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Simulink Model of Solar Operated EZ -Source Inverter

A.Yadunanda Kumar[1], M.Suneel Kumar[2]

Assistant Professor, Dept. of EEE, Brahmaiah College of Engineering, Nellore, Andhrapradesh, India[1]

PG Student [PE], Dept. of EEE, Brahmaiah College of Engineering, Nellore, Andhrapradesh, India[2]

ABSTRACT: Z-Source inverters are used mainly for buck-boost energy conversion with the help of passive elements. In Z-source inverter topology, LC impedance network is used to couples the source and the inverter to achieve voltage boost and inversion. Embedded EZ-Source inverter and Z-Source inverter can produce the same gain. Input to the Embedded EZ-Source inverter can be obtained from solar cell. The ripple content in the output voltage of solar cell is filtered and pure DC is given to the three-phase inverter which converts DC in to three-phase balanced AC. The output of the Embedded EZ Source inverter is used to control the harmonics present in the load. The limitations of the conventional Z-source inverter can be overcome by using Embedded Z-source inverters. It can produce smoother current and increase voltage level across the Z-source and it has low harmonic distortions (THD). Simulations are carried out using MATLAB-SIMULINK. Hardware implementation and Microcontroller programming can be done in the lab.

KEYWORDS: EZ-source inverters, voltage boost, Z-Source inverter and Pulse Width Modulation (PWM), Total Harmonic Distortion (THD).

I.INTRODUCTION

For system design of EZ-Source inverter two PV panels are required. These PV panels work as a dc source which embedded within LC impedance network. The two DC source generate varying DC voltages whose values are depend on atmospheric conditions Voltage and current filtering can be done by using LC components

II. Z-SOURCE INVERTER

Traditionally there exist two types of inverters namely Voltage Source Inverter, Current Source Inverter [10]. Voltage source inverter is a buck (step-down) inverter for dc-to-ac power conversion and the voltage source converter is a boost (step-up) rectifier for ac-to-dc power conversion [6] [10]. Current source inverter is a boost inverter for dc-to-ac power conversion and

a buck rectifier (or buck converter) for ac-to-dc power conversion [6] [10]. Both the V-source converter and the I-source converter have the common problem that they can operate either a boost or buck converters and cannot be a buck–boost converter.

The limitations of the traditional voltage source and current source converters can be eliminated by introducing Z-source inverter [6]. Z-Source inverter utilize LC impedance network which performs both buck-boost energy conversions [1] [2] [4]. It can be used in implementing dc-to-ac, ac-to-dc, ac-to-ac, and dc-to-dc power conversion. The Z-source network boosts the input voltage level for inverter and also provides filtered output. Thus this technique improves efficiency of inverter.

and non shoot-through states, expressed by (1) and (4) with a balanced network assumed ($L1 = L2 = L$ and $C1 = C2 = C$). These equations are used to derive the gain of inverter.

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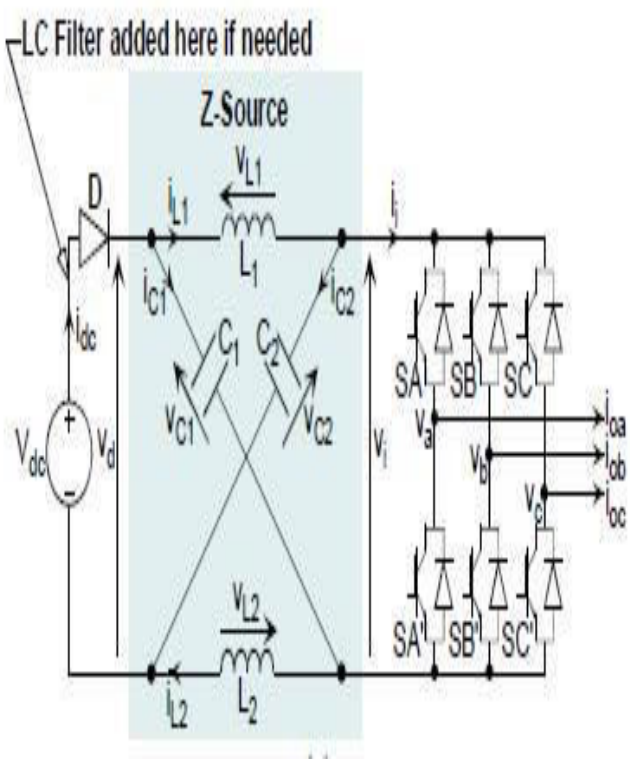

Fig-1: Z-source inverter

Conditions of Shoot-Through state:

(Sx = Sx1 = ON, x = A, B, or C; D = OFF)

vL =VC; vi = 0; vd = 2VC; vD = Vdc − 2VC---- (1)
iL = − Ic; ii = iL − iC; idc = 0---- (2)

Conditions of Non Shoot-Through state:

(Sx ≠Sx1, x = A, B, or C; D = ON)
vL =Vdc − VC ;vi = 2VC – Vdc; vd = Vdc; vD = 0 ---(3)

idc =iL + iC; ii = iL – iC; idc ≠ 0--- (4)

The following expressions are for VC capacitive voltage, peak dc-link voltage ˆvi, and peak ac output voltage vx.

VC =(1 − T0/T)/(1 − 2T0/T) *Vdc-----(5)

ˆvi = Vdc / (1 − 2T0/T)= BVdc------(6)

vx =M vi/2= B(M Vdc/2)------(7)

where T0/T denotes the shoot-through ratio (T0/T < 0.5) per switching period, M is the modulation index used for traditional inverter control, and B is boost factor given by expression B = 1/(1 − 2T0/T).

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III. EMBEDDED Z-SOURCE INVERTER

Fig.2. shows the circuit of Embedded EZ-Source inverter. It consist L1 and L2 inductive elements and C1 and C2 capacitive elements which forms LC impedance network.

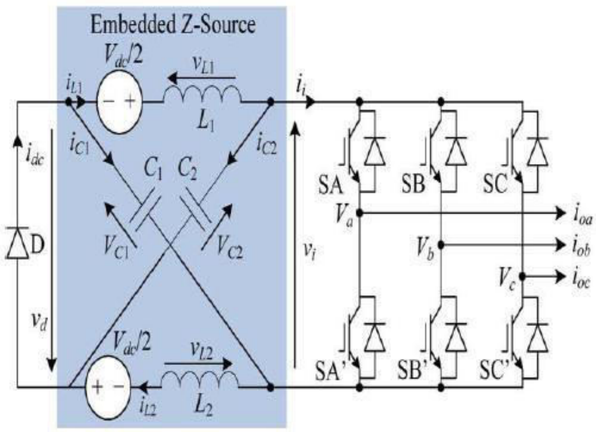


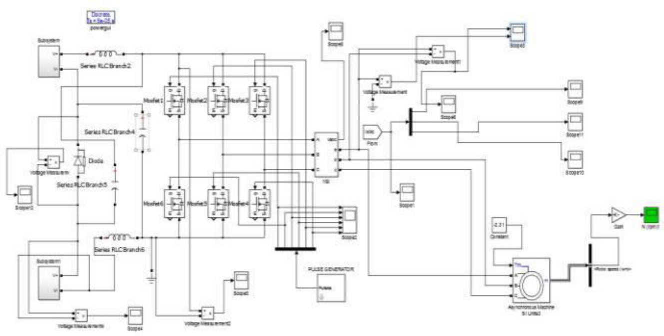
Fig-2: EZ-source inverter

Two DC sources embedded within the X-shaped LC impedance network. In the case of voltage type EZ-source inverter inductive elements L1 and L2 used for filtering the currents and in case of current type EZ-source inverters capacitive elements C1 and C2 used for voltage filtering in current type EZ-source inverters keeping the voltage or current gain of the inverter constant. The input DC can be taken from the solar cell given to the Z-source. The filtered, ripple free, pure DC given to the three phase inverter which converts pure DC into three phase balanced AC.

IV. EXPERIMENTAL RESULTS

The simulation of proposed system is done in MATLAB SIMULINK. The output voltage from two DC sources fed to the Z filter of Embedded EZ-Source Inverter. The filtered DC output from Z filter is given to the Embedded EZ-Source Inverter which converts pure DC into three phase balanced AC.

The simulation circuit diagram of Embedded EZ-Source inverter is shown in fig.3. The triggering pulses for switches of Embedded EZ-Source inverter is shown in fig.4.



The line current waveform is shown in fig.5, fig.6 and fig.7 Fig-3: Simulation circuit diagram represents line voltage waveforms. The output from the Embedded EZ-Source Inverter is given to the induction motor which is asynchronous machine. Three phase induction motor is taken as a load. Fig.8 shows the plot of rotor speed of induction motor with respect to time. It represents the speed of induction motor increases and settles down above 1600 RPM (Revolution per

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minute). For calculation of total harmonic distortion FFT analysis for current of the system is taken. It shows that THD value is 3.93% shows in fig.9. Thus total harmonic distortion is low in Embedded EZ-Source inverter system.

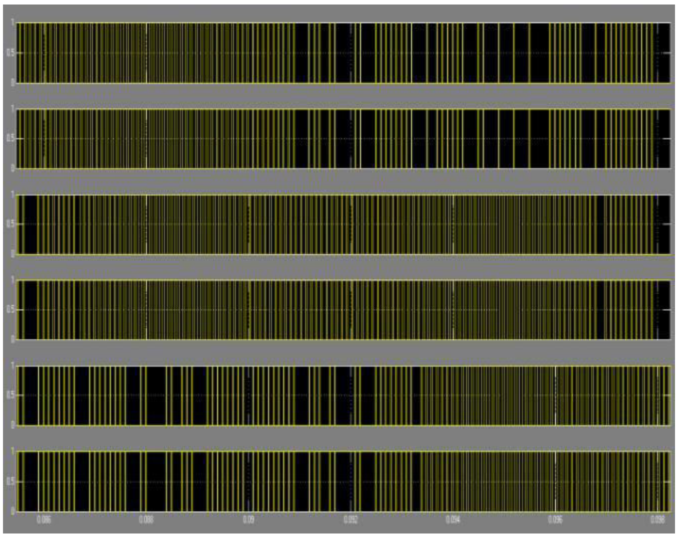
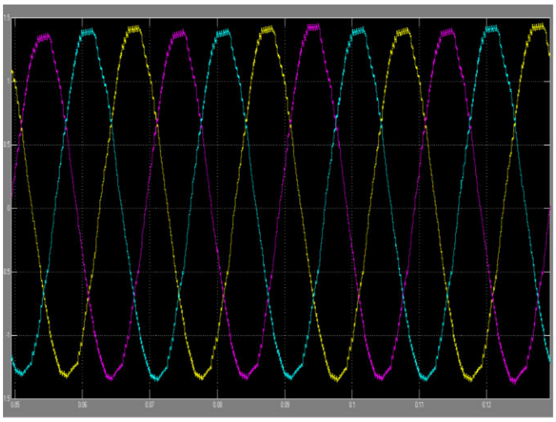


Fig-4: Triggering pulses



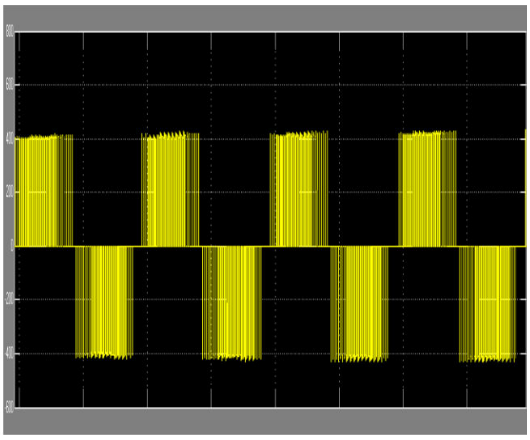


Fig-5: Line current waveform

Fig-6: Phase to Phase voltage

V. CONCLUSION

The simulation of EZ-Source inverter system is carried out in MATLAB SIMULINK software. From the experimental results are presented in this paper, we observed that the given system provides voltage boosting and current filtering using impedance network also it has advantages of reduced harmonic distortions of about 3.93%. Its hardware implementation has been done and results are obtained by using PV panels at input and motor load at the output. Thus EZ-source inverter has great advantages over current source and voltage source inverters.

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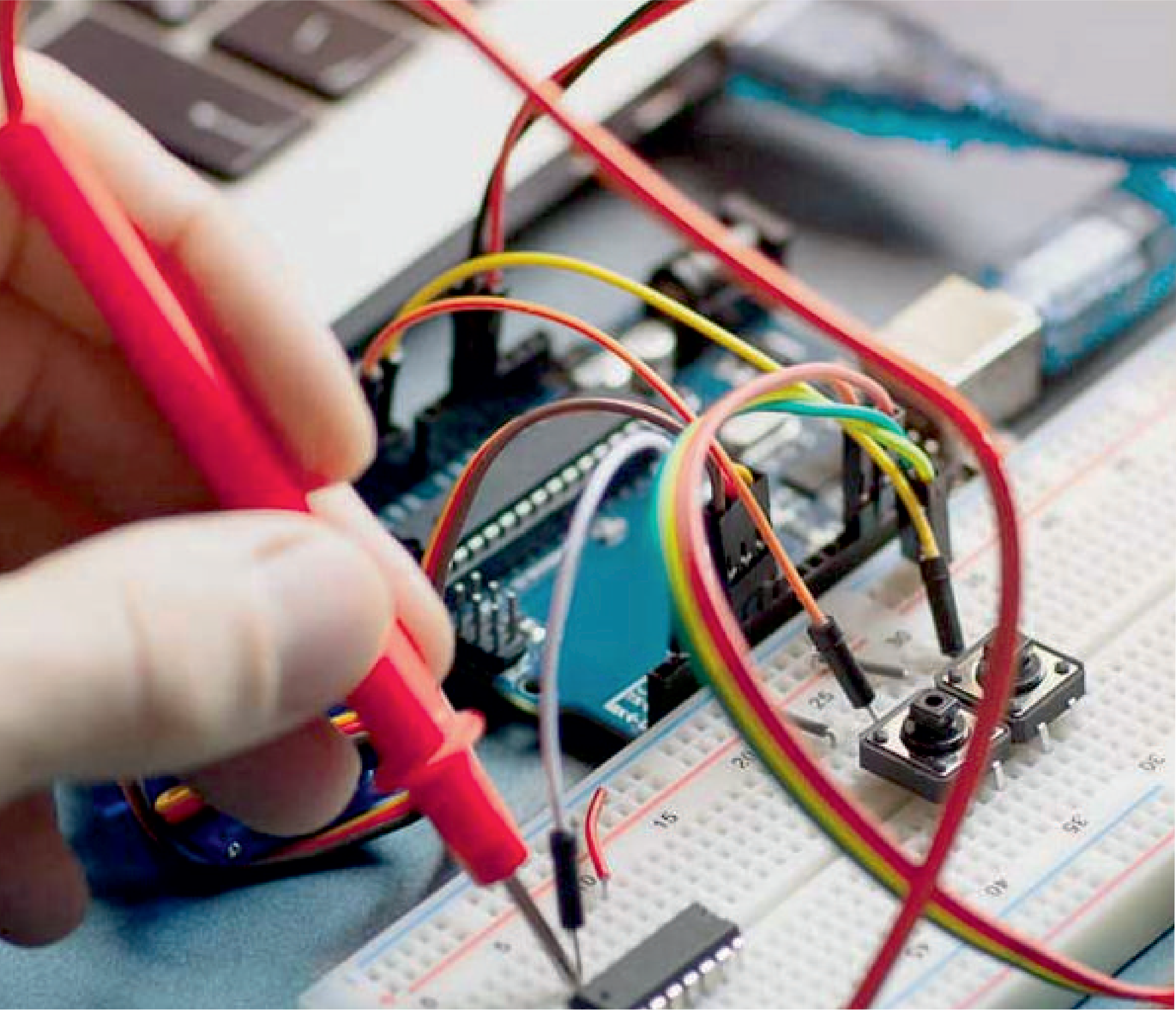

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