THD Comparison for 180, 120 & 150 Degree Conduction Mode of Three Phase Inverter

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Abstract— Device that converts dc input voltage to ac output voltage of desired magnitude and frequency is called inverter. Inverter can be classified into single phase inverter & three phase inverter. Inverters are widely used in industrial application such as uninterrupted power supply (UPS), flexible ac transmission system (FACTS) devices, variable frequency drives (VFD), active power filters, high voltage direct current transmission system, etc. So, the improvement in the output voltage & reduction in harmonic distortion is very important factor to be considered. A variable output voltage can be obtained by varying the gain of the inverter, which is normally accomplished by pulse width modulation control within the inverter.

Key words: Three Phase VSI, THD Comparison, MATLAB Simulation

I. INTRODUCTION

Basic construction of three phase voltage source inverter is shown in figure. They are normally used for high power applications. In order to get three phase output, three single phase inverters can be connected in parallel. The gating signal of the three single phase inverter should be advanced voltage. Three phase voltage source inverter contains six switches. Switch may be IGBT, MOSFET, GTO, etc. depending upon the application, the diodes are connected across the s1 to s6 switches are the feedback diodes. These diodes will return back the stored energy from the inductive load to the dc supply. If the proper gate signals are given to the switches. This capacitor also suppressed the harmonic fed back to the dc source.

II. DESIGN OF AN INVERTER SWITCHING TOPOLOGY IN MATLAB

In the all industrial application variable frequency & voltage require for different application. Three phase full bridge inverter is more popular than any other inverter topology. There are six switches connected in a bridge form which provider three legs. Each leg generate single phase. Upper switch provide positive voltage & lower switch provide negative voltage. The output of inverter is six pulse because conduction of switches change in a six different steps.
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<table>
<thead>
<tr>
<th>Srno.</th>
<th>Conduction of states</th>
<th>Conduction switches</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0 to 60</td>
<td>S1 S5 S6</td>
</tr>
<tr>
<td>2</td>
<td>60 to 120</td>
<td>S1 S2 S6</td>
</tr>
<tr>
<td>3</td>
<td>120 to 180</td>
<td>S1 S2 S3</td>
</tr>
<tr>
<td>4</td>
<td>180 to 240</td>
<td>S2 S3 S4</td>
</tr>
<tr>
<td>5</td>
<td>240 to 300</td>
<td>S3 S4 S5</td>
</tr>
<tr>
<td>6</td>
<td>300 to 360</td>
<td>S4 S5 S6</td>
</tr>
</tbody>
</table>

Table 3: Conduction of Different States & Switches in 150 Degree Conduction Mode of Inverter

In 150 degree conduction mode of inverter, a 30 degree dead time period is provided between two switches which is large enough to avoid short circuit on dc supply. It eliminates lower order harmonics to a larger extent.

III. RESULTS

A. 180 degree conduction mode of inverter with R (R=5 Ω) Load:

B. 120 degree conduction mode of inverter with R (R=5 Ω) Load:

Fig. 3: Waveform for Input Voltage, Output Voltage & Output Current for R – Load

Fig. 4: THD Result of Voltage in R – PHASE

Fig. 5: THD Result of Current in R – PHASE

Fig. 6: Waveform for Input Voltage, Output Voltage & Output Current for R - Load

Fig. 7: THD Result of Voltage in R - PHASE
THD Comparison for 180, 120 & 150 Degree Conduction Mode of Three Phase Inverter

C. 150 Degree Conduction Mode of Inverter with \( R(R=5 \Omega) \) Load:

D. 180 Degree Conduction Mode of Inverter with RL \( (R=5 \Omega \text{ & } L=0.1 \text{ mH}) \) Load:

Fig. 8: THD Result of Current in R - PHASE

Fig. 9: Waveform for Input Voltage, Output Voltage & Output Current for R - Load

Fig. 10: THD Result of Voltage in R - PHASE

Fig. 11: THD Result of Current in R - PHASE

Fig. 12: Waveform for Input Voltage, Output Voltage & Output Current for RL - Load

Fig. 13: THD Result of Voltage in R - PHASE
Fig. 14: THD Result of Current in R - PHASE

E. 120 Degree Conduction Mode of Inverter with RL (R=5 Ω & L=0.1 mH) Load:

Fig. 15: Waveform for Input Voltage, Output Voltage & Output Current for RL - Load

Fig. 16: THD Result of Voltage in R - PHASE

Fig. 17: THD Result of Current in R - PHASE

F. 150 Degree Conduction Mode of Inverter with RL (R=5 Ω & L=0.1 mH) Load:

Fig. 18: Waveform for Input Voltage, Output Voltage & Output Current for RL - Load

Fig. 19: THD Result of Voltage in R - PHASE
THD Comparison of 180, 120 & 150 Degree Conduction Mode of Three Phase Inverter

THD comparison of 180, 120 & 150 degree conduction mode of three phase inverter for R and RL load is shown in below table.

<table>
<thead>
<tr>
<th>Sr no.</th>
<th>Degree of conduction for current &amp; voltage</th>
<th>THD for R load</th>
<th>THD for RL load</th>
</tr>
</thead>
<tbody>
<tr>
<td>(1)</td>
<td>180 degree for current in R-Phase</td>
<td>21.08%</td>
<td>30.68%</td>
</tr>
<tr>
<td>(2)</td>
<td>180 degree for voltage in R-Phase</td>
<td>21.08%</td>
<td>30.42%</td>
</tr>
<tr>
<td>(3)</td>
<td>120 degree for current in R-Phase</td>
<td>24.73%</td>
<td>31.87%</td>
</tr>
<tr>
<td>(4)</td>
<td>120 degree for voltage in R-Phase</td>
<td>24.73%</td>
<td>31.09%</td>
</tr>
<tr>
<td>(5)</td>
<td>150 degree for current in R-Phase</td>
<td>7.40%</td>
<td>17.19%</td>
</tr>
<tr>
<td>(6)</td>
<td>150 degree for voltage in R-Phase</td>
<td>7.40%</td>
<td>17.06%</td>
</tr>
</tbody>
</table>

Table 4: THD Comparison Table for R & RL Load

V. CONCLUSION

From the above analysis it is concluded that THD for 150 degree conduction mode of inverter is less i.e. 7.40% for R - LOAD & 17.19% for RL - LOAD compare to 180 & 120 degree conduction mode of inverter, because it eliminates lower order harmonics to a larger extent. Also there is a 30 degree dead time period is provided between two switches which is large enough to avoid short circuit on dc supply.

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