Power Optimization Using Cycloconverter through IGBT

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Abstract: *This paper is going to discuss about control the speed of induction motor in three steps by using cycloconverter through IGBT. Induction motors used in many domestic appliances such as washing machines, vacuum cleaners, water pumps, and others. The difficulty of varying the speed of induction motor is one of the main disadvantages, because the AC supply frequency cannot be changed. The induction motor speed control in two ways, one is by changing the number of poles and second one is by changing the supply frequency. In first method, the number of poles cannot be change in running condition because the machine size also becomes bulky. This problem can conquer by control the supply frequency. Cycloconverter is power electronics device used for renovate constant AC frequency into variable AC frequency. Induction motors drawback is overcome by using cycloconverter. The status of the Switches enables the microcontroller to deliver the pulses to trigger the IGBT in a bridge. Thus, the speed of the induction motor can be achieved in three steps i.e. (f, f/2 and f/3).*

Keywords: Cycloconverter, Induction Motor, Optocoupler, Microcontroller, IGBT

1. Introduction

Induction motors are the most widely used electrical motors. Because motors do not essentially have the potentiality of variable speed operation. Due to this reason, earlier Dc motors were applied in most of the electrical drives. Recently noteworthy efforts Have been made in regulating speed induction motor drives. the rotor fluctuation and the speed manage loops, designed using the active trouble rejection control method, with the aim to contend with both exogenous and endogenous turbulence, which are approximate by means of two linear extended state observers and then indemnify. Furthermore, with the aim of achieving total robustness, a sliding style based component is designed, in order to take into account trouble estimation errors and uncertainties in the facts of the control gains. Cycloconverter is used for high power application for driving induction and synchronous motor. Induction motor is widely used in many application such as washing machine, water pump, vacuum cleaners due to its energy well-organized characteristics. Induction motor is constructed with two windings on the stator side and collector enclosure winding at rotor side .The auxiliary winding is used to produce a turning field to start the motor. The axis of the auxiliary winding is placed 90 of the main winding. The imitation of the motor is presented in the motionless d-q border to face the application of the inverter and the feedback regulators. Power electronics and micro-electronics, changeable voltage and changeable frequency ac motor drive have come to amplified use in various industrial applications. These new approaches need a simple method of control for ac motors. Control of ac motors become very popular because it is possible to obtain the characteristics of dc motors by getting better control techniques. It is well-known that the control method of an ac motor is moderately more difficult to understand because of participation of various controllable parameters like voltage, current, frequency, torque, flux and so on. although it is possible to achieve almost the same characteristics of dc motor using induction motor, it is very complicated to realize because of need for on line co-ordinate transformation and continuous need of either speed or position signal.

2. Literature Survey

1) Speed Control of Induction Motor by Using Cyclo-converter: This paper is used to control the speed of the induction motor. The speed control of Induction Motor is easy and can be made inexpensive by using different methods to control the process of Cyclo-converter which in turn controls the performance of motor. the frequency can be varied under running conditions also and there is no change in the size of the motor. In this method, the frequency varying device is Cyclo-converter.
2) Simulation of cycloconverter based three phase induction motor: The process mechanism including stipulation for variation in load and this is achieved by using three phase cycloconverter based changeable voltage changeable frequency method. To understand this, a demand torque characteristics of a specific process machine is intentional. The cycle duration of demand torque characteristics is divided into suitable number of time intervals. The subdivisions of time intervals in form of frequencies are tabulated to simplify design procedure.
3) Cycloconverter to control speed of induction motor: The project is implemented to control the speed of induction motor using PWM technique. Induction motor is called as a constant speed machine. The AC supply frequency cannot be transformed so this project uses a MOSFET to drive the induction motor and to control the speed of induction motor by using the PWM method.
4) Cycloconverter Drive for AC Motors: This paper is going to discuss an competent technique to control the speed of a single phase induction motor in three steps by using cyclo convertor technique by thyristors. the AC supply frequency cannot be changed, so this paper presents a thyristor controlled cyclo converter which enables the control of speed in steps for an induction motor.
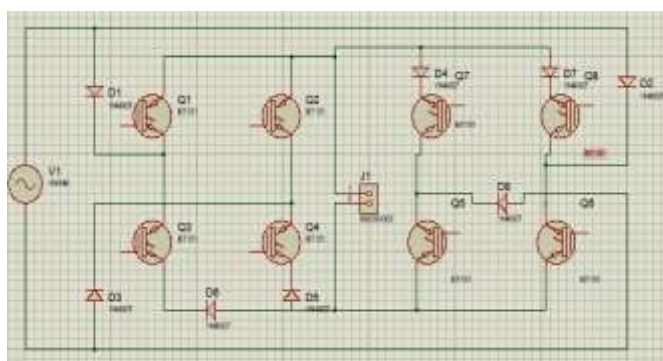
3. Methodology

This circuit consists of DC power supply, zero voltage crossing detectors, Micro-controller(AT89C51), LCD, opto-isolator, and Capacitor. The necessary DC power supply for Micro-controller and other peripherals is supplied by the DC power supply.
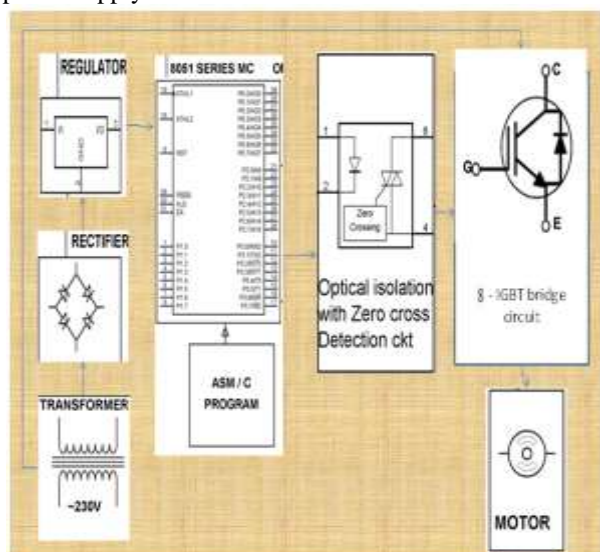
Figure 1: Block Diagram

4. Simulation Work Circuit of IGBT Bridge

Figure 2: IGBT Bride

For the computation of the power factor by the Micro-controller we require digitized voltage and current signals. The voltage signal from the mains is taken and it is converted into vivacious DC by bridge rectifier and is given to a comparator which generates the digital voltage signal. the present signal is transformed into the voltage signal by taking the voltage fall of the load current across a resistor of 10 ohms. This A.C signal is again transformed into the digital signal as done for the voltage signal. Then these digitized voltage and current signals are sent to the micro-controller. the opto-isolators that in turn switch ON back to back connected IGBT to bring the capacitors in shunt across the load. Thus, the required numbers of capacitors are linked in parallel to the load as required. By this the power factor will be improved.

5. Operation

The output of the regulator 7805 is given to the Microcontroller (AT89C51). The vivacious dc is fed to

Resistor. The unfettered voltage is fed to 7812. 7805 output which is 5v is fed to Microcontroller. The output of the 7812 regulator is 12v and is fed to op-Amp. In this circuit we have another bridge rectifier it gives an output as vivacious dc corresponding to the current flowing across the load. The LCD display is connected to corresponding pins. Relay drive's relay's and the connections of relays switch ON the shunt capacitors.

6. Cycloconverter

Cycloconverter converts a steady voltage, steady AC frequency waveform to another AC waveform of inferior frequency by manufacture the output waveform from section of the AC supply without an intermediate DC connection. The frequency can be varied by varying the broadcast period for each IGBT. The gate beat for IGBT can be provided by either by using dismissal circuit. Here for positive half cycle of input or supply. T1, T2" are forward prejudiced, T1 is given beat. For negative half cycle of input or supply T1", T2 are forward prejudiced. T1" is given beat. For another positive half cycle T2" is given beat. For another negative half cycle T2 is given beat. By using Cycloconverter we can vary voltage and frequency.

Figure 3: cycloconverter

AC motor characteristics necessitate the practical voltage to be proportionally adjusted at any time the frequency is changed in order to deliver the rated torque this method is also called volts. Cycloconverters are the straight type converters used in high power application for driving introduction and synchronous motors. Cycloconverters are typically phase-controlled appliance.

7. Microcontroller (AT89C51)

An 8051 microcontroller comes compact with the following features
a) 64K bytes on-chip program memory (ROM)
b) 128 bytes on-chip data memory (RAM)
c) Four register banks
d) 128 user defined software flags
e) 8-bit bidirectional data bus
f) 16-bit unidirectional address bus
g) 32 general purpose registers each of 8-bit
h) 16 bit Timers (usually 2, but may have more or less)
i) Three internal and two external Interrupts
j) Four 8-bit ports,(short model have two 8-bit ports)

8. Advantages

1) In a cyclo-converter, ac power at one frequency is transformed directly lower frequency in a single conversion phase.

2) Cyclo-converter function by means of phase commutation, without auxiliary forced commutation circuits.
3) Cyclo-converter is intrinsically able of power transfer in either direction between source and load.
4) Commutation breakdown causes a short circuit of ac supply.

9. Conclusion

The cyclo-converter circuit have intended for speed control of induction motor for regulating frequency. Single phase Cyclo-converter used to alter the speed of induction motor with the help of AT89C51 microcontroller, dissimilar wanted frequency is obtained to match the desired speed. This different frequency of cyclo-converter is obtained in the way of modifiable speed to F, F/2 & F/3. Furthermore, it provides means for limiting the trip and consequently the motor current, also high voltage circuit from affecting the system receiving the signal can be prevent with the help of opto-coupler. This means a drop in the Cyclo-converter ranking and better effectiveness.

References

[1] P. R. Lole ,K. D. Adhav, S. D. Gholap , S. R. Karkade , P. G. Medewar (Electrical Engg. Dept.) IOSR Journal of Electrical and Electronics Engineering (IOSR-JEEE) "Speed Control of Induction Motor by Using Cyclo-converter" e-ISSN: 2278-1676,pISSN: 2320-3331, PP 50-54 www.iosrjournals.org

[2] Sandeep Pande, Hashit Dalvi International Journal of Advances in Engineering and Technology, "Simulation of cycloconverter based three phase induction motor" July 2011. IJAET ISSN: 2231-1963

[3] G.K. Venayagamoorthy; R.G. Harley; D.C. Wunsch 1997 IEEE Transaction, "A Digital Controller Based Cycloconverter – Fed Drive" Volume: IE-33, Issue: 2, May 1986 Page(s): 126 - 131

[4] Stephen F. Gorman, Jimmie J. Cathey, Joseph a. Weimer, - Link Brush. IEEE Transactions on Industrial Electronics "A Multi-Microprocessor Controller for a VVVF Cycloconverter" (Volume: 35, Issue: 2, May 1988) Page(s): 278 – 283

[5] Bhagawati Patil, Rushali Aute, Pramila Mhaske ,Nitin Patil international research journal of engineering and technology (irjet) "cycloconverter to control speed of induction motor" E-ISSN: 2395 -0056 VOLUME: 03 ISSUE: 04 — APRIL-2016 P-ISSN: 2395- 0072 c 2016, IRJET value: 4.45 — Page 2444

[6] Manishkumar M. Tayade and S.S. Dhamse Department of Electrical Engineering"Cycloconverter Drive for AC Motors" International Journal of Electrical Engineering. ISSN 0974-2158 Volume 6, Number 5 (2013), pp.569-581International Research Publication House.

[7] Vytla Satish, Sravan Kumar Konathala, A. Uday Ravi Kiran Department of EEE "Design and Implementation of Single Phase Matrix Converter for Cycloconverter Operation" International Journal of Engineering Research & Technology (IJERT) Vol. 3 Issue 1, January - 2014 IJERT ISSN: 2278.

[8] Vinamra Kumar Govil1 , Yogesh Chaurasia2 "Modeling & Simulation of PWM Controlled Cycloconverter FED Split Phase Induction Motor" International Journal of Advanced Research in Electrical, Electronics and Instrumentation Engineering Vol. 1, Issue 3, September 2012 Copyright to IJAREEIE www.ijareeie.com.

[9] Abhishek Pratap Singh1 and V.K. Giri2 "SIMULATION Of CYCLOCONVERTER FED SPLIT PHASE INDUCTION MOTOR" Abhishek Pratap Singh et al. / International Journal of Engineering Science and Technology (IJEST)

[10] Yazhou Liu, Gerald Thomas Heydt, Ron F.Chu "The Power Quality Impact of Cycloconverter Control Strategies" IEEE Transactions on power delivery, Vol. 20, no.2, April, 2005, pp. 1711-1718.

[11] Maamoun, A., "Development of cycloconverters," Canadian Conference on Electrcal and Computer Engineering, 2003. IEEE CCECE 2003. Vol.1, 4-7 May 2003, pp.521 – 524

[12] M. Abdel-Halim, H. G. Hamed, and K. M. Hassaneen, "Modeling and Simulation of VSI-FED Induction Motors", Middle East Power Systems Conference (MEPCON"2000), pp.80-84.