DESIGN OF MULTILEVEL INVERTER FOR REDUCING TOTAL HARMONIC DISTORTION

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ABSTRACT: Multilevel inverter used for many kind of operation like reducing the total harmonic distortion, increase thevoltage level. Conventional two-level inverter is used to get AC output voltage waveform from DC voltage.A lot of harmonics is produced in the voltage output through this inverter. There are three different typesof topologies of Inverter are going to compare First is Diode Clamped/Neutral Point clamped multilevelinverter ,second is Flying Capacitors Multilevel Inverter and the last is Cascaded H-Bridge Multilevelinverter . Multi-level inverter which is based on cascaded H-bridge, producing a high power quality.summarily focuses on generating high level inverter output with optimal number of switches and THD asll as dv/dt across the switches.
Keywords: Multilevel Inverter Topology , Symmetrical Method , Asymmetrical Method.

I. INTRODUCTION

An inverter is an electronic device or equipment that gives alternating current (AC) from direct current (DC). We use power semiconductor devices to control, convert and condition electrical power output. Inverters comes in different sizes. They can be as small as 150 watts in power, or can be as large as 1 megawatt (10 lakh watt). Inverter can be entirely made up of electronic components or may be a combination of mechanical equipment (rotatory equipment) and electronic devices. Now a day, most of the inverters are static inverters and do not use any moving parts in the conversion procedure.

Types of inverter

Inverters are broadly classified into three types which are available in market according to their output waveform: square wave, modified -sine wave and pure sine wave. Off-the-shelf or stand-alone inverters are most of the time either square wave or modified-sine wave inverters. This is because they are less costly to manufacture and output delivered is the same average voltage to the load. Pure sine wave inverters give pure sine wave as the name suggest and offers more accuracy and gives less harmonics in their output waveform and deliver power with less power losses and less heat generation, as such they are appropriate for delicate electronic devices which rely on precise timing and delicate loads like computers etc. but, tend to be more complex in design and are most costly.

- Square wave Inverter
- Modified square wave Inverter
- Sinewave Inverters

II. MULTI LEVEL INVERTERS

Conventional two-level inverter is used to get AC output voltage waveform from DC voltage. It can only generate to different levels. A lot of harmonics is produced in the voltage output through this inverter. They are generally switched with PWM, but it also creates Electromagnetic Interference (EMI) that produces humming noise in radio communication, and high dv/dt across the switch. Also, switching losses of the switch increases which causes heating of the switch, produces hotspots and reduces lifespan of the switch.

1. Multilevel Inverter Topologies

- Diode Clamped/Neutral Point clamped multilevel Inverter
- Flying Capacitors Multilevel Inverter
- Cascaded H-Bridge Multilevel Inverter

Enhanced MLI Topology

Problem formulation: In this section, some problems are formulated while designing the multilevel inverter and to improve various characteristics like number of steps, voltage balancing, total harmonic distortion etc. and various challenges faced by existing and proposed techniques.

Research Motivation

Renewable energy has become gained much importance in the recent years and there is a lot of research and potential in renewable energy sources especially in solar panel and wind energy generation systems and their connectivity with grid. They are no longer operated as isolated and for low power applications but now they are grid connected and with increased proportion of electrical energy generation from them. The output of either renewable energy source is dependent on various factors and are uncontrolled and needs to be connected to grid and requires pure sine wave having very less total harmonic distortion, voltage imbalance and frequency mismatch. This thesis aims at design of multi-level inverter and applying various techniques and design to eliminate the harmonics. The selection of type of multilevel inverter and the topology used plays an important role in its performance. The main motive is to reduce cost of inverter for economic benefits and to make it affordable to be used in various places by reducing the number of switches used and the number of isolated DC sources required.

III. OBJECTIVES

To design an improved topology of inverter in MATLAB (Simulink) for reduced harmonics,To reduce the total number of voltage source required for operation AND To compare the performance of inverter in terms of total

harmonic distortion(THD), and voltage imbalance that occurs.

Asymmetrical Multilevel Inverter:-
A conventional H-bridge as shown in Fig 3.1 is having four power MOSFET switches (T1-T4) and can produce three different levels, which includes the zero, positive and negative levels of the applied voltage at the bridge input. The voltage VH across the terminals of the bridge input is having only positive voltage levels. By adding H-bridge in cascaded connection as depicted.

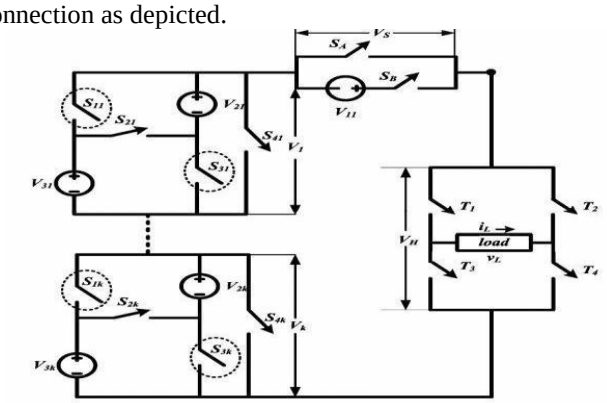

Fig :-1 Proposed cascaded multilevel inverter topology

when the MOSFETs (T1, T4) are ON, then the load voltage VL is equal to +VH. When the MOSFETs (T2, T3) are ON, then load voltage VL is equal to –VH. The zero voltage level is done by turning on either (T1, T2) or (T3, T4). To validate the theoretical analysis of proposed MLI, a simulation is carried out in MATLAB/SIMULINK software tool.

IV. RESULTS AND DISCUSSION

MATLAB simulation of 15 level Asymmetrical Multilevel Inverter

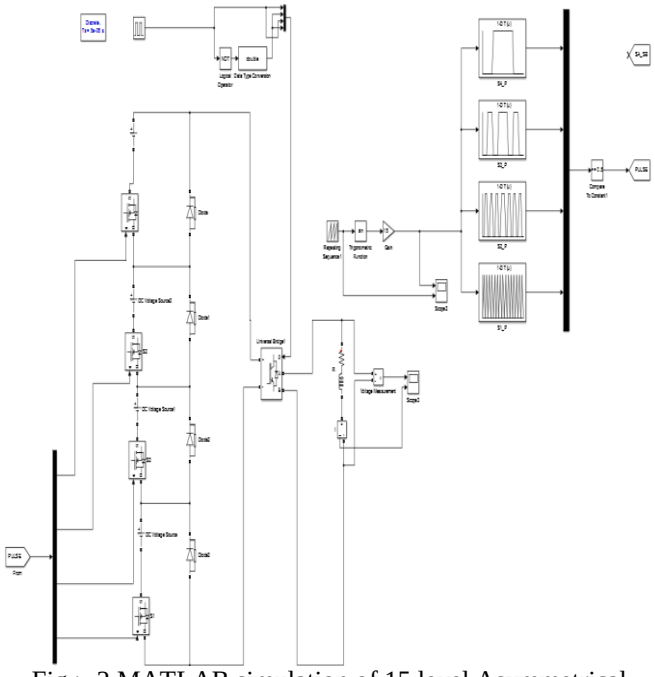

Fig :- 2 MATLAB simulation of 15 level Asymmetrical Multilevel Inverter

Waveform of 15 Level Asymmetrical Multilevel Inverter

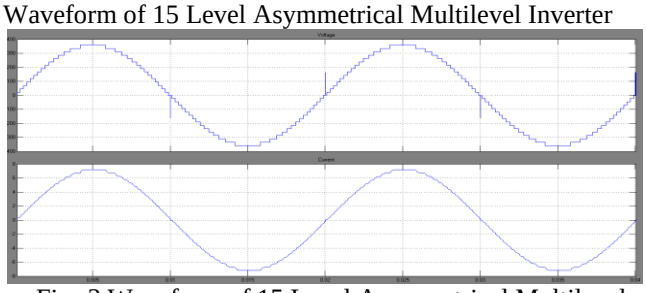

Fig:-3 Waveform of 15 Level Asymmetrical Multilevel Inverter

THD of 15 Level Asymmetrical Multilevel Inverter

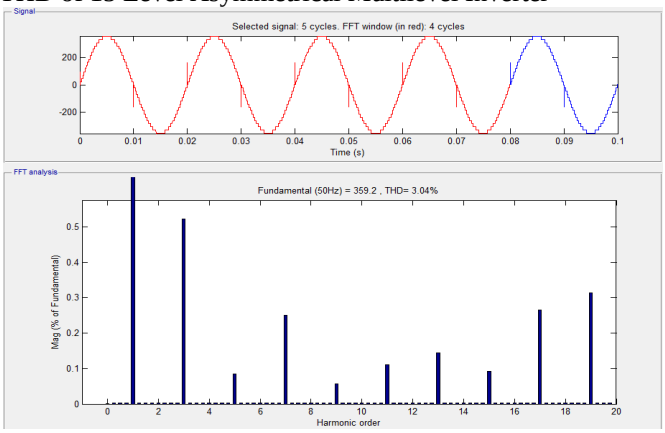

Fig :- 4 THD of 15 Level Asymmetrical Multilevel Inverter

MATLAB Simulation of 31 level Asymmetrical Multilevel Inverter

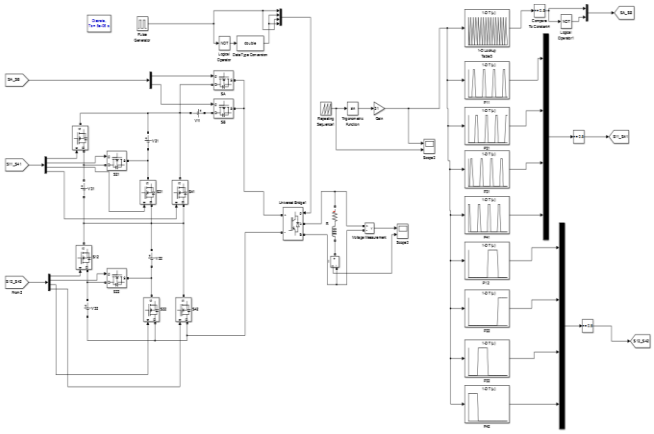

Fig:- 5 MATLAB Simulation of 31 level Asymmetrical Multilevel Inverter

Waveform of 31 level Asymmetrical Multilevel Inverter

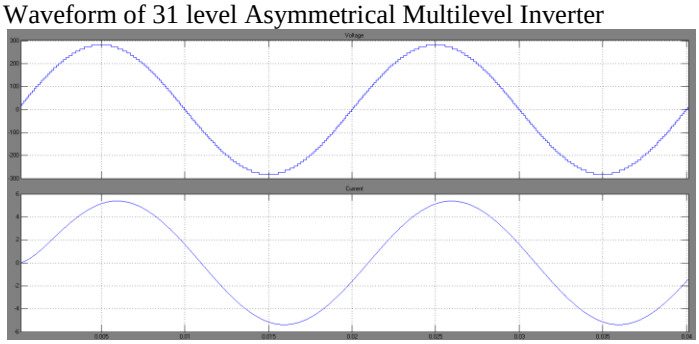

Fig:- 6 Waveform of 31 level Asymmetrical Multilevel Inverter

THD of 31 level Asymmetrical Multilevel Inverter

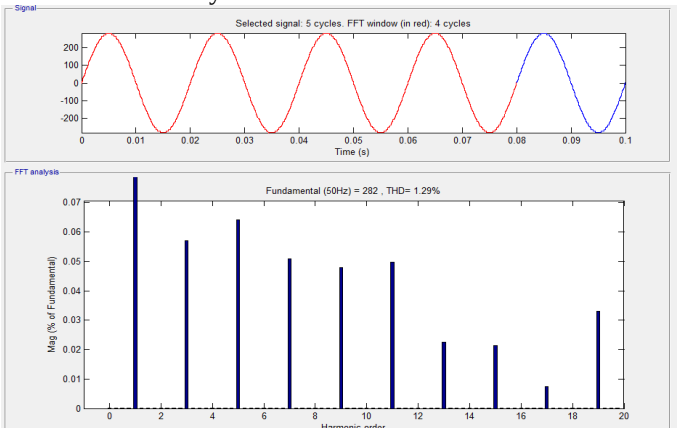

Fig :- 7THD of 31 Level Asymmetrical Multilevel Inverter

V. CONCLUSION

This is aimed at designing a multilevel inverter with reduction of switches as well as sources. It aims at controlling EMI (electromagnetic interference), reduces voltage stress and dv/dt across the switches and also reducing the THD drastically. This configuration can be compared with three types of multilevel inverter and this type is more suited for medium and high power applications.As we are increasing the level of inverter the harmonics will more be reduced and it is aimed that in nearest future a multilevel inverter.

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