DUAL OUTPUT INVERTERS FOR AC LOADS

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ABSTRACT

BACKGROUND
To achieve two single phase AC loads with one inverter, it is desirable to minimise the number of semiconductor switches. Using a three-switch leg structure, two types of dual leg and single leg topologies are developed, which respectively are functionally comparable to two full bridge and half bridge inverters working independently, though with a less number of semiconductor switches. This paper analyses the output waveform properties of six switch and three switch structures via simulation and hardware.

KEYWORDS
Converter Control, Three Leg Converter and Switches.


BACKGROUND
The utilisation of independently supplying a number of AC loads in several applications is using separate inverters for each of them. This may lead to increase in system cost, size and weight. The conventional reduced switch count system consist of single phase three legs, four legs and six legs converter, respectively. Dual-terminal reduced switch count topologies be employed as dual-output inverters to independently supply two AC loads. The reduced switch count inverter uses six switches, three switches per leg, the middle switches share the common rows for both of them and two single phase loads connected to the joints between the switches. The dual leg structure can be considered as two full bridge inverters. Another approach of the six switch inverter is replacing a leg of three switch into a series combination of capacitors, so as to further economise the inverter cost by reducing the number of power switches. The single leg topology, which uses only three semiconductor switches for independently supplying two single phase loads is structurally comparable to two half bridge inverters with a common of switch and capacitor.

A. Objective
The design of this method using three-switch leg structure, which effectively minimises switch count with reduced cost and improved efficiency for multi-drive system.

B. Motivation
To fulfill the growing demand for independently supplying a number of AC loads in several applications, needs separate inverters for each system. But, the main disadvantage of these system is that this may lead to undesirable increase in system cost, size and weight. The conventional reduced switch count system consist of single phase three legs, four legs and six legs converter, respectively. Thus, to overcome the above drawback, our paper uses reduced switch topology three switch and six switch topology. There is a growing trend in power electronics for reduced switch count power converters with the aim of sustaining high power quality and enhancing the system reliability.

C. Block Diagram

Figure 1. Shows the Block Diagram of Three Switch Leg Inverter

Figure 1 shows the block diagram of three switch leg inverter. It consists of DC source, which gives the supply to the three switch leg inverter, the microcontroller generates the PWM pulses to the driver circuit to control the gates of the MOSFET switches and gives the AC supply to the load.

Proposed a current controlled VSI-PWM rectifier and inverter with capacitor DC link is regarded as one most promising structures for three-phase to three-phase conversion. The type of converter normally requires twelve switches for a rectifier and inverter composed of self-turnoff switch such as bipolar transistor or IGBT with an antiparallel diode. In this paper, a new three-phase to three-phase converter for AC motor drives is proposed. The proposed converter employs only eight switches and has a capability of delivering sinusoidal input currents with unity power factor and bidirectional power flow. This paper describes the feasibility and the operational limitations of the proposed structure. A mathematical model of the system is derived using generalised modulation theory and experimental results for steady state and dynamic behaviour are presented to verify the developed model.

Financial or Other, Competing Interest: None.
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DOI: 10.14260/jtasr/2016/33
Circuit Diagram

A. Circuit Diagram for Six Switch Inverter

![Image of Circuit Diagram for Six Switch Inverter]

**Figure 2. Shows the Circuit Diagram of Six Switch Inverter**

It consists of two three-switch legs and two single phase loads connected to the joints between the switches. The dual leg structure can be considered as two full-bridge inverters, which share a row of switches (the middle switches of the proposed structure). Consequently, the proposed configuration reduces the number of switches by 25%. The two output voltages is similar to single-phase full bridge inverter. Compared to two-switch leg, which creates four possible switching states of which two are acceptable to avoid DC bus short circuit and floating of the loads, only the three switching states of Table 1 are acceptable.

<table>
<thead>
<tr>
<th>Switching States</th>
<th>J1</th>
<th>J4</th>
<th>J5</th>
</tr>
</thead>
<tbody>
<tr>
<td>S1</td>
<td>ON</td>
<td>OFF</td>
<td>ON</td>
</tr>
<tr>
<td>S2</td>
<td>OFF</td>
<td>ON</td>
<td>ON</td>
</tr>
<tr>
<td>S3</td>
<td>ON</td>
<td>ON</td>
<td>OFF</td>
</tr>
</tbody>
</table>

*Table 1. Shows the Switching States of Six Switch Inverter*

B. Operation when the switches of the same row are OFF both outputs are in zero state. When the upper or lower switch rows are ON, the corresponding output is in zero state and the other is in active state and finally when the opposite switches of the two legs are OFF, both outputs are in active state. Middle switch gate signals are logical XOR of the upper and lower gate signals of the same leg.

C. Circuit Diagram for Three Switch Inverter

The proposed three-switch inverter is actually developed by replacing a leg of the six-switch inverter with a series combination of capacitors at the cost of losing zero output voltage state, so as to further economise the inverter cost by reducing the number of power switches. The single leg topology, which uses only three semiconductor switches for independently supplying two single phase loads is structurally comparable to two half-bridge inverters with a common row of switch and capacitor (middle row of the proposed structure).

**D. Operation**

Fig.3 shows, there is no zero state for neither of the outputs in this inverter. Moreover, the low level of an output voltage may not be negative of its high level and voltage levels of the upper and lower outputs may not be equal depending on the capacitor voltage levels. When the lower switch is OFF, both outputs are positive; when the upper switch is OFF, both outputs are negative. Middle switch gate signals are logical XOR of the upper and lower gate signals of the same leg.

**SIMULATION AND RESULT**

Simulation Circuit for Three Switch Inverter

![Image of Simulation Circuit for Three Switch Inverter]

**Figure 4. Shows the Output Waveform of Load 1**

**Figure 5. Output Waveform for Load 2**
A. Simulation Circuit for Three Switch Inverter

**Figure 6. Output Waveform for Load 1**

**Figure 7. Output Waveform for Load 2**

Here Both the Output Voltage of the Three Switch Inverter are Equal

C. Hardware Model

**The Hardware Consists of Power Supply Unit, Pic Microcontroller, MOSFET Driver Circuits and MOSFET Switches**

D. Hardware Output

**The Output Waveforms of the Two Single Phase Outputs are presented with R-Load**

HARDWARE IMPLEMENTATION

A. Introduction
The hardware model is implemented using six switch inverter to independently supplying two AC loads with one inverter.

B. Control Circuit

**Figure 8. Shows the Control Circuit of Six Switch Inverter**

RESULT ANALYSIS
Dual leg and single leg reduced switch count dual-output inverter topologies based on three-switch inverter leg were proposed in this paper with the aim of reducing cost, size and weight of the inverters. The performance of the system was analysed via simulation and hardware.

The scope for future work is to reduce the switch count in three phase inverter.

REFERENCES


