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A NOVEL IMPLEMENTATION OF SWITCHING REDUCTION IN SINGLE PHASE TO THREE PHASE CONVERTER

Senthilkumar.A[1], Kahajavali.B[2],Imtiyas.A[3]

[1]Associate Professor/ECE Sri Shanmugha College of Engineering and Technology, Salem Anna University, (India)

[2,3]Assistant Professor/ECE Sri Shanmugha College of Engineering and Technology, Salem Anna University, (India)

ABSTRACT

In this implementation consists two single-phase to three-phase conversion systems for a three-phase load application. The load is connected to a single-phase grid through an ac–dc–ac single-phase to three-phase converter. The single-phase rectifier is composed of two parallel single-phase half-bridge rectifiers. The main objective of this design is based on number of switching devices is reduced in the case of full-bridge rectifier and three-leg inverter systems. In addition, the source voltage sensor is eliminated with a state observer, which controls the deviation between the model current and the system current to be zero. A simple scalar voltage modulation method is used for a two-leg inverter, and a new technique to eliminate the effect of the dc-link voltage ripple on the inverter output current is proposed. Although the converter topology itself is of lower cost than the conventional one, it retains the same functions such as sinusoidal input current, unity power factor, dc-link voltage control, bidirectional power flow, and variablevoltage and variable-frequency output voltage. Proposed design permit to improve the harmonic distortion. In addition, the P5L converter can reduce the converter power losses.

Key words: Total Harmonic Distortion, P5L converter, P4L converter Switching Reduction, Two-leg inverter, VVVF output voltage

I.INTRODUCTION

In view of the machine efficiency, power factor, and torque ripples, a three- phase induction motor is preferable to a single-phase induction motor. Therefore, it is desirable to replace the single-phase induction motor drives by the three phase induction motor drives in residential appliances, farming, and low-power industrial applications. However, where only a single-phase utility is available, asingle- phase-to-three-phase power converter system is required to feed the three-phase induction motor drives. Conventionally, a full-bridge diode rectifier plus three-leg pulse width modulation (PWM) inverter has been used. However, the diode rectifier produces harmonic currents to flow into the supply and has no capability of regenerative operation.

A few recent papers dealt with the half-bridge PWM rectifier and the two- leg three-phase PWM inverter. However, even if a three phase voltage source is available, a power converter is needed to allow speed or torque control of the induction motor drive. But, if only a single-phase utility is available, a single-phase to three-phase (1ph-to-3ph) converter is indispensable to feed a three-phase motor. Furthermore, nowadays some rural loads, e.g., electronic power converters, computers, communications equipment, etc., demand high power quality with sinusoidal balanced three-phase voltages. The 1ph-to-3ph power converter based on a full-bridge diode rectifier is a standard solution. However, this solution provides high harmonic distortion and a low power factor. To solve this problem, a controlled rectifier in place of the diode rectifier is required. Such an alternative solution can provide low harmonic distortion and a high power factor to the grid.

The 1phto-3ph converter based on a controlled rectifier is composed of five legs (ten controlled power devices),in order to reduce the cost and power losses in the power converter, different configurations of 1ph-to-3ph converter with a reduced number of power devices. Within that range of possibility, we can highlight the configurations with four legs (composed of a full-bridge rectifier and a three-leg inverter with a shared leg), denominated here conventional 4L converter and the configuration using three legs (composed of a half-bridge rectifier and two-leg inverter), denominated here conventional 3L converter. The 4Lconverter uses less switches than the full-bridge 5L converter, but its dc-link voltage rating is equal to the 3L converter. For the 4L converter, using constant frequency output voltage and suitable control strategy, the dc-link voltage rating is the same as the conventional 5L counterpart. The conventional 3Lpower converter uses only six power switches instead of ten of the conventional full-bridge 5L power converter. However, it increases the harmonic distortion of input current and twice of the dc-link voltage is required.

Parallel converters are a promising solution for 1ph-to-3ph conversion systems, due to the reduction of irregular distribution of power losses among the switches of both rectifier and inverter, with the reduction of the current processed by rectifier switches. Additionally, the interleaved technique can still be employed to improve the harmonic distortion, reliability, and efficiency of parallel converters.

II. LITERATURE SURVEY

2.1 Analytical power losses model of boost rectifier

In this paper, an analytical power losses model of boost rectifier is presented. Power losses model that takes into account both continuous and discontinuous current modes is derived. Analytical expressions of conduction and dynamic losses, including losses in inductor core and winding, are given. Also, equivalent input resistance, which models single phase and three-phase rectifiers' power losses, is modeled. The model is verified through simulations and experimental measurements on single-phase boost rectifier that is used in wind turbine with permanent magnet generator.[1,2]

Nowadays, converters are becoming important part of electrical systems and devices. In the renewable energy sources and devices with battery supply, due to variability and limitation of primary energy sources, efficiency of used converters is very important. Efficiency can be improved using appropriate converter topology and/or control algorithms. High-efficiency converters have small dimensions, weight and temperature changes. Accurate power losses model is important for developing algorithms that improves efficiency of boost converter. Beside accuracy, it is important to reduce amount of time needed for simulation as much as possible. Also, it is important that parameters of power losses model for used components can be obtained from the manufactures technical specifications .Many models for evaluation of the converter efficiency, focusing on specific application conditions, are developed so far. A model that, in addition to conduction losses, considers only significant sources of dynamic losses, without modeling inductor core and winding losses due to skin and proximity effects, is given. When efficiency optimization algorithms based on variable switching frequency are developed, it is very important to accurately model converter dynamic losses for both continuous and discontinuous current modes. SPICE models of semiconductor elements are very accurate for these applications, but inductor model does not include winding losses due to skin and proximity effects. Also, SPICE simulation may result in excessive computer time and convergence problem. In order to find relation between converter efficiency and its elements and switching frequency, an analytical power losses model of boost rectifier is derived in this paper. Power losses model is valid for both converter operation modes, continuous current mode (CCM) and discontinuous current mode (DCM). Analytical expressions of conduction and dynamic losses, including losses in inductor and switching losses due to diode recovery time, are given. Inductor winding power losses due to skin and proximity effects are considered. Also, equations for power losses in MOSFET and IGBT are given.AC source is commonly connected to boost converter through the rectifier (e.g. wind turbines, power factor corrector – PFC).

ADVANTAGES

1. Less power losses
2. High Efficiency

DISADVANTAGES

1. High skin and proximity effects

2.2 Modeling and control of unbalanced three-phase systems containing PWM converters

This paper proposes two complex vector models to characterize unbalanced three-phase four-wire systems that contain pulse width-modulated voltage-source converters (PWM-VSCs). In the first case, the three-phase system is decomposed in orthogonal components. A complex vector model is then built from the and components. In the second case, a complex vector model is introduced by decomposing the system in three single-phase systems. In both cases, an orthogonal, fictitious circuit is introduced to handle a single-phase system, such as the homopolar system or each one of the three single-phase systems that compose a three-phase four-wire system. From the vector models, two digital controllers, which employ two different reference frames, are proposed. Also, the use of the same gains for both controllers simplifies the equations of the controller in the stationary reference frame. As an example, current control in a PWM-VSC system is presented. [3,4]

This paper proposes two different types of vector-modeling techniques to characterize unbalanced three-phase four-wire systems. To handle single-phase subsystems, like the homopolar system or each one of the three single-phase systems that compose a three-phase four-wire system, a fictitious circuits introduced. The vector models are used to design two digital vector controllers, one for the positive-sequence vector and another for the negative-sequence vector. These controllers can be implemented in either the synchronous reference frame or stationary reference frame. Simulation and experimental results are presented for an unbalanced three-phase system containing a pulse width-modulated voltage- source converter(PWM-VSC).This system contains an ac grid (infinite bus, line,and step-down transformer that are represented by a three-phase source with series impedance), a parallel ac load (three-phase and single-phase), a PWM-VSC with series impedance, a capacitor bank, and a dc load. Different interpretations can be provided for this configuration.

2.3 Comparison of Three Software Single-Phase PLL Algorithms For UPS Applications

In this paper, the performance assessment of three software single-phase phase-locked loop (PLL) algorithms is carried out by means of dynamic analysis and experimental results. Several line disturbances such as phase-angle jump, voltage sag, frequency step, and harmonics are generated by a DSP together with a D/A converter and applied to each PLL. The actual minus the estimated phase- angle values are displayed, providing a refined method for performance evaluation and comparison. Guidelines for parameters adjustments are also presented. In addition, practical implementation issues such as computational delay effects, ride- through, and computational load are addressed.[5,6]

The developed models proved to accurately represent the PLLs under real test conditions. To correct line phase-angle is a very important in other grid- connected equipment such as controlled rectifiers, active filters, dynamic voltage restorers, and also in emerging distributed generation systems such as eolic and photovoltaic power plants. In UPS systems, in order to achieve bump less operation when the bypass switch is turned on, it is necessary to guarantee prior good synchronization between the inverter output voltage and the primary source voltage. The same is true when the transfer switch is engaged in offline or line- interactive UPSs. In parallel redundant UPS arrangements, a very precise synchronization is also required prior to each UPS connection to the protected bus in order to avoid catastrophic transients. To estimate the phase-angle, open-loop and closed-loop methods are available. The closed-loop methods are commonly known as phase-locked loops (PLLs).Generally, the line frequency varies within a limited range even in isolated systems, and its rate of change is limited by generators mechanical inertia. However, when grid faults occur, equipment become exposed to phase-angle jumps and voltage sags. However, it is often difficult to recognize their exact behavior and to compare their performances because the results are not presented in a quite satisfactory way, i.e., usually in the form of saw tooth or sine waves that represent the real and estimated phase angles. The main objectives of this paper are to evaluate and to compare three selected single-phase PLL algorithms for UPS applications under diverse controlled line disturbances by means of dynamic analysis and experimental phase-angle error data. Approximate linear models are presented, and parameter adjustment guidelines are also proposed. The selected structures have simple digital implementation and, therefore, low computational burden. Despite their differences, all PLL algorithms are derived from a standard structure which can be divided into three main sections: phase detector (PD), filter, and voltage controlled oscillator (VCO. The differences from one PLL to another are concentrated in the PD section, which is nonlinear in general. The implementation of the filter and VCO sections is common to all structures covered in this paper. The linear model will be used to model the PLLs throughout this paper. The PD section dynamics are represented by F(s), the compensator C(s) is a proportional plus integral controller (PI) needed to meet closed-loop performance specifications, and, finally, the VCO function is represented as an integrator.

2.4 Single-Phase To Three-Phase Drive S/M Using 2 Parallel Single-Phase Rectifiers

This paper proposes a single-phase to three-phase drive system composed of two parallel single-phase rectifiers, a three-phase inverter, and an induction motor. The proposed topology permits to reduce the rectifier switch currents, the harmonic distortion at the input converter side, and presents improvements on the fault tolerance characteristics. Even with the increase in the number of switches, the total energy loss of the proposed system may be lower than that of a conventional one. The model of the system is derived, and it is shown that the reduction of circulating current is an important objective in the system design. A suitable control strategy, including the pulse width modulation technique (PWM), is developed. Experimental results are presented as well. [7,8]

And thus a new geometry core and relative winding arrangements are proposed in accordance with the orthogonal flux decoupling technology. Due to the four secondary windings are arranged in a quadratic pattern at the base core plate with the two perpendicular primary windings, a name of “four quadrants integrated transformers” (FQIT) is therefore given to the proposed construction. Since the two primary windings are uncoupled, the FQIT allows the two input power stages to transfer the energy into the output load simultaneously or at any time multiplexing scheme, which can optimize the utilization of input sources, simplify the system structure and reduce the overall cost, so they are attractive for the hybrid renewable power system. It initiates a discussion for the advantages of the FQIT. In order to verify the feasibility of the FQIT in multiple-input converter, a dual input isolated boost dc-dc converter with the FQIT is designed and tested.

This technology can transfer power from two or multiple different input voltage sources to the output load simultaneously meanwhile reverse blocking diodes are required at the input power stage sides. The reverse blocking diodes are needed to prevent a reverse power flow from one of the input voltage sources to another input voltage source through the coupled primary sides of the transformer as well as body diodes of semiconductor switches of the input power stages. Without these reverse blocking diodes, different input sources coupled to the multiple-input power converter cannot deliver power to the load. Simultaneously. Furthermore, this technology cannot be applied in the buck type isolated MICs unless the input voltages are strictly limited according to the turns ratio of multiple primary windings. Otherwise, an undesirable voltage difference stresses on one of the input power stages, causing an extremely high current on the semiconductors and thus damages the circuit

ADVANTAGES

1. Higher efficiency.
2. The reliability and performance of the integrated converters is high

DISADVANTAGE

1. The control and modulation schemes complicate.
2. Large number of power conversion stages

2.5 Shunt Active Power-Filter Topology Based On Parallel Interleaved Inverters

In this paper, an interleaved active-power-filter concept with reduced size of passive components is discussed. The topology is composed of two pulse width- modulation interleaved voltage-source inverters connected together on the ac line and sharing the same dc-link capacitor. The advantages of the proposed approach are as follows: 1) significant reduction in the linkage inductors' size by decreasing the line-current ripple due to the interleaving; 2) reduction of the switching stress in the dc-link capacitor, due to the shared connection; and 3) more accurate compensation for high-power applications, because the power sharing allows one to use a higher switching frequency in each inverter. This paper analyzes the design of the passive components and gives a practical and low-cost solution for the minimization of the circulation currents between the inverters, by using common-mode coils. Several simulation results are discussed, and experimental results with a three-phase 10-kVA 400-Vunit are obtained to validate the theoretical analysis. [9,10]

However, the harmonic compensation using active solutions for high-power applications is usually limited by the available semiconductor technology due to the maximum current and voltage ratings, losses, and switching frequency. In order to cope with high-power requirements, several solutions, such as hybrid topologies. Paralleling multiple inverters makes the design, production, installation, and maintenance much simpler and more flexible. In addition, it is easier to extend the total rated power of an active power filter (APF) by simply adding a new module. Furthermore, the parallel inverters may be physically realized in a modular implementation, which has an intrinsic redundancy advantage. Thus, it provides a ride-through capability when a module fails and, also, much simpler replacement procedures. This paper analyzes the application of the (two) parallel interleaved inverters for harmonic-current compensation with APFs.

ADVANTAGES

Increased tracking capability It prevent a reverse power flow

Significant reduction in the linkage inductors' size by decreasing the line- current ripple due to the interleaving;

DISADVANTAGES

Increasing switching stress.

Less accurate compensation

III .PROPOSED SYSTEM

3.1 Introduction

In this proposed design is consists of two single-phase half-bridge rectifiers (rectifiers A and B),a dc-link, a three-phase inverter and a three-phase motor or a three-phase load. On the other hand, the P4L configuration is consists of a two-leg inverter instead three-leg inverter of the P5L converter.

The following model is derived:

$$e_g = r_{g1} i_{g1} + l_{g1} \frac{di_{g1}}{dt} + v_{g10}$$

$$e_g = r_{g1} i_{g2} + l_{g1} \frac{di_{g2}}{dt} + v_{g20}$$

$$i_g = i_{g1} + i_{g2}$$

Where rg1 represents the resistance of the inductor filter Lg1, lg1represents the inductance of the inductor filter Lg1, vg10, andvg20 are the pole voltages of the rectifiers A and B, respectively, it is the grid current and ig1 and ig2 are the input currents of the rectifiers A and B, respectively. The previous model can also be expressed by using the circulating current is introduced by

$$i_{g1} = \frac{i_g}{2} + i_o$$

$$i_{g2} = \frac{i_g}{2} - i_o.$$

From above equations the complete system model is given by

$$e_g = \left(\frac{r_{g1}}{2}\right) i_g + \left(\frac{l_{g1}}{2}\right) \frac{di_g}{dt} + v_g$$

$$v_o = r_{g1} i_o + l_{g1} \frac{di_o}{dt}$$

$$i_o = \frac{i_{g1} - i_{g2}}{2}$$

$$v_g = \frac{v_{g10} + v_{g20}}{2}$$

$$v_o = \frac{-v_{g10} + v_{g20}}{2}.$$

It is clear that the grid and circulating currents depend on the voltages vg and v0, respectively. Then, the rectifier pole voltages can be calculated from desired voltages (vg and v0) to control these currents. Considering circulating current null and the equivalent inductor Lg = Lg1/2 equal to that of the conventional converter, the front-end model of the design .The inverter model for the P5L configuration is given by

$$v_{s1} = v_{s10} - v_{n0}$$

$$v_{s2} = v_{s20} - v_{n0}$$

$$v_{s3} = v_{s30} - v_{n0}$$

Where vs10, vs20, and vs30 are the pole voltages of the inverter, vs1, vs2, and vs3 are the voltages of the three-phase load, andvn0 is the voltage between the point n and the dc-link midpoint0.

IV.MODULES

4.1 Single Phase AC Source

In electrical engineering, single-phase electric power is the distribution of alternating current electric power using a system in which all the voltages of the supply vary in unison. Single-phase distribution is used when loads are mostly lighting and heating, with few large electric motors. A single-phase supply connected to an alternating current electric motor does not produce a revolving magnetic field; single-phase motors need additional circuits for starting, and such motors are uncommon above 10 kW in rating. Single phase AC power systems peak in voltage at 90° and 270°. A cycle completes at 360°. Because of the rises and falls in voltage, power is not delivered at a constant rate.

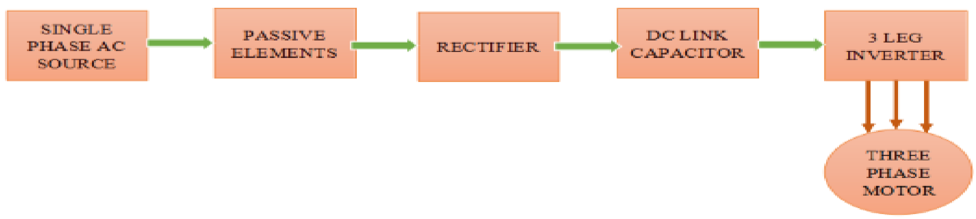

Fig 4.1 Five LEG AC to DC to AC Converter

Single Phase power refers to a two wire Alternating Current (AC) power circuit. Typically there is one power wire and one neutral wire. In the US, 120V is the standard single phase voltage with one 120V power wire and one neutral wire. Single phase power system schematic diagram shows little about the wiring of a practical power circuit. It is a very simple AC circuit. If the load resistor's power dissipation were substantial, we might call this a "power circuit" or "power system" instead of regarding it as just a regular circuit. The distinction between a "power circuit" and a "regular circuit" may seem arbitrary, but the practical

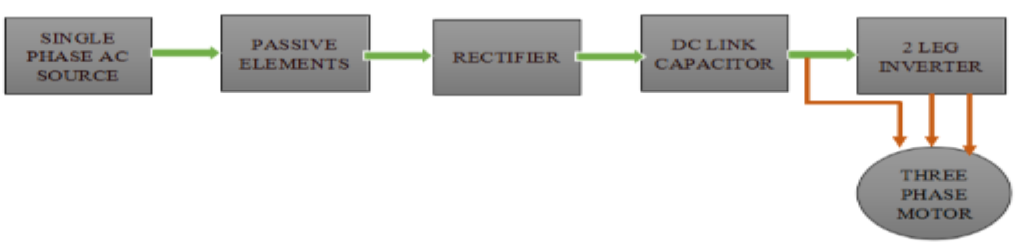

Fig 4.2 4 Leg AC to DC to Ac Converter

One such concern is the size and cost of wiring necessary to deliver power from the AC source to the load. Normally, we do not give much thought to this type of concern if we're merely analyzing a circuit for the sake of learning about the laws of electricity. However, in the real world it can be a major concern. If we give the source in the above circuit a voltage value and also give power dissipation values to the two load resistors, we can determine the wiring needs for this particular circuit:

V SYSTEM REQUIREMENTS SOFTWARE REQUIREMENTS:

OS : Windows

Software : Mat lab2013a

HARDWARE REQUIREMENTS:

Processor : Intel Pentium

RAM : 2GB

5.1 Software Description

MATLAB is a high-level technical computing language and interactive environment for algorithm development, data visualization, data analysis, and numerical computation. Using MATLAB, you can solve technical computing problems faster than with traditional programming languages, such as C, C++, and FORTRAN.

MATLAB and IMAGES

- The help in MATLAB is very good, use it!
- An image in MATLAB is treated as a matrix
- Every pixel is a matrix elemen
- All the operators in MATLAB defined on matrices can be used on images: +, -, *, /, ^, sqrt, sin, cos, etc.
- MATLAB can import/export several image formats

➢ BMP (Microsoft Windows Bitmap) ➢ GIF (Graphics Interchange Files) ➢ HDF (Hierarchical Data Format) ➢ JPEG (Joint Photographic Experts Group) ➢ PCX (Paintbrush) ➢ PNG (Portable Network Graphics) ➢ TIFF (Tagged Image File Format) ➢ XWD (X Window Dump) ➢ MATLAB can also load raw-data or other types of image data

Data types in MATLAB

➢ Double (64-bit double-precision floating point) ➢ Single (32-bit single-precision floating point) ➢ Int32 (32-bit signed integer) ➢ Int16 (16-bit signed integer) ➢ Int8 (8-bit signed integer) ➢ Uint32 (32-bit unsigned integer) ➢ Uint16 (16-bit unsigned integer) ➢ Uint8 (8-bit unsigned integer)

Images in MATLAB

Binary images: {0, 1}

- Intensity images: [0, 1] or uint8, double etc.
- RGB images: m-by-n-by-3
- Indexed images: m-by-3 color map
- Multidimensional images m-by-n-by-p (p is the number of layers)

5.2 Image Types in MATLAB

Outside MATLAB images may be of three types i.e. black & white, grey scale and colored. In MATLAB, however, there are four types of images. Black & White images are called binary images, containing 1 for white and 0 for black. Grey scale images are called intensity images, containing numbers in the range of 0 to 255 or 0 to 1. Colored images may be represented as RGB Image or Indexed Image.

In RGB Images there exist three indexed images. First image contains all the red portion of the image, second green and third contains the blue portion. So for a 640 x 480 sized image the matrix will be 640 x 480 x 3. An alternate method of colored image representation is Indexed Image. It actually exist of two matrices namely image matrix and map matrix.

5.3 Image Type Conversion

- RGB Image to Intensity Image (rgb2gray) \
- RGB Image to Indexed Image (rgb2ind)
- RGB Image to Binary Image (im2bw)
- Indexed Image to RGB Image (ind2rgb)
- Indexed Image to Intensity Image (ind2gray)
- Indexed Image to Binary Image (im2bw)
- Intensity Image to Indexed Image (gray2ind)
- Intensity Image to Binary Image (im2bw)
- Intensity Image to RGB Image (gray2ind, ind2rgb)

VI RESULTS AND DISCUSSION

Single-Phase to Three-Phase Converters with Two Parallel Single-Phase Rectifiers and Reduced Switch Count

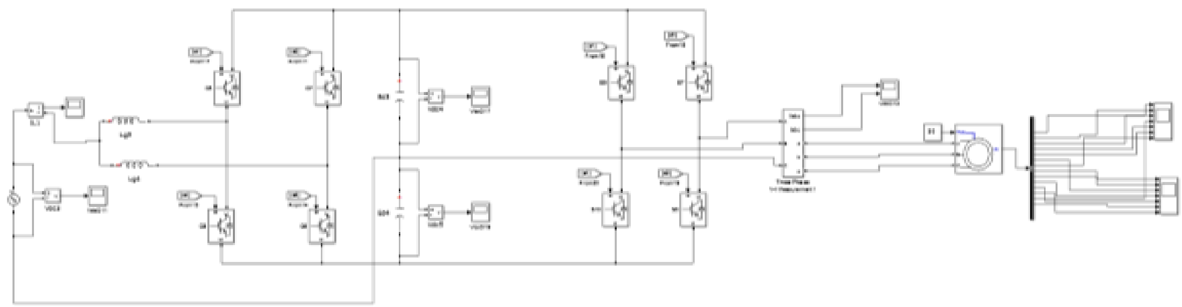

FIG 5.1 Four Leg Inverter

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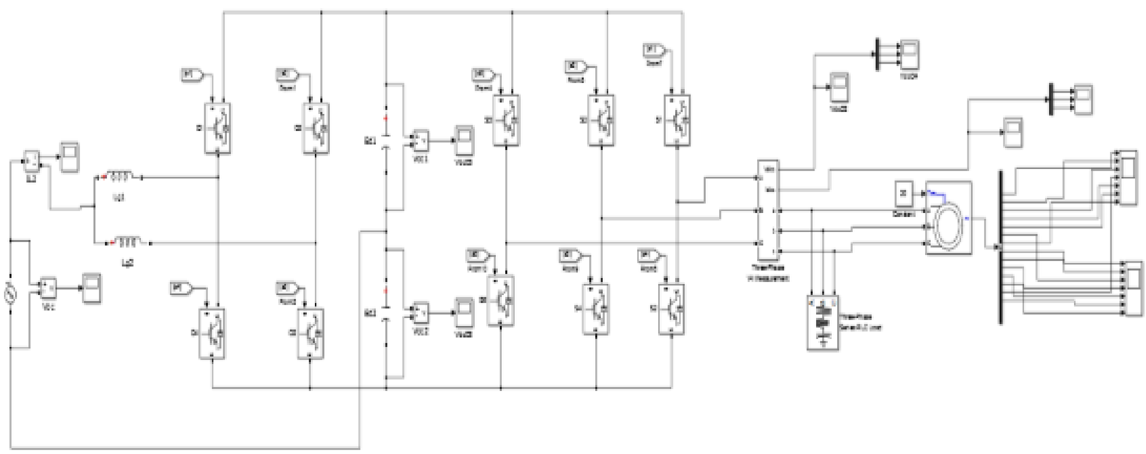

Fig. 5.2 Five Leg Invereter.

THD output current waveform

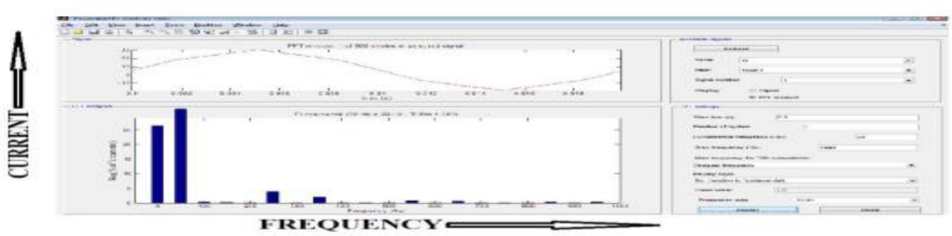

Fig.5.3 THD output current waveform

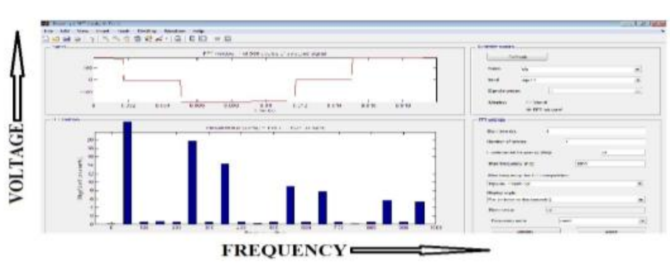

Fig 5.4 THD output voltage waveform

COMPARISON TABLE

S.No	Parameter	Five leg output	Four leg output
1.	Input voltage	Singlephase 250 v	Single phase 250
2.	No of semiconductor switches	10	8
3.	THD	9.2%	6.52%
4.	Output voltage	Output voltage Three phase each phase 150V	Output voltage Three phase each phase 150V
5.	No of Passive elements	4	4
6.	Conversion efficieny	46.35%	49.03%

Table 5.1 Parameters comparison table

VII CONCLUSION

The proposed designs are consists of an ac–dc–ac single-phase to three- phase converter. The single-phase rectifier combines two parallel single-phase half-bridge converters without transformers. Suitable model and control strategy, including the PWM strategy. Among these configurations, the P5L topology presents the best performance, because it reduces:1) power losses, due to a reduction of the rectifier currents and 2)the harmonic distortion on the utility grid, when the interleaved technique is applied. Furthermore, this configuration uses only15% more of dc-link voltage rating that the conventional 5Lconverter. The other drawback of the topology P5L is the use of a greater number of inductors compared with the conventional 5Lone. On the other hand, the P4L topology (with double-carrier PWM implementation) reduces the harmonic distortion when compared with the 3L converter and provides the same value of WTHD when compared with the conventional 5L converter. Additionally, the proposed systems permit to reduce the switch currents of the rectifier and the irregular distribution of power losses among the switches of the rectifier and inverter circuits.

REFERENCES

[1] P. Enjeti, A. Rahman, and R. Jakkli,(Jul. 1993) "Economic single-phase to three phase converter topologies for fixed and variable frequency output," *IEEE Trans. Power Electron. vol. 8, no. 3, pp. 329–335*.

[2] .F. Khosravi, N. Ahmad Azli, and A. Kaykhosravi,(Mar. 2014.) "Design of a reduced component count single-phase to three-phase quasi-z-source converter*," IET Power Electron., vol. 7, no. 3, pp. 489–495,*

[3]. A. Gonzalez, C. Hernandez, and M. Arjona, (Jun. 2014)"A novel high- efficiency parallel-winding connection for a three-phase induction motor fed by a single-phase power supply," *IEEE Trans. Energy Converter., vol. 29, no. 2,pp. 269–277, .*

[4]. R. Machado, S. Buso, and J. Pomilio, (Nov. 2006.)"A line-interactive single- phase to three-phase converter system*," IEEE Trans. Power Electron*., *vol. 21, no.6, pp. 1628–1636*.

[5] E. Cipriano, C. Jacobina, E. da Silva, and N. Rocha, (May 2012.)"Single-phase to three phase power converters: State of the art," *IEEE Trans. Power Electron. Vol. 27, no. 5, pp. 2437–2452*.

[6]B. Lee, B. Fahimi, and M. Ehsani, (2001)"Overview of reduced parts converter topologies for AC motor drives," in *Proc. IEEE Power Electron. Spec .Conf, vol. 4, pp. 2019–2024.*

[7] S. Bekiarov and A. Emadi, (Jun. 2003)"A new on-line single-phase to three- phase ups topology with reduced number of switches," *in Proc. IEEE Power Electron. Spec. Conf., vol. 1, pp. 451–456.*

[8]P. Enjeti and A. Rahman, (Jul./Aug. 1993.)"A new single-phase to three-phase converter with active input current shaping for low cost AC motor drives*," IEEE Trans. Ind. Appl., vol. 29, no. 4*, pp. 806–813,.

[9] C. B. Jacobina, E. C. dos Santos Jr., and M. B. R. Correa, "Control of the single-phase to three-phase four-leg converter for constant frequency output voltage," in Proc. *IEEE Power Electron. Spec. Conf., 2005, pp. 52–58.*

[10] C. Jacobina, E. Cipriano dos Santos, M. de Rossiter Correa, and E. Cabralda Silva, (May 2008.)"Single-phase-input reduced-switch-count AC-AC drive systems," *IEEE Trans. Ind. Appl., vol. 44, no. 3, pp. 789–798,* .

Senthilkumar.A PersuingPh.D. in the area of Power quality in Anna University Chennai and working as Associate Professor/ECE in Sri Shanmugha College of Engineering and Technology Salem District,Tamilnadu, India
Kahajavali.B working as Assistant Professor/ECE in Sri Shanmugha College of Engineering and

Technology Salem District, Tamilnadu, India

Imtiyas.A working as Assistant Professor/ECE in Sri Shanmugha College of Engineering and Technology Salem District,Tamilnadu, India