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Study of Different Inverter Topologies

[1] Sneha M Chakre, [2] Diksha C Borkar, [3] Vaishali M Wankhede, [4] Resham P Tondare
Dept. of Electrical Engineering, KDK College of Engineering,Nagpur

***Abstract*: -- We know that nowadays inverters are in huge demand and various type of inverters are already available. This paper deals with different inverter topologies such as 1- ΦH-bridge inverter,3-Φ 3-leg inverter, 3- Φ 3-leg split capacitor inverter. DC power can be converted into AC power at desired output voltage and frequency using power electronics circuit known as an inverter. There are many topologies of inverter depending on the combination and orientation of switches. The different topologies of an inverter are provided to obtain the optimum output, reducing the losses and cost.**

I. INTRODUCTION

Power electronics devices provide a major role in the conversion and control of electric power. The conversion of DC power into ac power can be obtained by using power electronics circuit known as inverter(Inverters can be single phase or three phase).The AC power is mainly used for electric devices like lights , motors, RADAR and other industrial applications.In recent time,nearly all major industrial applications have begun to require high power, while some industrial applications requires low or medium power for their applications. By adopting a power source for all industrial loads might prove beneficial to some motors requiring high power but it can be damage other loads. Some medium voltage source electric drives and applications require medium voltage. The vast development in the semiconductor converter technology have allows the flexibility in all the applications .The desired output can be obtain by using converter and controlling strategy. The modern trend is to use different inverters for different applications according to its characteristics. According to the type of the dc source used, the dc source may be current or voltage. There are two types of inverter topologies such as current source inverter (CSI) and voltage source inverter (VSI). This inverters can be controlled by using power electronic switching devices as thyristors, IGBTs, transistors ,GTOs etc .The IGBT is the most advantages over other switching devices .As IGBT allows the high frequency switching operation for both low and medium voltage applications, there are many inverter topologies for single phase and three phase applications. The most basic inverter topologies are as 1- ΦH-bridge inverter,3-Φ 3-leg inverter, 3- Φ 3-leg split capacitor inverter.

INVERTER TOPOLOGIES

In this paper, three commonly used inverter topologies are discussed.

1.1- Φ H-bridge inverter

The inverter is mainly used to convert DC power into AC power. Inverters are the integral part of many technologies including induction heating, variable frequency drive and many more. All of these technologies use inverters to achieve various goals, but they all produce AC power from a DC input. There are many different types of inverter designs. The most common topology of inverter that are use here is referred to as H-bridge topology. The basic configuration of H-bridge is shown in fig.1

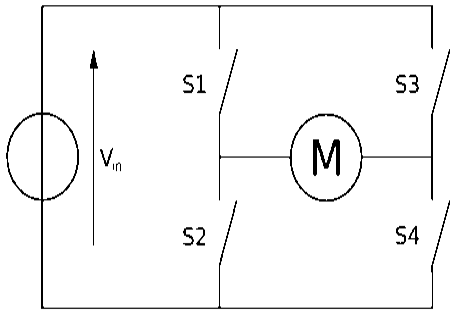

Fig.1 1- Φ H-bridge inverter

The term H-bridge is derived from the construction of such a circuit. An H-bridge is built with four switches. When the switches S1 and S4 are closed and S2 and S3 are open a positive voltage that will applied to the motor. Then S1 and S4 switches are open and S2 and S3 switches are closed and this voltage is reversed and it would results in reverse operation of the motor. The switches S1 and S2 should never be closed at the same time because it would result in short circuit on the input voltage source. The same would be applies to the switches S3 and S4.

Operation of 1-Φ H-bridge inverter

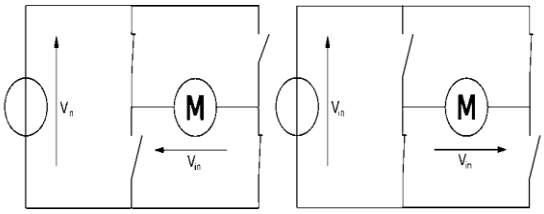

Fig.2 operation of 1-ΦH-bridge inverter

The arrangement of H-bridge is mostly used for reversing the polarity or direction of the motor and it can also be used to brake the motor from which the motor comes to a sudden stop

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when the terminals of the motor are shorted or let the meter 'free run' to a stop because effectively the motor is disconnected from the circuit. The table shown below summaries the operation of H-bridge with all the four switches from S1 to S4 corresponding to diagram above.

S1	S2	S3	S4	Result
1	0	0	1	Motor moves towards right
0	1	1	0	Motor moves toward left
0	0	0	0	Motor coasts
1	0	0	0	Motor coasts
0	1	0	0	Motor coasts
0	0	1	0	Motor coasts
0	0	0	1	Motor coasts
0	1	0	1	Motor brakes
1	0	1	0	Motor brakes
1	1	0	0	Short circuit
0	0	1	1	Short circuit
0	1	1	1	Short circuit
1	0	1	1	Short circuit
1	1	0	1	Short circuit
1	1	1	0	Short circuit
1	1	1	1	Short circuit

Table 1 operation of 1-ΦH-bridge inverter

2. 3-Φ 3-leg inverter

Three-phase three-leg inverter is one of the most popular topologies for inverters. When short-circuit fault occurs, the inverter is generally switched to the current-controlled mode from voltage-controlled mode to limit the fault currents. In this situation, the inverter becomes equivalent to a symmetric, three-phase, positive sequence current source. However, the voltage limiting may happen under asymmetrical fault

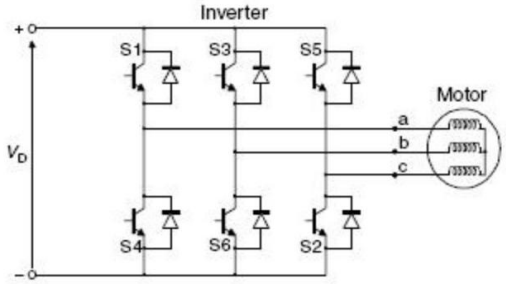

Fig. 2 3-Φ 3-leg inverter

Depending upon application 3- phase VSI contains six switches like IGBT, MOSFET, GTO etc. Here the feedback diodes, connected across the switches S1 to S6, will return back the stored energy from inductive load to the DC supply. Three phase VSI takes DC power as input and converts DC power into AC power if the proper gate signals are given to the switches. To make the input dc voltage constant sometimes a large capacitor is connected at the input terminals of the inverter which is also suppressing the harmonics fed back to the dc source. Operation of switches in 180° conduction modes is shown in table 2

Interval	Duration	Conducting Switches							
1	60°	S1	S2	S3					
2	60°		S2	S3	S4				
3	60°			S3	S4	S5			
4	60°				S4	S5	S6		
5	60°					S5	S6	S1	
6	60°						S6	S1	S2

Table 2 180° conduction mode operation

Operation of switches in 120° conduction modes is shown in table 3

Interval	Duration	Conducting Switches						
1	120°	S1	S2					
2	120°		S2	S3				
3	120°			S3	S4			
4	120°				S4	S5		
5	120°					S5	S6	
6	120°						S6	S1

Table 3 120° conduction mode operation

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3. 3-Φ 3-leg split capacitor inverter.

In this VSI topology the split dc capacitors are used and the capacitor is split up equally and voltages are Vc/2 & Vc/2. The split topology results in reducing the capacitor rating and better compensation performance

II. CONCLUSION

In this paper an overview of three-phase and single phase inverter topologies is given. The most interesting topologies are 1-Φ H-bridge inverter and 3-Φ 3-leg inverter due to their simple topology. These topologies provide a three-dimensional control which is interesting in active filtering applications .This inverters posses the advantage of generating output voltages with extremely low distortion. Nevertheless, inverter will play an important role in the future

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