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L Z SOURCE INVERTER WITH CLOSED LOOP CONTROL SYSTEM

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ABSTRACT

This paper proposes closed loop of LZ source inverter. This inverter has three diode and two inductors in the main circuit. It boosts up the input DC voltage. The traditional inverters have capacitors in the main circuit which lead to many problems such as resonance produced in the circuit, voltage surge which can damage the devices, large volume, more cost, and reduced life span of the system. This inverter does not have capacitor in the main circuit and therefore eliminates the problems present in traditional inverters. But in industrial applications the control of output voltage becomes a difficult factor. The sudden voltage change creates many problems such as instability in the system, damage to devices etc. The voltage control is an important factor for stable operation of the system in real time. It can be achieved using the closed loop control of L Z source inverter.

Keywords: voltage, PI controller, LZ inverter, load change.

1. INTRODUCTION

In the open loop system the voltage in the system change at different levels due to variation in the load. This can lead to many problems such as damage of components in the system and interruption in the operation of the system. The cost of the system is also high due to high cost of devices. It again decreases the efficiency of the whole system. So it becomes a necessity to maintain the voltage in the system. In industrial applications the stability and reliability of the system is very important. These problems are overcome using the closed loop control. The closed loop system maintains the voltage at constant level which improves the system reliably and protects the device from sudden voltage changes produced in the system due to load variations. This paper shows the problems that are existing with open loop and how it is overcome using the closed loop control.

2. OPERATION

In the closed loop control the output voltage is controlled to maintain a constant output voltage. In this technique the output voltage is fed back as input to the PI controller. The PI controller is control loop feedback mechanism used in industrial control system. The output voltage and reference voltage are compared to get the difference. The PI controller then creates the corrected signal and sends it to the PWM generator. The pulse width modulation generator produces the corrected pulse width signals and it fed to the gate of the switches. The pulses with fixed frequency and magnitude but with variable pulse width are produced by the pulse width generator. The pulse width signals turn on and turn off the switches for required interval. The pair of conduction of switches keeps changing at regular intervals. At any time one switch from upper leg and one switch from lower leg are turned ON. The conduction of specific switch is based on the maximum width of the pulse. The three phase inverter then converts the DC voltage to AC voltage based on the triggering pulses given by pulse width modulation generator. The fig1 shows the open loop system.

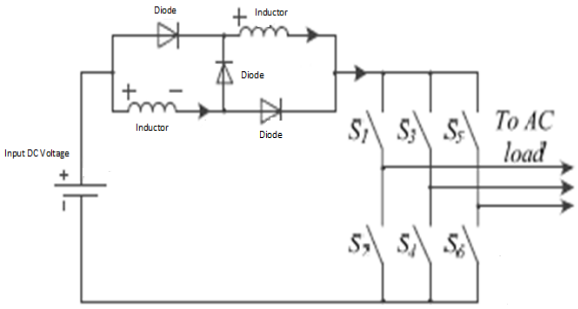

Figure-1. Open loop system.

Figure-2 shows the closed loop system.

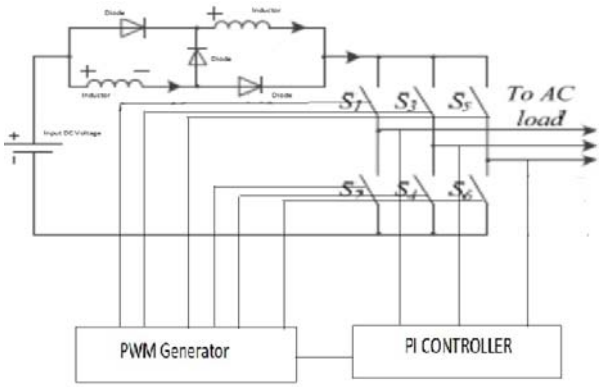

Figure-2. Closed loop system.

3. BLOCK DIAGRAM

The input DC voltage is applied to main circuit. The main circuit produces the amplified DC voltage at the output. The amplified DC voltage is then fed as input to the three phase inverter. The switches in the three phase inverter are triggered by the pulses that are generator by the PWM generator. The three phase inverter converts the DC voltage to the output AC voltage. The output AC voltage is then fed as input to the load. The block diagram of open loop system is shown in Figure-3.

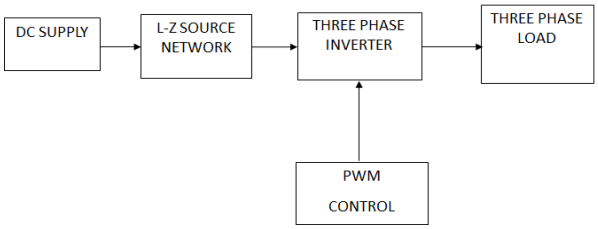

Figure-3. Existing system block diagram.

Similar to the open loop system the input DC voltage is amplified using the main circuit and three phase inverter converters the DC voltage to AC voltage. Additionally, the output voltage is fed back to PI controller where it is compared with the reference signal to produce the error signal if there are any differences. The obtained signal is sent to PWM generator which then creates pulse width of required width and triggers the switches present in the three phase inverter such that the output voltage is maintained at constant level. The block diagram of closed loop control system is shown in Figure-4.

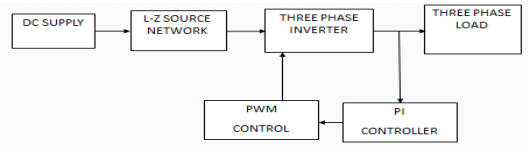

Figure-4. Proposed closed loop diagram.

4. OPERATION MODES

The operating modes of the system are explained below.

Mode 1: Non-Shoot through state

In this mode the diodes in the upper and lower arm are in off state and the diode in the middle arm of the circuit is conducting. So the inductors in the upper and lower arm are connected in series. In this state the inductors transfer the energy from the input source to the output load. The circuit diagram is shown in Figure-5.

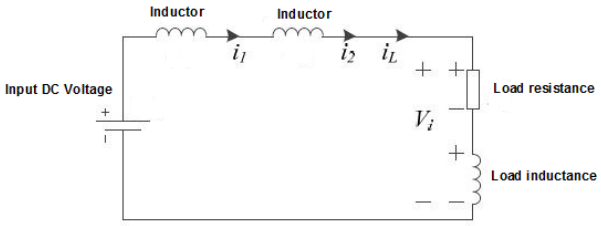

Figure-5. Non Shoot through mode.

Mode 2: Shoot through state

In this mode the diodes in the upper and lower arm are conducting and the diode in the middle arm circuit is in off state. The three phase inverter side is shorted by the upper and lower switching devices. So the inductors in the upper and lower arm are connected in parallel and inductors stores energy in this mode. The circuit diagram is shown in Figure-6.

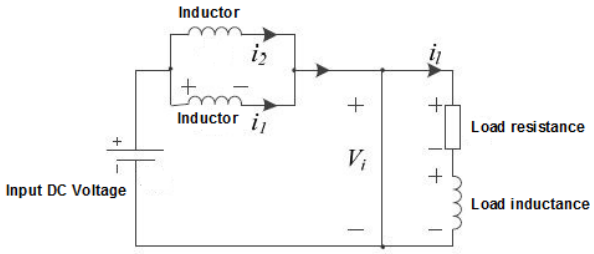

Figure-6. Shoot through mode.

5. SIMULATION RESULTS OF EXISTING OPEN LOOP SYSTEM

The simulation of existing and proposed system has been carried out using the MATLAB simulink tool. The simulation of the existing system shows the problems present in the existing system. The simulation diagram is shown in Figure-7.

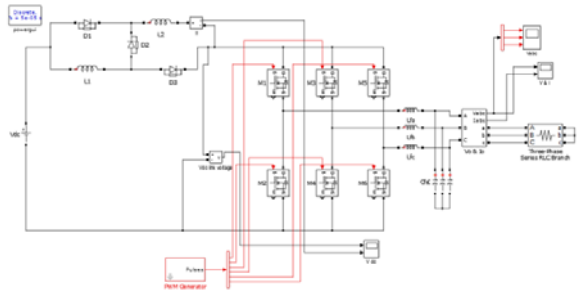

Figure-7. Existing open loop system.

The simulation results of existing system are shown below. When the input DC voltage is 48 V and the

output resistive load is 100 ohm. It is found that output voltage at the load is 180V. The output voltage waveform is shown in Figure-8.

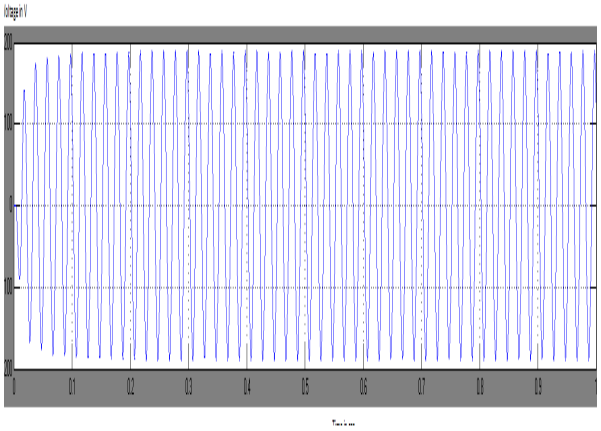

Figure-8. Output voltage at input voltage 48V and load resistance 100ohm.

When the input DC voltage is 48V and the load is changed to 50ohm from 100 ohm. It is found that the output voltage at the load is 120V. The output voltage is shown in Figure-9.

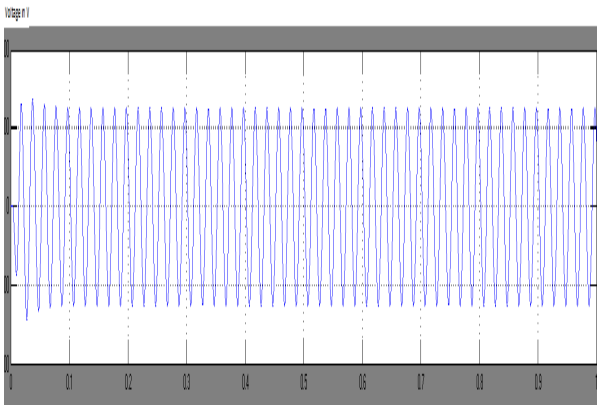

Figure-9. Output voltage at input voltage 48V and load resistance 50ohm.

6. SIMULATION RESULTS OF MODIFIED CLOSED LOOP SYSTEM

The simulation of existing and proposed system has been carried out using the MATLAB simulink tool. The simulation of the proposed system shows how those problems in closed loop system are overcome.The simuilink diagram of proposed closed loop system is shown in Figure-10.

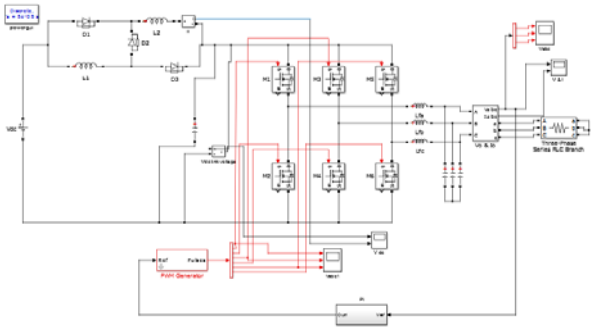

Figure-10. Proposed closed loop system.

The simulation result of the closed loop system is shown below. When the input DC voltage is 48 V and the output resistive load is 100 ohm. The output voltage at the load is 100V. The output voltage is shown in Figure-11.

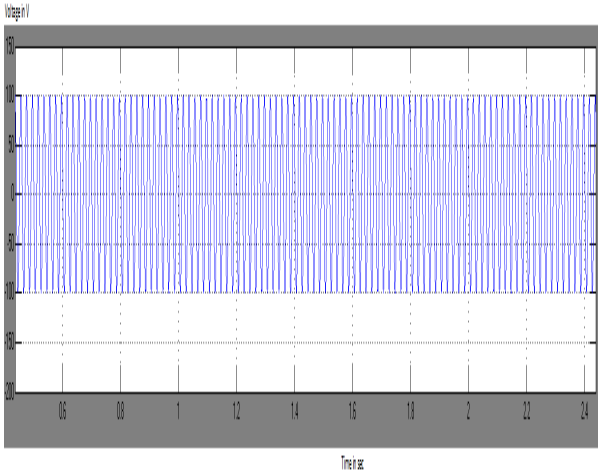

Figure-11. Output voltage waveform at input voltage 48V and load resistance 100ohm.

When the input DC voltage is 48V the load is changed to 50ohm from 100 ohm. The output voltage at the load is maintained at 100V. The output voltage is shown in Figure-12.

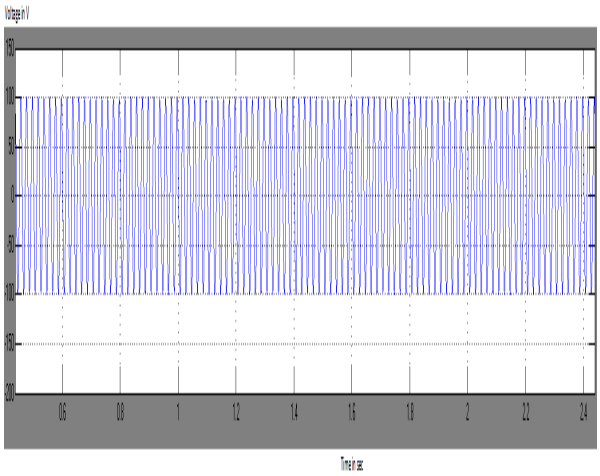

Figure-12. Output voltage waveform at input voltage 48V and load resistance 50ohm.

In the open loop system when the load resistance is changed from 100 ohm to 50 ohm the output voltage also varies suddenly in the system. It creates many problems in the system and disturbs the stability in the system.

When the load is changed from 100 ohm to 50 ohm in the closed loop system it is shown that the output voltage is maintained at constant level. Thereby improving the reliability, life span of the system. It decreases the cost of the system by fixing the rating of the components. It provides the uninterrupted supply stability and thereby increases the efficiency of the system. The results of open and closed loop are shown in Table 1 and 2.

Table-1. Specifications.

Existing open loop system		
Parameters	**Result I**	**Result II**
Input DC voltage	48	48
Load resistance	100	50
Output voltage	180	120

Table-2. Specifications.

Modified closed loop system		
Parameters	**Result I**	**Result II**
Input DC voltage	48	48
Load resistance	100	50
Output voltage	100	100

7. CONCLUSIONS

This paper has presented the closed loop system for L Z source inverter. The simulation of open loop control and closed loop control are simulated using the MATLAB SIMULINK. The simulation results with open loop control system shows that in real time applications when the load undergoes a sudden change then the voltage in the system also varies at unpredicted level. In industrial applications this lead too many problems such as interruption of supply, damage to the system devices, reduced efficiency etc. The simulation of the inverter with closed loop control system is also been carried using the MATLAB SIMULINK tool. The closed loop simulation proves that the problems with open loop system are completely eliminated in closed loop system. The closed loop system improves the stability and reliability of the system. The closed loop system is suitable for industrial applications.

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