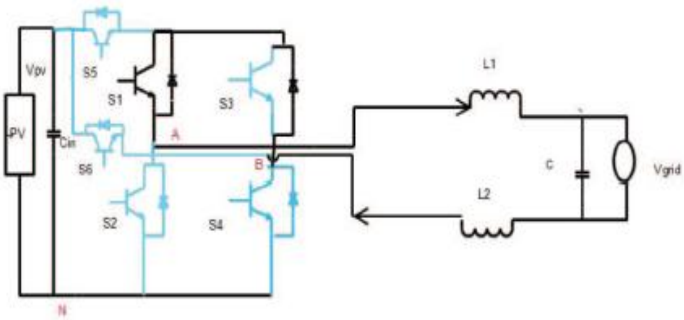

Fig. 3(b)

iii. Active mode : In this mode for negative half period current flows through switch S2, S3 and S6 and switches S4 and S1 remains OFF. In this mode three switches are turned ON, current flows through S3 and S6 hence conduction losses are reduced as shown in fig 3(c).

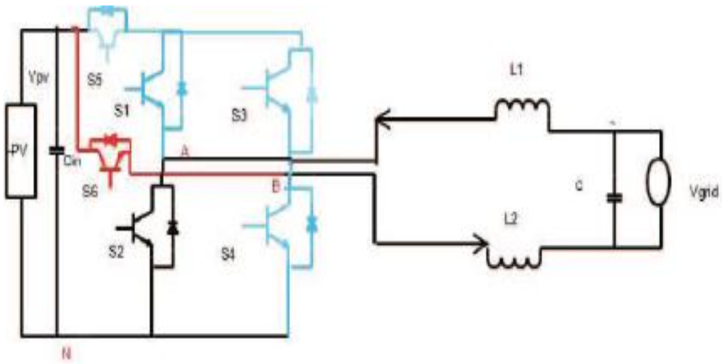

Fig. 3(c)

iv. Freewheeling mode : In this mode current passes through switches S3 and S1 and all other switches remains in OFF position as shown in fig 3(d).

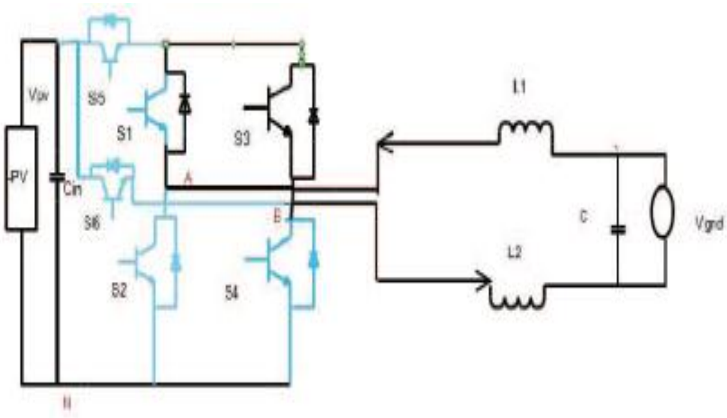

Fig. 3 (d)

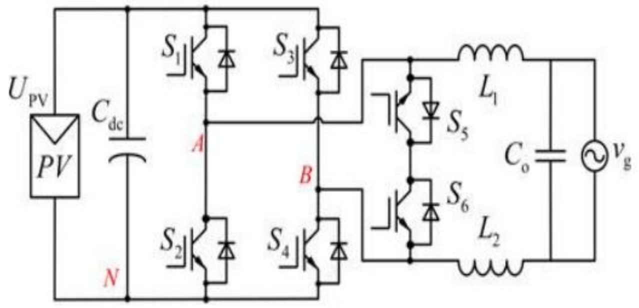

Fig 4. HERIC Inverter

In HERIC (High efficient and reliable inverter concept) inverter to create freewheeling path switches are added on the AC side[2][10].

Modes of operation of HERIC inverter

i. Active mode : In active mode current passes through switches S1, S4 and S6 as shown on fig 4(a).

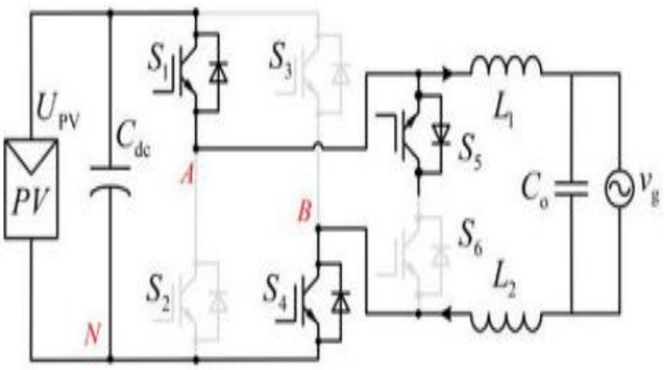

Fig 4(a)

ii. Freewheeling mode : In freewheeling mode Current Passes through S5 and D6 as shown in fig 4(b).

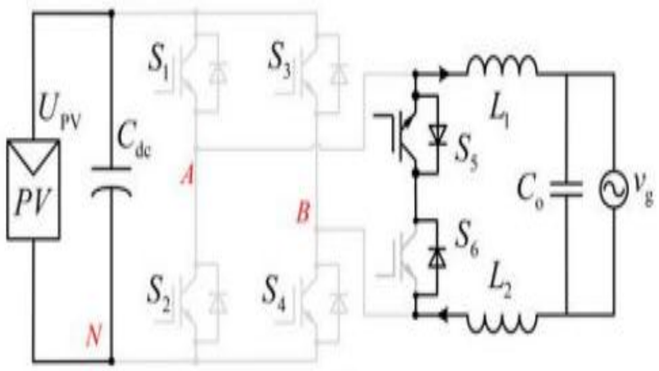

Fig. 4(b)

iii. Active mode : In active mode current passes through S2, S3 and S6 as shown in fig 4(c).

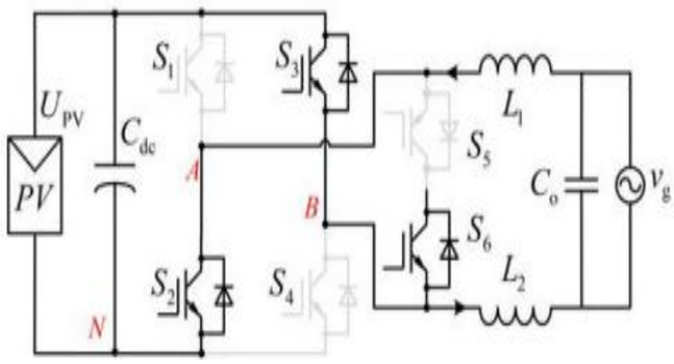

Fig. 4(c)

iv. Active mode : In this mode current flows through D5 and S6 as shown in fig 4(d).

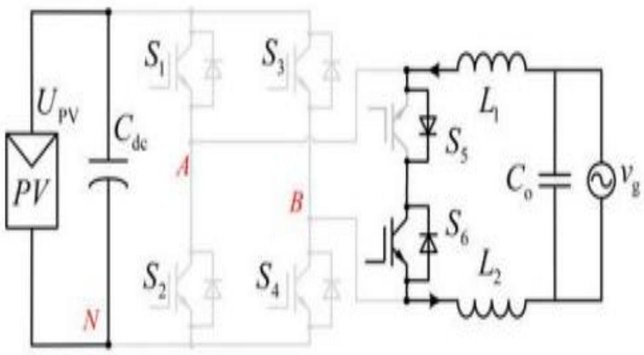

Fig. 4(d)

3. CONCLUSION

The performance of different topologies for transformer-less system are carried out on the basis of their efficiency, common mode voltage and leakage current.

	H5 Inverter	H6 Inverter	HERIC Inverter
Efficiency	High	High	High
Leakage Current	High	Very low	Very low
Common Mode Voltage	Floating	Constant	Floating

As from table 1 the conclusion is, compared to H5 and HERIC inverter topology, H6 inverter topology is more efficient , because it has very low leakage current, constant CM voltage and High efficiency.

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