Automatic DOL starter with programmable timer

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Abstract:

In this modern age automation is taking place in every field of life. This automatic DOL starter of 3 phase induction motor is also a work in this automation process. Induction motors find their application in vast field of engineering and daily life. This paper implements a device which provides automation to the 3 phase induction operation. Due to wide range of application induction motor automation in working of induction motor will cover a wide area of automation.

Keywords: Induction motor starter, Automatic Starter, Starter with Timer, Microcontroller

Introduction:

Induction motors are widely used due to low maintenance expenditure, good efficiency and fast pick-up, low-cost and sturdy construction. In most of the operations related with 3 phase induction motor, motor not need to run continuously it is required to run for a particular amount of time and in some of the tasks motor is required to be started frequently after a particular time. So with the help this automatic DOL starter of 3 phase induction motor device this purpose can be fulfilled without any extra effort. With the help of this device user just need to feed the amount of time for the motor operation is required or the time after which the motor is required to start, in the device and after the completion of time motor will start or stop on the basis of lever setting provide in the device. This system is designed with the help of microcontroller which works as programmable timer which is the heart of the whole system. As 3 phase induction motor of large size cannot be started directly or with DOL method so in this system star-delta connection space is provide so that the motor can be connection star-delta formation for protection purpose.

Method:

The embedment of a microcontroller into the system makes it a standalone system that is capable of taking decisions to keep the system functioning properly. Microcontroller is programmed in such a way that it takes input in the numeric value as time which will be fed the user. On the completion of time entered by the user, microcontroller will switch the relay in working mode which can be set in a way that it should turn the motor ON after the entered time delay or to stop the running motor. This is done with the help of given lever connected to the relay connection. A rectifier is provided which will convert the ac supply (1 phase from 3 phase supply) in dc for working of electronic component and microcontroller which require 5v dc supply for working. This device is applied to DOL starter of motor and also the star delta connection can be made on device. Connection points for star delta connection are provided on device which will help in secure and efficient starting of machine. Hence by applying this starter for the control of 3 phase induction motor accurate and efficient operation of machine may be obtained.

Block Diagram:

The block diagram for the system is shown in fig.1 (a). Here we can see the heart of the system that is the microcontroller AT89S52 which is programmable and is programmed as timer, for the operation 5 keys wiz. Increment, decrement, shift, set and reset are connected with the microcontroller for time input. These keys will help in setting the time by user. 3 relays are connected next to the timer which will control the supply to the motor in accordance with the timer and key setting by the user. A rectifier is used to supply 5v dc for electronics components of the system.
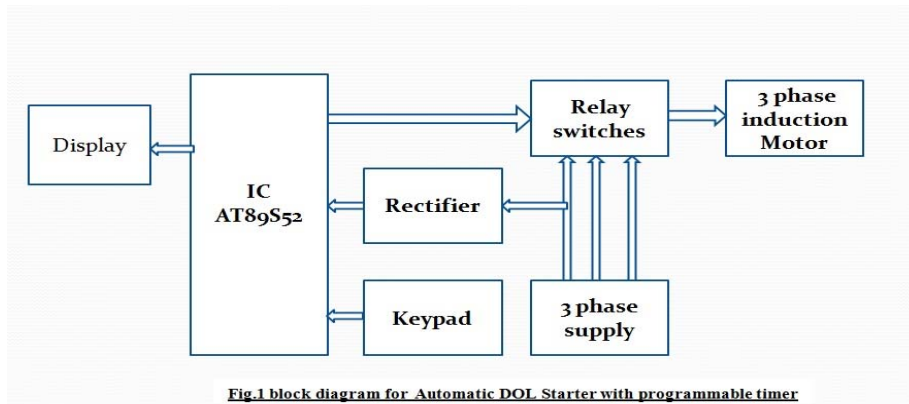
Fig.1 block diagram for Automatic DOL Starter with programmable timer

Circuit Diagram:

Circuit diagram for the system is shown in fig. 1(b). A simple timer is nothing other than up/down counter. However, to incorporate various facilities like setting the counter, start, stop, reset and display, these circuits would require many discrete components.

A microcontroller-based industrial timer can be programmed and used as a time totaliser. Here circuit shows a simple design of timer based on 40-pin Atmel AT89S52 microcontroller that performs count-down operation up to 9999 minutes/second with four 7-segment displays showing the actual time left. Along with this, 3 relays , toggling switches etc. are also implemented as shown in fig 1(b) for the desired operation .The relay energises/de-energises as you press the start button and remains as it is till the countdown reaches '0000.' Five tactile, push-to-on switches are used to start/stop, to select range (either minutes or seconds), to set the time for count-down operation (using 'up' and 'down' keys) & to reset the timer as shown in fig.1(b).
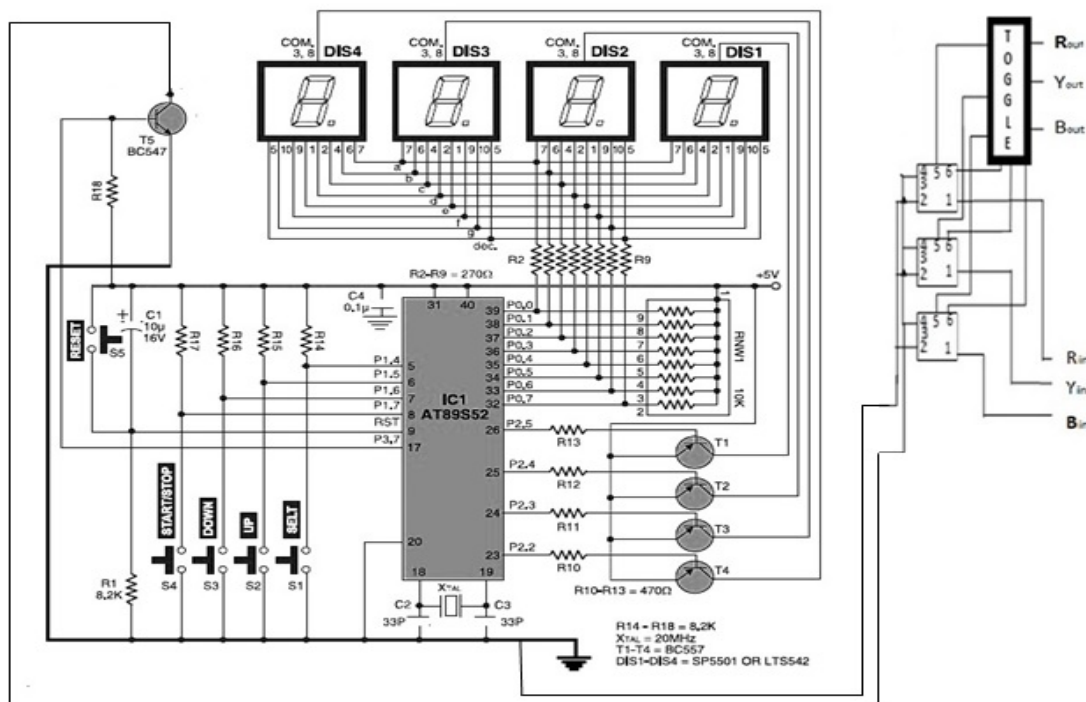

Fig.1 (b) Circuit Diagram of Automatic DOL starter with programmable timer

Operation:

The microcontroller is reset by power-on-reset and then timer is in 'seconds' mode. The 'select' key is then used to selects the format of time input either in minute or in second in the range of '0000' to '9999'.This is displayed as '0' for seconds and '1' for minutes on the hundred's digit display (DIS3), respectively. 'Up' key increments the time setting in seconds and minutes and 'Down' key decrements the time setting in seconds and minutes. After setting the desired time with the help of 'up' and 'down' keys, microcontroller's counts down is made to run with the help of START key and once the display becomes zero the relay energizes or de-energizes on the basis of lever setting. There are two mode of operation which are selected by the user with the help of lever provide in the system. In one mode of operation it will stop the running motor after a particular time entered by the user. And in another mode it will start the motor after the delay of particular time entered by the user.

The time limit entered in the microcontroller may be modified by using reset key and again by setting a new time limit. After pressing the 'reset' key, counter returns to its initial state i.e. '0000' and after which user may enter the new value of time.

There is two other modes too in which timer has no impact on the operation of the relays. If user does not want to use timer in that case he has a another choice of not starting the timer and the control liver will work as a ON/OFF switch.

Advantages:

➢ User can set time for the starting or stopping of the motor.
➢ User has very wide range for time input from 1 sec. to the 9999 minutes.
➢ Since motor will run for required time so it will save the energy and machine as well.
➢ In some the case a man has to keep his/her eyes on the watch for motor operation so by using this system he can be free for any other work.

➢ User has two choices of using this set up either with timer or without timer.
➢ Simple and easy working.
➢ No deep knowledge required to use this setup.
➢ Power rating of the system may be increased & just only by replacing relays by higher ones.
➢ Since electronic part are not in direct touch with the power supply to the motor hence less harmonics induced.
➢ Since setup is capable to work without timer hence no effect on operation of motor if any of part of timer stops working.

Disadvantage:

➢ External dc supply or single phase supply with rectifier is required for the operation of electronic parts of the system.
➢ There is always some power consumption if we use it with timer.
➢ Capability of the setup to work with or without timer on the cost of single phase operation of microcontroller may result in single phasing of motor without detection.
➢ Cost of the starter is increased in comparison to starter without timer circuit.

Applications:

➢ May be used in industries where time limited operation is required.
➢ May be used in the laboratories for time related experiments of motor
➢ Not only motor, other loads may be connected to its terminals hence may be used in offices, homes etc.
➢ May be used for controlling three single phase motor instead of one three phase motor.
➢ May be used for time control operation of appliances.

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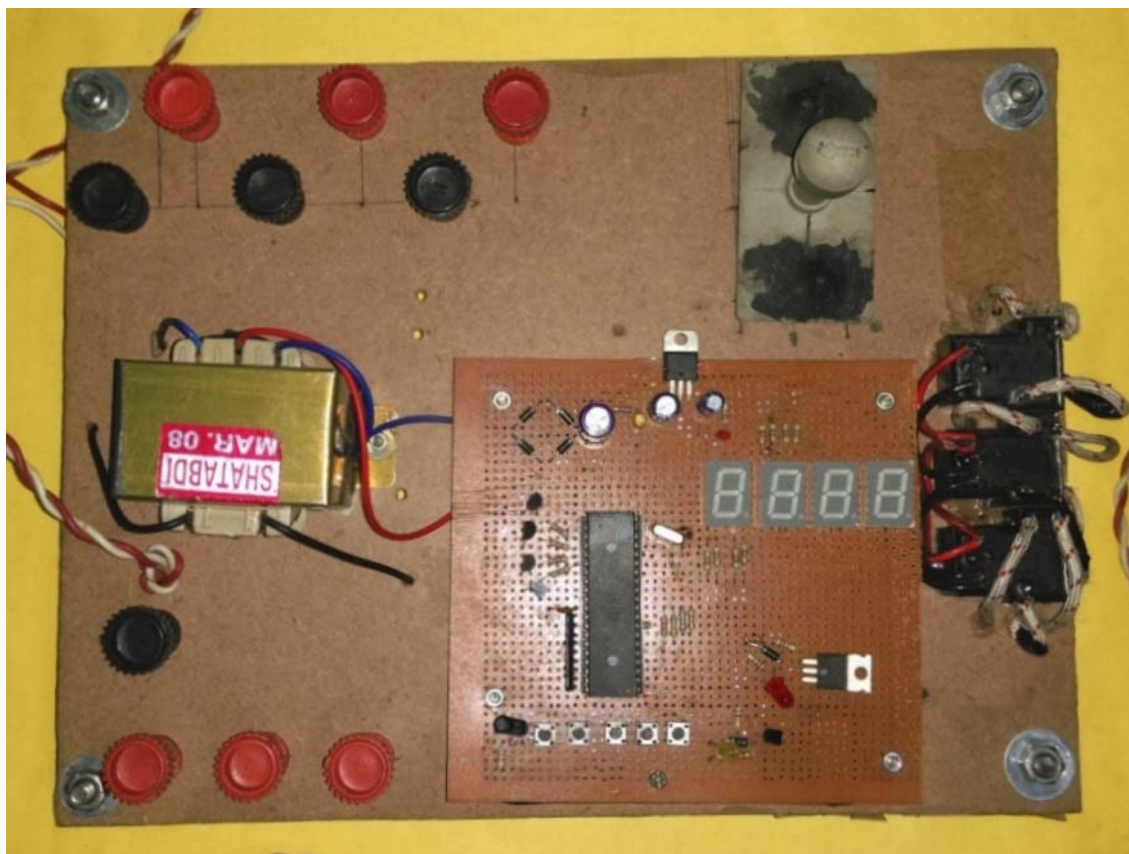8. http://electrical-engineering-portal.com/direct-on-line-dol-motor-starter

Fig. 1(C)- Actual Figure of Automatic DOL starter with programmable timer