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A Single Phase to Three Phase Converter With Active Input Current Changing Which Fed for Small Capacity AC Motor Drives

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ABSTRACT: This paper review on single phase to three phase converter having active or value of current changing which fed for alternating current fed motor drive is proposed & comparison with single phase parallel rectifier method, full bridge rectifier with full bridge inverter arduino based method & 3 phase rotary converter. Proposed converter utilized only six switches & implement active input current shaping feature which results in alternating input current at close to unity power factor & this method is better than the traditional methods. Front end rectifier convert AC to DC in the proposed converter & fed to 3ph invert via split capacitor DC link & provides efficient regulation against fluctuations in source voltage. This feature also give regenerative braking of the ac motor drive. An easy to implement control strategy to maintain near about unity power factor over the full operating range is detailed.

KEYWORDS: Converter, rectifier, inverter, IGBTs, SCR, MOSFET , ph.(phase)

I.INTRODUCTION

In this paper a new single phase to three phase converter which utilized only six transistor or IGBT type switches is given. Proposed configuration incorporates a front end half bridge active rectifier structure which provides dc-link with active input current shaping feature. Further, front end rectifier convert AC to DC in the proposed converter & fed to 3ph invert via split capacitor DC link. A four switch inverter configuration with implantation of split capacitors in dc-link provides a balanced three phase output connected to ac motor load at adjustable voltage & frequency. Transistors & IGBT switches can operate at high frequency, advanced PWM techniques known for inverter control can be used. Therefore proposed converter can be controlled to draw sinusoidal input current at close to unity power factor & to simultaneously deliver high quality 3ph. output voltages to the load.

It utilize only six MOSFET or IGBT switches for 1 ph. to 3 ph. variable voltage & variable frequency conversion. It draws near to sinusoidal current for ac mains at close to unity power factor and therefore satisfies strict harmonic current standards. Bi-directional power flow is possible between ac mains and the dc-link. This property provides for better voltage regulation against voltage variations in ac-mains & also facilitates regenerative braking of ac motor drive. Compact size, since six switch converter structure is available in a modular package from several device manufacturers.

It provides high quality balanced 3 ph. output voltages. A detail evaluation of the proposed converter is presented in the following sections. A design procedure for selection of input filter, dc-link capacitors is illustrated in detail. Finally, selected results are verified experimentally on a laboratory 1 ph. to 3 ph. converter.

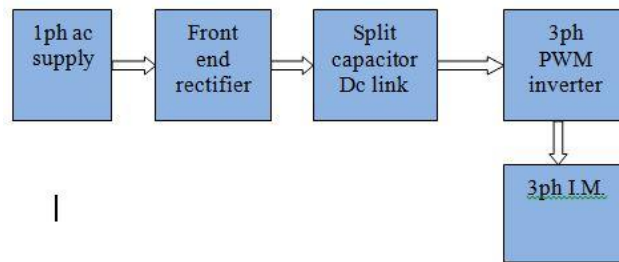


Fig.1. Block diagram of proposed system

II. LITERATURE SURVEY

A. Parallel rectifier method

In parallel rectifier 2 rectifier which enabled with fully controlled are attached in parallel manner. This rectifier consist eight SCR units and division of current in two rectifier circuit, therefore device switching losses are decreased. Main benefit of this method to make reduction in rectifier switching current which also reduces harmonic distortion at converter input end and enhancement in fault tolerance characteristic. By increase in total number of switches we can reduce losses as compare to traditional method. This model of system replicate that reduction in circulating current is main aim of this system design prospective.

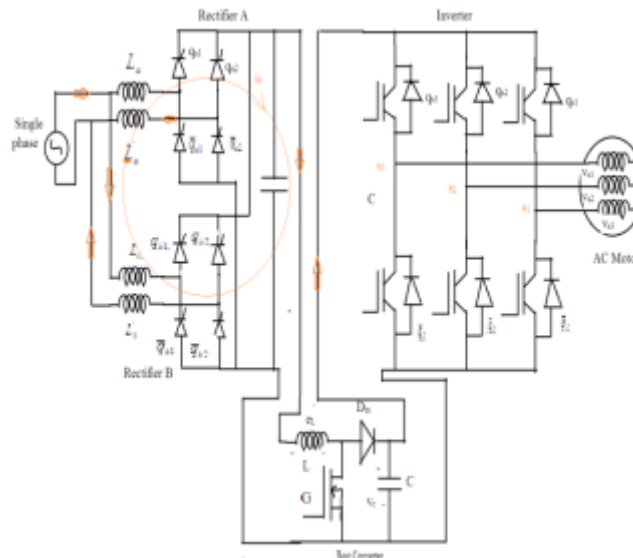


Fig. 2. Single phase to 3 phase converter by using parallel inverter method

B. Full bridge rectifier with full bridge inverter method Arduino based system

Using 3 ph. power source, we able to run any motor. Block diagram replicate converting 1 ph. to 3ph. power supply consist of input, rectifier, filter, inverter, load, driving stage, microcontroller, & power source as replicate in fig. 3. As we seen from diagram that first stage is input, input is given in two circuits, first one is given to rectifier and further towards the other and the second input is given to controller stage Since the input is first works in rectifier which converts the ac supply into pulsating dc but after rectification also having some ac contain. So to remove that filters are used consisting of inductors and capacitors which helps to eliminate the ac contain and gives nearly pure dc. In next step the supply is given to inverter where IGBT's are connected. In addition with main power supply again energizing stage is there which use to energies IGBT's i.e. DRIVING STAGE comprises of micro controller interfaced with scilab where simulations are made accordingly and supply is given to inverter stage as per the programmer's and circuit requirement. Afterwards the dc supply which is fed to inverter is transformed into ac or sinusoidal in the form of 3wire i.e. 3ph. supply. When 1ph supply gets converted into the three phase supply is given to load which is motor.

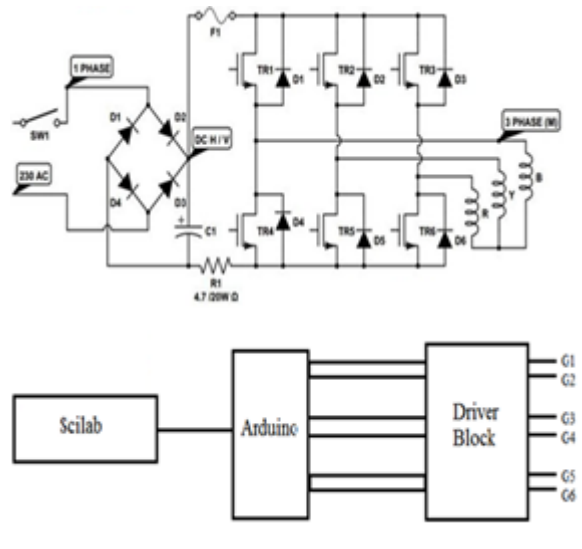


Fig. 3. Single phase to 3 phase converter by using parallel inverter method

C. Three phase rotary converter

A rotational type converter is having robust property with more reliability which perform dual role of function such as motor & generator by utilizing 1ph motor to drive generator for generation of 3 ph power. At first glance rotary converter observed like huge motor with big junction box connected . it having more cost as compare to static converter . A major advantage is that a suitably sized rotary converter can be used to supply 3-phase power to all or multiple of 3 phase motors in a facility.

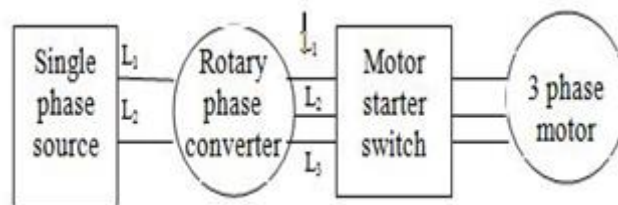


Fig. 4. Schematic of 3-phase rotary converter installation

III. DESIGN OF PROPOSED SYSTEM

The proposed single phase to three phase converter employing six MOSFET or IGBT or transistor type devices. A split capacitor bank forms the dc-link. The switches T1 and T2 form connected before the of rectifier. The inverter connected to convert the dc-link voltage to a balanced three phase output with adjustable voltage and frequency features is configured with four switches. T3 to T6 respectively. 230V to 415v 3 phase converter with switching frequency having specification from 2KHz to 20 MHz fed to the 3 phase ,415 V , 1h.p. motor having 5amp full load current & class B insulation.

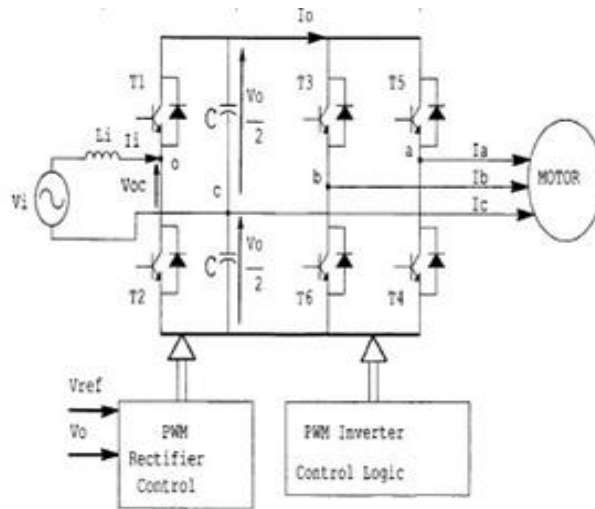


Fig. 5. Circuit Diagram of proposed system

A input which is single phase in nature with constant frequency is rectified by the front end rectifier switch name as T1 and T2. Split capacitor bank present at circuit of dc-link is charged via the diodes present in T1 & T2. The switches T1 and T2 are operated on a PWM pattern synchronized to ac mains to shape the input current to be alternating in nature. Filter inductor L, aids in filtering higher order current harmonics. The fundamental component of voltage at points 'o' and 'c' is Voc1 which is essentially the reflected voltage due to the PWM operation of T1 and T2. An advanced PWM technique which selectively eliminates several lower order harmonics is for control T1 and T2. Fig.6 (b) shows phasor diagram of the input voltage $V_i < 0$ and $V_{oc1} < \theta$. here θ is phase shift angle between the voltages V_i , and V_{oc1} .

Output side of the proposed 1 ph. to 3ph phase converter consists of a four switch ("T3 to T'6) inverter. center point of the capacitors forms third phase 'c'. A detailed comparison of four switch inverter with conventional six switch configuration is given in However, the operation and control options for four switch inverter.

The split capacitor bank in the dc-link is essential to minimize the required power semiconductor switches in the front end rectifier as well as in the output inverter stage. Further, the capacitors must be able to accept an effective alternating current of $0.707 I_C$ at the point 'c'

Parameters/ components	Proposed 1ph. To 3ph. converter	Parallel inverter method	Full bridge rectifier with full bridge inverter method Arduino based system.	3 phase rotary converter
Number of power semiconductor device	6 switches	6 switches & 4 diode	6 switches & 4 diode	NA
Filter capacitor	2	1	1	No filter capacitor is provided
Filter inductor	One on ac side	Four on ac side	Not provided	Not provided
Bidirectional power flow	yes	no	no	no
Voltage regulation for i/p	Excellent	unidirectional	unidirectional	Not provided
Economical	yes	no	no	yes

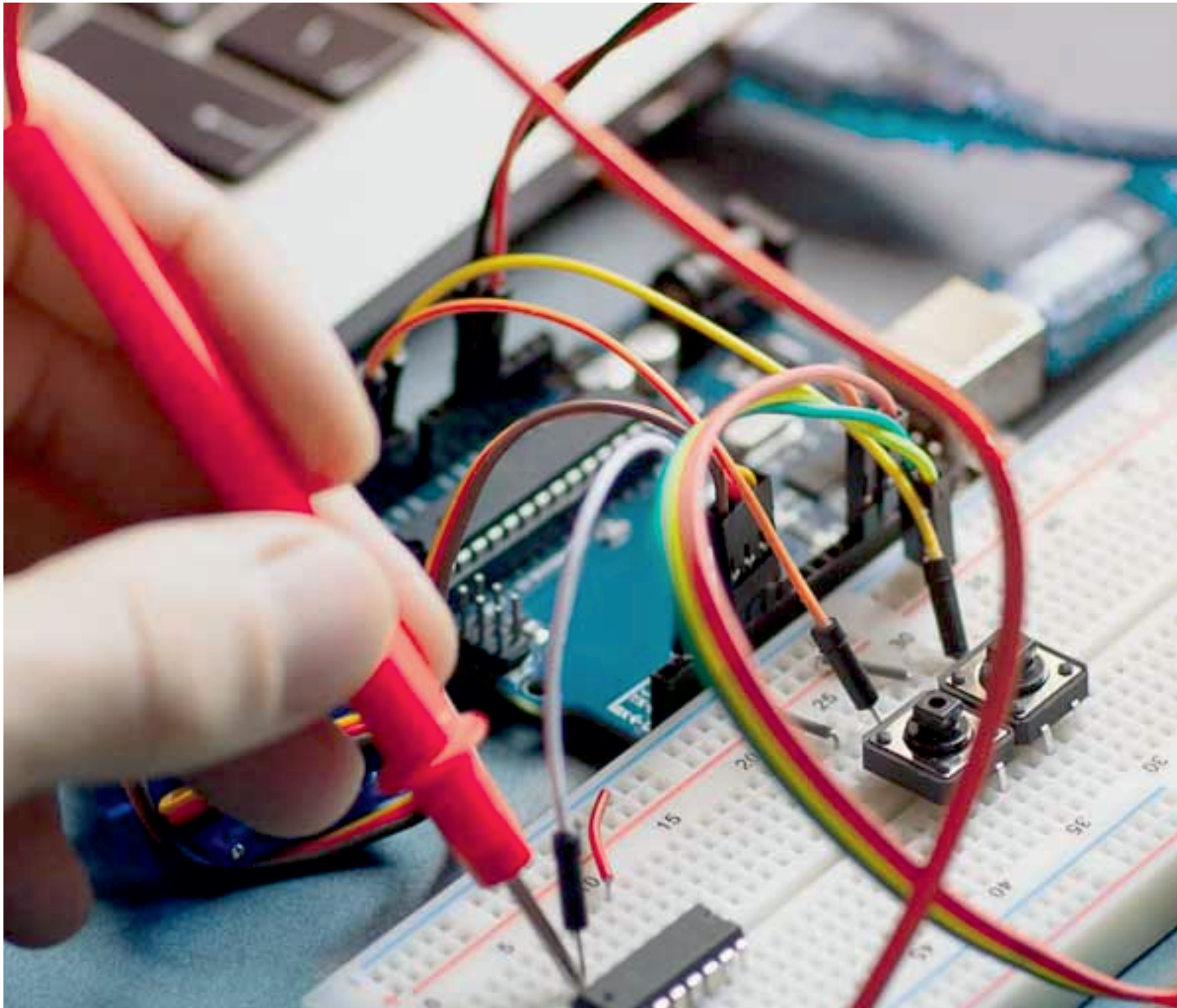


VI. CONCLUSION

A novel design of 1 ph. to 3 ph. converter study has been proposed. Proposed converter is capable of powering a three phase adjustable speed ac motor drives from a 1ph. ac mains while maintaining sinusoidal input current at near unity power factor. This method is more capable and economical as compared to other methods .

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