

Star – Delta Starter using Static Switches with Raspberry- PI as a Base Drive Circuit

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Abstract:- This paper represents automatic Star – Delta Starter of Three-Phase Induction Motors. This unit is developed for the automatic Star – Delta Starter operation of Three – Phase Induction Motors. This unit is developed to overcome all the disadvantages of conventional types of contractors used in the starting process of Three – Phase Induction Motor. In this unit the operation of Star – Delta Starter Conversion is entirely made automatic with the help of Raspberry-Pi. Now a days the processes & operations in electrical engineering field are going for entire automation, we can easily replace the big space consuming, complicated processes in electrical engineering field operation. The Opto-isolator is used to isolate the Digital Control Circuit from high voltage Power Circuit. The Raspberry-Pi is programmed in such a way that the starter operation automatically takes place based on the time delay provided.

Keywords:- Raspberry-Pi, Opto-isolator, Static Switch Module, Three - Phase Induction Motor

I. INTRODUCTION

The Star-Delta Starter is common type of starter which is used to connect the induction motor in star during starting & in delta during running condition.

The Star – Delta Starters are preferred as a method of starting in low starting torque applications. An Induction Motor during start behaves like a short circuited transformer, now when the supply is given to the stator windings; it draws high current at constant voltage as the windings are short circuited. The starting current of Induction Motors are 6-7 times the full-load current. Starters are employed to reduce the starting current. [1]

This reduces the voltage across the winding. The voltage across the winding will $1/\sqrt{3}$ times line voltage. After the starting time is set in the timer the winding will be connected in Delta. The voltage across the winding will be equal to the line voltage. The switching of winding configurations is done by device called Contactors. We are completely eliminating the contactors by using this process hence reducing the cost and space of the operation. The operation will become more simple, reliable and fast. [2]

II. AUTOMATIC STAR-DELTA STARTER UNIT

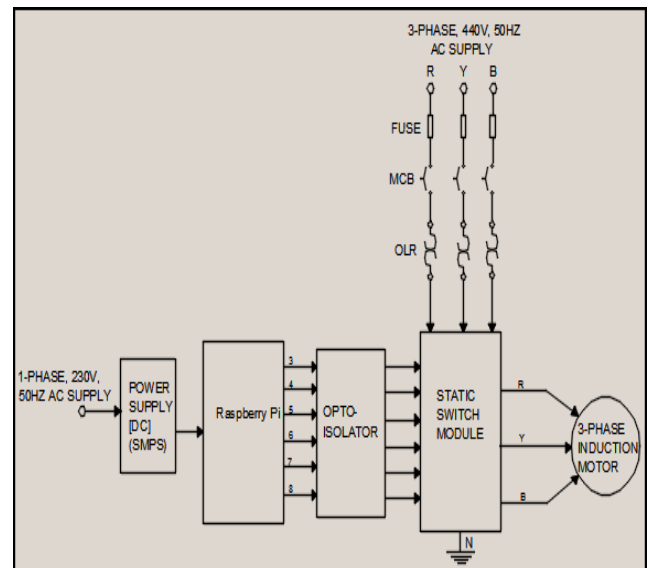


Fig 1:- Block Diagram of Star-Delta Starter Unit

Figure (1) shows the block diagram of Star-Delta Starter Using Static switches. Single phase 230V supply is given to the SMPS which converts AC to DC. 5V DC supply is provided to the Raspberry-Pi, when it is switched ON the Raspberry-Pi starts executing the programs from its 1st instruction. This will give high output logic 1 to its pins 2, 4, 6 so the output of these pins is given to the Opto-isolator in order to give protection for the Raspberry-Pi from the high voltage power circuit. From here it is connected to the Static Switch Module. It consists of 6 static devices (IGBT/MOSFET/Power Transistor). Three static switches for Star connection and remaining three static switches for Delta connection. [3] When pin number 3, 4, 5 is at logic 1 the three Star connection static switches will turn on and three phase motor gets connected in star fashion that is A2, B2, C2 winding terminals gets shorted through solid wire. After few seconds delay (say 10 seconds according to the program) provided by Raspberry-Pi pin number 3, 4, 5 will goes to logic 0 state and pin number 6, 7, 8 is at logic 1 at the same time star connection is converted into delta connection. And three phase motor gets connected in delta fashion that is A1-C2, B1-A2, C1-B2 winding terminals gets shorted through solid wire.

Hence with the help of this unit we are completely eliminating the use of contactors from the circuit operation of Star-Delta starters and making the operation easier and reliable. [4]

Unlike Microcontroller, Raspberry Pi can do multiple tasks like computer and also can handle multiple programs running parallelly. It has advantage of coding in many languages like C, C++, Java python etc. Switching of different operating systems on single Raspberry Pi board. Internet connectivity is fairly comfortable for server based applications.

III. ADVANTAGES

- Speed of operation is very fast.
- The system is highly accurate & reliable & it requires less space.
- The effect of Gravity & Sparking can be eliminated.
- The system is cost effective.
- The system has a longer life.

IV. DISADVANTAGES

- If there is some malfunction in the Raspberry-Pi, the system may misbehave. But chances of occurring such malfunction are almost nil.

V. CONCLUSION

The automatic Star-Delta starter using Static Switches is having several advantages over the conventional method of Star-Delta conversion using the contactors. With the help of this unit the operation will become more simple, reliable and fast and accurate. The system is cost effective and has a longer life. Also it requires less space as compared to the contractors. We are completely eliminating the contactors by using this process, and also chances of occurring faults in the operation is almost nil by using this system.

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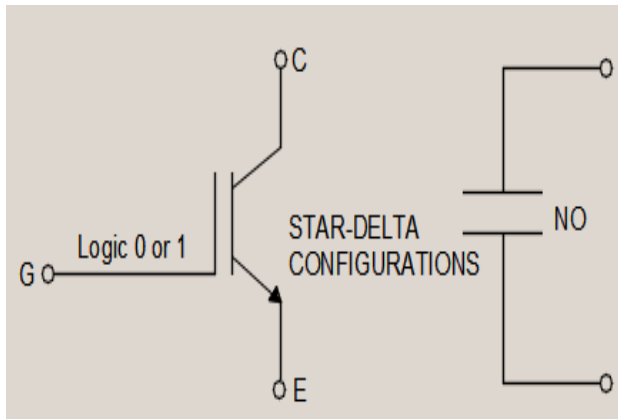


Fig 2:- Single switch from static switch module

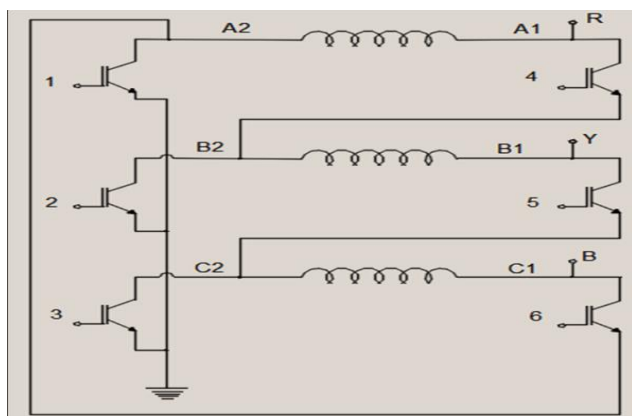


Fig 3:- Static Switch Module

Figure (3) shows the static switch module which consists of 6 static switches used for Star-Delta Conversion. Switches 1, 2 & 3 for star connection and 4, 5 & 6 for delta connection respectively. This switches get the gate pulses from the Raspberry-Pi. [6]

At the starting condition the motor is connected in star connection and switches 1, 2 & 3 are on and remaining switches are in off condition hence the current flows from A1-A2, B1-B2 and C1-C2 from RYB supply after the set delay in the Raspberry-Pi according to the time which motor takes to switch from starting condition to running condition.

After the provided delay the motor switches from star to delta, in this state the switches 1, 2 & 3 are off and switches 4, 5 & 6 are gets turned on and hence switching to the delta condition from the star connection in this case the current flows from A1-B2, B1-C2 and C1-A2 from the RYB supply. [5]