

Speed Control of Single Phase Induction Motor Using Thyristor Based Cycloconverter with Microcontroller

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ABSTRACT

This system makes use of Cycloconverter mechanism along with thyristor for controlling speed of single phase induction motor . As single phase induction motor is operated on constant speed it is difficult to control. This process is carried out in three steps . in this project 8051 microcontroller family interface is used to pair a slide switch for selecting required speed range as F , F/2 , F/3 , F/4 . as AC supply is given to single phase induction motor its frequency cannot be changed , so thyristor is used for that purpose . as the switches are set , microcontroller generates pulse and it triggers SCR in dual bridge.

KEYWORDS: *8051 series microcontroller , opto-isolator , LED , SCRS , slide switch , transformer , crystal , bulb , diodes.*

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I. INTRODUCTION

In this method we have used a single phase induction motor .single phase induction motor are simple motors which operate on single phase AC supply and in which torque is produced due to induction pf electricity caused by alternating magnetic field . The speed control induction motor is harder task , but by controlling the input frequency we can control speed of single phase induction motor and we have used thyristor working as Cycloconverter for controlling frequency of induction motor .

Thyristor is a solid state semi-conductor having four layers of alternating P and N type materials .It is mostly used as switch , it triggers or conducts when the gate receives a specific amount of current and continuing to conduct until the voltage across the device is reversed bias or until it has been removed . the primary function of thyristor is to control electric power and current by acting as a switch . in many ways the thyristor is similar as Silicon Controlled Rectifier (SCR) and it is also similar in construction .

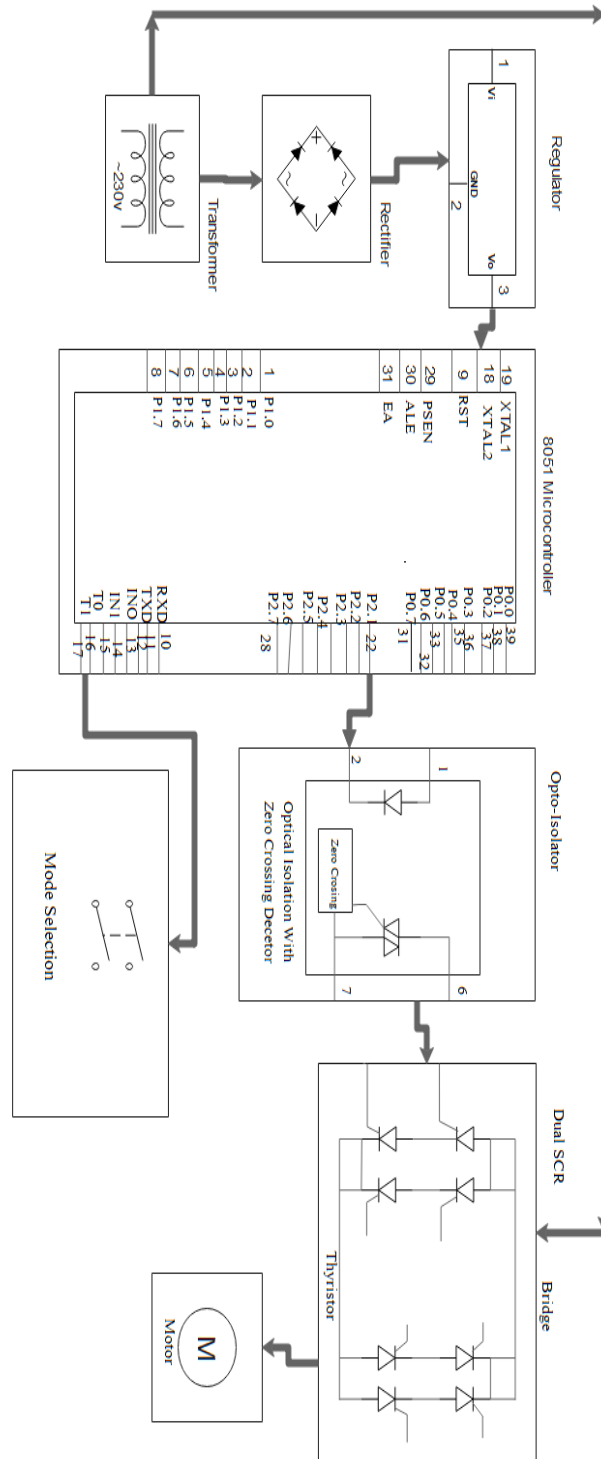
so in this method we are forming Cycloconverter with use of thyristors or SCR in series parallel combination . Cycloconverter basically converts constant voltage or frequency into another constant frequency of lower value . so here we have converted value of frequency into for parts F as it is having initial frequency , F/2 half of its initial frequency and correspondingly F/3 and F/4 .

here , main work is carried out by microcontroller 8051 . it is a 8 bit microcontroller , it has 40 pins dual inline package (DIP) , it has 4kb of ROM and 128 bytes of RAM . it has 2 16 bite timer it consist of four 8 nit ports which are programmable as well as addressable as per requirement .it also has an on clip crystal oscillator having crystal frequency of 12MHz . it also has four register banks and 32 general purpose registers each of 8 bits .

A Cycloconverter is a device that converts AC , power at one frequency into AC power of an adjustable but lower frequency without any direct current , or DC , stage in between . it can likewise be acknowledged as a static recurrence charger and holds silicon regulator rectifier's

BLOCK DIAGRAM

This is block diagram of the system consisting of all main component's.



1) Transformer :

Transformer is a passive electrical device that transfers electrical energy from one form to another . transformer is a electrical device consisting of two or more coils of wire used to transfer electrical energy by means of changing magnetic field. transformer is basically a static device which works on faradays law of induction . the transformer does this by linking together two or more electrical circuit using a common oscillation magnetic circuit which is produced by a transformer it self.

There are two types of transformer :

1. Step-up transformer
2. Step-down transformer

In this system we have used step down transformer . it is basically a transformer which is used to low the value of voltage to desired value.

2) Rectifier:

A rectifier is a device that converts an oscillation two directional alternating current into a single directional direct current . rectifiers can take a wide variety of physical forms , from vacuum tube and diodes and crystal radio receiver to modern silicon based device.

In simple language rectifier is a device that converts (AC) alternating current to (DC) direct current. There are three types of rectifier basically known as :

1. Half-wave rectifier
2. Full-wave rectifier
3. Bridge rectifier

In tis system we have used bridge rectifier which is basically a combination of 4 didoes . a bridge rectifiers provides full wave rectification from two wire AC input resulting in lower cost as well as weight compared to a rectifier with three wire input from a transformer with a center tapped with secondary winding.

3) Regulator:

It compares the output voltage which is precise reference voltage and adjusts the pass device the maintain a constant output voltage . a switching voltage regulator converts a DC input voltage to a switched voltage applied the MOSFET or BJT switch.

In simple language a regulator is used to provide desired amount of DC voltage to a given circuit.

4) 8051 microcontroller:

It is an 8 bit micro controller . it is build up with 40 pins DIP(dual input package) , 4 kb of ROM storage and kb of RAM storage , it has two 16 bit timers . it consist of four parallel 8-bit ports , which are programable as well as addressable as per requirement. An on chip crystal oscillator is integrator in the microcontroller having crystal frequency of 12MHz .

Following are pins of 8051 microcontroller:

1. pin 1 to 8 - These pins are known as port 1 . this port doesn't serve any other functions . it internally pulled up , bi-directional I/O port .
2. pin 9 – it is RESET pin , which is used to reset the microcontroller to its initial values
3. pin 10 to 17 – these pins are known as port 3 . this port serves some function like interrupts , timer input , control signals , serial communication signals ,RCD and TXD , etc.
4. pin 18 and 19 – these pins are used for interfacing an external crystal to get the system clock
5. pin 20 - this pin provides power supply to the circuit .
6. pin 21 to 28 – this pins are known as port 2 . it serves as I/O port . higher order address bus signals are also multiplexed using this port .
7. pin 29 – this is PSEN which stand for program store enable , it is used to read a signal from the external program memory.
8. pin 30 – this is EA pin which stand for external access input . it is used to enable/disable the external memory interfacing .
9. pin 31 – this is ALE , it stands for address latch enable , it is used to demultiplexed the address data signals of the port.
10. Pin 32 to 39 – these pins are known as port 0 . it serves as I/O port . lower order address and data bus signals are multiplexed using this port.
11. Pin 40 - this pin is used to provide power supply to the circuit.

5) Opto – isolator

Opto isolator is an electronic component that transfers electrical signals between two isolated circuits by using light . opto isolator also prevents high voltage from affecting the system receiving the signal . a common type of opto isolator consist of LED and a photo transistor in same package . other types of source sensor combination include LED-photodiode , LED-lascr ,and lamp-photoresistor pairs . usually opto-isolator transfer digital(on-off) signal's , but some techniques allow them to be used with analog signal.

An opto-isolator contains a source (emitter) Of light , almost always a near infrared light emitting diode (LED) , that converts electrical input signal into light , a closed optional channel and a photosensor , which detects incoming light and either generate electric energy directly or modulates electric current flowing from an external power supply.

6) Mode selection

8051 has a timer mode register and control register for selecting a mode of operation send controlling purpose .TMOD is an 8 bit register used to set timer of timer 0 and timer 1 . bit 7,3 -gate :1 enable timer /counter only when the INT0/INT1 pin is high and TR0/TR1 is set.

7) Cycloconverter

A Cycloconverter is a device that converts AC , power at one frequency into AC power of an adjustable but lower frequency without any direct current , or DC , stage in between . it can likewise be acknowledged as a static recurrence charger and holds silicon regulator rectifier's.

A single phase input Cycloconverter is 50Hz , 25HZ , 12.5Hz single phase output Cycloconverter . rectifier converts from single phase or three phase AC to variable DC voltage . chopper convert from DC to variable DC . inverters convert from DC to variable magnitude variable frequency single phase or three phase AC . cyclic converter converts from single phase or three phase AC to variable magnitude variable frequency single phase or three phase AC . a Cycloconverter is having four thyristor divided into a positive and negative bank of two thyristors each . depending upon the triggering pulse fed to the set of 8 thyristors between their gate and cathode we get F or F/2 or F/3.

8) Single phase induction motor

Single phase induction motor consist of single phase winding on the stator and a cage of winding on the rotor . when the single phase supply is connected to stator winding a pulsating magnetic field is produced . in pulsating field rotor does not rotate due to inertia . therefore single phase induction motor is not self starting and needs z starter.

II. WORKING :

In the following system we have used a single phase transformer having input of 230V Ac supply basically this transformer is been given single input and has two outputs one at rectifier side and one which gives supply to Cycloconverter .transformer works on the principle of mutual inductance . it basically is a combination of core and two coils named as primary and secondary coils , primary coil is given input and secondary sides gives output and mutual inductance takes place between two coils . further this output is given to rectifier and other is directly given to Cycloconverter.

A rectifier is a unit which converts AC to DC . it is a combination of four SCRs in above circuit the AC supply is given to rectifier through Single phase transformer and it converts it to DC supply by using SCRs in bridge combinations.

The outpour of rectifier that is direct current is supplied to voltage regulator to obtain certain voltage required . it consist of three pins voltage input(V_i) , voltage output(V_o) and ground , the input pin is connected to (V_i) and desired output is obtained at(V_o) . further (V_o) is connected to 8051 microcontroller .

The 8051 in 8051 the input from voltage regulator is given to crystal 2 and here main work of 8051 is to control mode section which is further connected to timer .

Further opto isolator is connected to 8051.opto isolator is basically a combination of an LED and photo transistor . it is basically used for wireless contact , the supply is given to LED and it is received by photo transistor and it converts to electric current . option isolator basically has six terminals anode cathode and no contact on supply side and emitter , base and collector on output side . here collector and base are connected are collected to zero crossing detector and emitter is further connected to Cycloconverter along with zero crossing detector . zero crossing dectator has two terminal at input side V_{ref} and V_{in} and one at output terminal V_o .

Mode selction is connected to 8051 for selction of speed of motor and main purpose is to vary frequency i.e. F , F/2 , F/3 and hence it is followed by Cycloconverter and 8SCR Cycloconverter controls the frequency and limits the speed of induction motors

III. CONCLUSION

Here at the end of this system we are at conclusion that we can control the speed of single phase induction motor using the Cycloconverter and 8051 by controlling the frequency . also it can be used for braking purpose also .

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