INTERNATIONAL JOURNAL OF INNOVATIVE RESEARCH & DEVELOPMENT

ISSN: 2278 – 0211 (Online)

Wireless Starting Of 3 Phase Induction Motor

Bijendra Kumar
Assistant Professor of Electrical & Electronics engineering department, Galgotias college of engineering and technology, Greater Noida, India
Kuldeep Singh
student of the final year, Electrical & Electronics engineering department, Galgotias college of engineering and technology, Greater Noida, India
Arvind Kumar
student of the final year, Electrical & Electronics engineering department, Galgotias college of engineering and technology, Greater Noida, India
Kapil Dev
student of the final year, Electrical & Electronics engineering department, Galgotias college of engineering and technology, Greater Noida, India
Deepak Sharma
student of the final year, Electrical & Electronics engineering department, Galgotias college of engineering and technology, Greater Noida, India

Abstract:

All induction motors require a starter to start the motor. The starter is used according to the motor ratings. Wireless three phase induction motor device can start the motor from long distance without using wire. This starter works with a mobile device. In this system a mobile works as a signal transmitter and other mobile is signal receiver. The mobile transmitter calls to receiver mobile. The call is automatically received by receiving mobile. When a numeric button is pressed during this time the transmitter mobile send a DTMF signal, this signal is received by receiving mobile and motor is started. And to stop the motor other specified button is pressed and motor get stopped.

***Key words**: Project introduction, Hardware description, circuit diagram, Project working, Applications, Limitation, references*

1.Introduction

Earlier we are looking into the face of future when we are talked about automated devices which could do anything on instigation of a controller, but today it has become a reality. An automated device can replace good amount of human working force.

All induction motors requires a starter to starting the motor. The starter is used according to the motor ratings. Wireless three phase induction motor device can start the motor from long distance without using wire. This starter works with a mobile device. In this system a mobile works as a signal transmitter and other mobile is signal receiver. The mobile transmitter calls to receiver mobile. The call is automatically received by receiving mobile. When a numeric button is pressed during this time the transmitter mobile send a DTMF signals, this signals is received by receiving mobile and motor get started. And to stop the motor other specified button is pressed and motor get stopped.

This starter has a controlling circuit that enables switching ON and OFF of Triacs. It can be used to switch motor from any distance. This circuit is based on the DTMF controller circuit. DTMF means “Dual tone multiple frequency”. The DTMF signals on mobile are used as control signals.

2.Hardware Description

2.1.Components

- Integrated circuits
    - IC-9170 Dtmf decoder
- IC-7805 Voltage regulator
- IC-7812 Voltage regulator
- Triac
- Diac
- Optocoupler
- Diode
- IN-4007
- Resistor
- R1 1k ohm
- R2 2k ohm
- R3 25k ohm (Variable)

- R4 500 ohm
- Capacitor
- C1 0.5 microf
- C2 0.5 microf
- Relay
- 12 volt, 3 NO contact
- Mobile with sim

3.Triac

TRIACs belong to the thyristor family and are closely related to Silicon controlled rectifiers (SCR). However, unlike SCRs, which are unidirectional devices (i.e. can conduct current only in one direction), TRIACs are bidirectional and so current can flow through them in either direction. Another difference from SCRs is that TRIACs can be triggered by either a positive or a negative current applied to its *gate* electrode, whereas SCRs can be triggered only by currents going into the gate. In order to create a triggering current, a positive or negative voltage has to be applied to the gate with respect to the A1 terminal (otherwise known as MT1). Once triggered, the device continues to conduct until the current drops below a certain threshold, called the holding current.

The bidirectionality makes TRIACs very convenient switches for AC circuits, also allowing them to control very large power flows with milliampere-scale gate currents. In addition, applying a trigger pulse at a controlled phase angle in an AC cycle allows one to control the percentage of current that flows through the TRIAC to the load (phase control), which is commonly used, for example, in controlling the speed of low-power induction motors, in dimming lamps and in controlling AC heating resistors.

During gate turn-on, the rate of rise of thyristor anode current dIF/dt is determined by the external circuit conditions. However, the whole active area of the thyristor (or triac) cannot be turned on simultaneously: the area nearest to the gate turns on first, followed by the remainder of the device. At turn-on it is important that the rate of rise of current does not exceed the specified rating. If dIF/dt is excessive then only a limited area of the device will have been turned on as the anode current increases. The resulting localized heating of the device will cause degradation and could lead to eventual device failure. A suitably high gate current and large rate of rise of gate current (dIG/dt) ensures that the thyristor turns on quickly (providing that the gate power ratings are not exceeded) thus increasing the thyristor turn-on di/dt capability. Once the thyristor has latched then the gate drive can be reduced or removed completely. Gate power dissipation can also be reduced by triggering the thyristor using a pulsed signal.

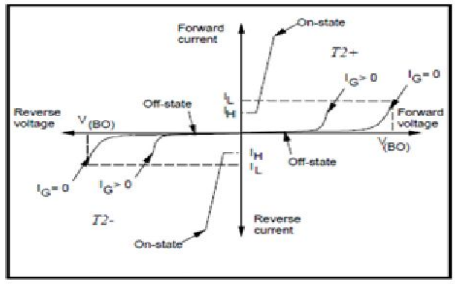

Figure 1: Characteristics Of Triac

3.1.Snubber Circuit

Snubbers are frequently used in electrical systems with an inductive load where the sudden interruption of current flow leads to a sharp rise in voltage across the current switching device, in accordance with Faraday's law. This transient can be a source of electromagnetic interference (EMI) in other circuits. Additionally, if the voltage generated across the device is beyond what the device is intended to tolerate, it may damage or destroy it. The snubber provides a short-term alternative current path around the current switching device so that the inductive element may be discharged more safely and quietly. Inductive elements are often unintentional, but arise from the current loops implied by physical circuitry. While current switching is everywhere, snubbers will generally only be required where a major current path is switched, such as in power supplies. Snubbers are also often used to prevent arcing across the contacts of relays and switches and the electrical interference and welding/sticking of the contacts that can occur.

A simple snubber uses a small resistor (R) in series with a small capacitor (C). This combination can be used to suppress the rapid rise in voltage across a thyristor, preventing the erroneous turn-on of the thyristor; it does this by limiting the rate of rise in voltage (dV/dt) across the thyristor to a value which will not trigger it. An appropriately-designed RC snubber can be used with either DC or AC loads. This sort of snubber is commonly used with inductive loads such as electric motors. The voltage across a capacitor cannot change instantaneously, so a decreasing transient current will flow through it for a small fraction of a second, allowing the voltage across the switch to increase more slowly when the switch is opened. Determination of voltage rating can be difficult owing to the nature of transient waveforms, and may be defined simply by the power rating the snubber components and the application. RC snubbers can be made discretely and are also built as a single component.

2.3.IC 9170 DTMF Decoder

This board decodes DTMF signal either from an audio source or phone line to 4 bit binary TTL(5V) level output. It also indicates outputs with LED. It can be use directly with microcontrollers to develop various DTMF related applications like remote monitoring, remote control, Caller ID, Auto Dialer and such.

The HT9170 series are Dual Tone Multi Frequency (DTMF) receivers integrated with digital decoder and bandsplit filter functions. The HT9170B and HT9170D types supply power-down mode and inhibit mode operations. All types of the HT9170 series use digital counting techniques to detect and decode all the 16 DTMF tone pairs into a 4-bit code output. Highly accurate switched capacitor filters are employed to divide tone (DTMF) signals into low and high group signals. A built-in dial tone rejection circuit is provided to eliminate the need for pre-filtering.

2.4.DTMF Output Table

Low Group (Hz)	High Group (Hz)	Digit	OE	D3	D2	D1	D0
697	1209	1	H	L	L	L	H
697	1336	2	H	L	L	H	L
697	1477	3	H	L	L	H	H
770	1209	4	H	L	H	L	L
770	1336	5	H	L	H	L	H
770	1477	6	H	L	H	H	L
852	1209	7	H	L	H	H	H
852	1336	8	H	H	L	L	L
852	1477	9	H	H	L	L	H
941	1336	0	H	H	L	H	L
941	1209	*	H	H	L	H	H
941	1477	#	H	H	H	L	L
697	1633	A	H	H	H	L	H
770	1633	B	H	H	H	H	L
852	1633	C	H	H	H	H	H
941	1633	D	H	L	L	L	L
—	—	ANY	L	Z	Z	Z	Z

Z: High impedance

Data output

The data outputs (D0~D3) are tristate outputs. When OE input becomes low, the data outputs (D0~D3) are high impedance.

Table 1

2.5.DIAC

The DIAC conducts current only after its breakover voltage has been reached momentarily.When this occurs, the diode enters the region of negative dynamic resistance, leading to a decrease in the voltage drop across the diode and, usually, a sharp increase in current through the diode. The diode remains "in conduction" until the current through it drops below a value characteristic for the device, called the holding current. Below this value, the diode switches back to its high-resistance (non-conducting) state. This behavior is bidirectional, meaning typically the same for both directions of current.Most DIACs have a three-layer structure with breakover voltage around 30 V. In this way, their behavior is somewhat similar to (but much more precisely controlled and taking place at lower voltages than) a neon lamp.DIACs have no gate electrode, unlike some other thyristors that they are commonly used to trigger, such as TRIACs. Some TRIACs, like Quadrac, contain a built-in DIAC in series with the TRIAC's "gate" terminal for this purpose. DIACs are also called symmetrical trigger diodes due to the symmetry of their characteristic curve. Because DIACs are bidirectional devices, their terminals are not labeled as anode and cathode but as A1 and A2 or MT1 ("Main Terminal") and MT2.

2.6.Optocoupler

we can use transformers to not only provide higher or lower voltage differences between their primary and secondary windings, but to also provide “electrical isolation” between the higher voltages on the primary side and the lower voltage on the secondary side. In other words, transformers isolate the primary input voltage from the secondary output voltage using electromagnetic coupling by means of a magnetic flux circulating within the iron laminated core. But we can also provide electrical isolation between an input source and an output load using just light by using a very common and valuable electronic component called an optocoupler.

An Optocoupler, also known as an Opto-isolator or Photo-coupler, are electronic components that interconnect two electrical circuits by means of an optical interface. The basic design of an optocoupler consists of an LED that produces infra-red light and a semiconductor photo-sensitive device that is used to detect this emitted infra-red light. Both the LED and photo-sensitive device are enclosed in a light-tight body or package with metal legs for the electrical connections as shown.

An optocoupler or opto-isolator consists of a light emitter, the LED and a light sensitive receiver which can be a single photo-diode, photo-transistor, photo-resistor, photo-SCR, or a photo-TRIAC and the basic operation of an optocoupler is very simple to understand.

2.7.Photo-Transistor Optocoupler

Assume a photo-transistor device as shown (fig-2). Current from the source signal passes through the input LED which emits an infra-red light whose intensity is proportional to the electrical signal. This emitted light falls upon the base of the photo-transistor, causing it to switch-ON and conduct in a similar way to a normal bipolar transistor. The base connection of the photo-transistor can be left open for maximum sensitivity or connected to ground via a suitable external resistor to control the switching sensitivity making it more stable.

When the current flowing through the LED is interrupted, the infra-red emitted light is cut-off, causing the photo-transistor to cease conducting. The photo-transistor can be used to switch current in the output circuit. The spectral response of the LED and the photo-sensitive device are closely matched being separated by a transparent medium such as glass, plastic or air. Since there is no direct electrical connection between the input and output of an optocoupler, electrical isolation up to 10kV is achieved.

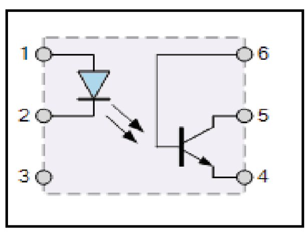

Figure 2: Photo Transistor

2.8.Triggering Circuit Of Triac

Figure (fig-3) shows a triac firing circuit employing a diac. In this circuit resistance R3 is variable where as resistance R1 has constant resistance. When R3 is zero, R1 protect the diac and triac gate from gating exposed to almost full supply voltage. Resistor R4 limits the current in the diac and triac gate when diac turns on the value of C2 and resistor R3 are so selected as to give as firing angle range of nearly zero degree and 180 degree. In practice however a triggering angle range of 10 degree and 170 degree is only possible by the firing circuit of the figure. (fig-3)

Variable resistor R3 controls the charging time of capacitor and therefore the firing angle of the triac. When R3 is small the charging time constant is small therefore source voltage charges capacitor to diac trigger voltage earlier and firing angle for triac is small. Likewise, when R3 is high firing angle of triac is large.

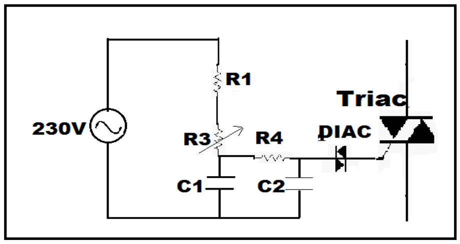

Figure 3: triggering circuit of triac

When capacitor C2 charges to breakdown voltage Vdt of driac, diac turns on. As a consequence, capacitor discharges rapidly there by applying capacitor voltage Vc in the form of pulse across the triac gate to turn it on. After triac turn on at firing angle α, source voltage Vs appears across the load during the +ve half cycle for (π-α) radians. When vs becomes 0 at ωt=π,triac turns off.after ωt=π,vs becomes negative, the capacitor c2 now charges with lower plates positive. When vc reaches vdt of diac ,diac and triac turn on and vs appears across the load during the negative half cycle for(π-α) radians. At ωt=2π , triac turns off again and the above process repeat.

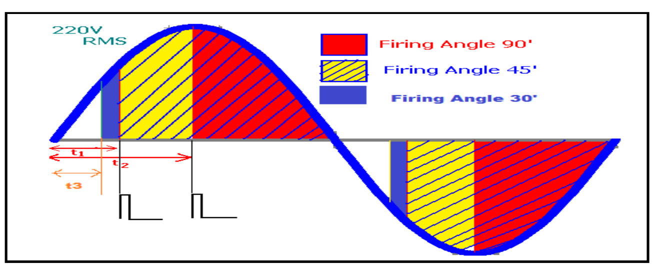

Figure 4: output waveform

From firining circuit of triac adjust the value of R3 as to higher the triac at 30 degree. At this condition, the voltage gain to the motor per phase is given by

α=30 degree

$$Vo=1/\pi \int Vm\sin\omega t\, d(\omega t) \quad \ldots(1)$$

now the source voltage per phase is 230 v. therefore at 30 degree trigging the voltage given to the motor will be approx $vm/\pi\ [\cos\pi+\beta-\cos\alpha]$ when $\alpha=30$ then the vo=135 v per phase .these are three triac in the circuit which fires at 30 degree and given a supply to motor $1/\sqrt{3}$ of the supply voltage per phase. Therefore the phase to phase voltage in the motor is $\sqrt{3}$*phase voltage equal to approx 230 v. this starting voltage is suitable for the motor starting and motor take a lower current then direct starting. The torque is also reduced in this condition by 1/3 of the direct straining.

3.Circuit Diagram

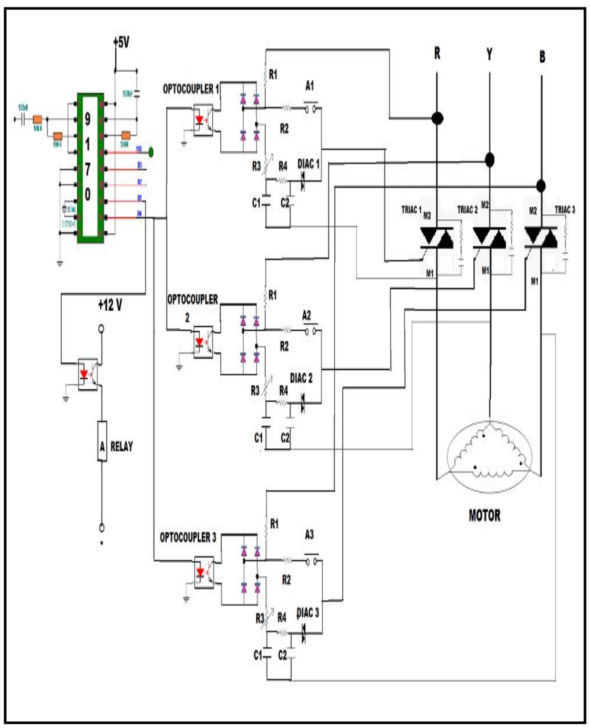

Figure 5: circuit diagram of starter

4.Project Working

First of all, transmitter mobile calls to the receiver mobile. In the receiver mobile the call is automatically received after two rings. Now the transmitter mobile in hand can be used as a remote. The key 1 is used for starting of the motor. When key 1 is pressed, a DTMF signal is received by receiver mobile and the receiver mobile send it to DTMF decoder IC 9170. This DTMF IC converts this DTMF pulse into a BCD code 0001. The output of pin 11 of DTMF IC is given to the three optocoupler. When DTMF signal is received by DTMF, it gives 0001 output at the pins. The optocoupler is like a switch. They are closed , when a input in the LED is high. The optocoupler is a switch connected in series in the firing circuit of Triac. When opto coupler is closed, the triggering circuit of the Triac is completed. It turns ON the triac at a firing angle 30 degree. The firing angle is adjusted by changing the R3 resistor value. At starting motor gets $1/\sqrt{3}$ of the line voltage. After 10-15 second the button 2 is pressed in transmitter mobile and it sends another DTMF signal, according this dtmf signal, DTMF IC gives a BCD code 0010, this makes to turn on the optocoupler 4. This turning on of optocoupler 4 enables to energize a DC relay. This relay has three normal open contacts which are closed when relay is energized. These contacts close the firing circuit of the triac directly and the triac is directly fired at zero degree. In this condition the triac gives a full supply voltage to the motor. The resistance R2 in the circuit controls the gate current. By pressing the key no 4 motor is Stopped.

5.Application

Water pumps, industry, traction, automation

6.Limitation

- Motor is started and stopped only in the presence of mobile network.
- It takes few seconds to operate the motor.

7.Acknowledgment

With the profound respect and gratitude we take the opportunity to convey our thanks to our project guide Mr .Bijendra kumar, Assistant professor of Electrical And Electronics Department of Galgotia`s collage of Engineering & technology, Greater Noida (Utter Pradesh), for his cooperation and guidance in the actual implementation of project.

I also heart fully thanks to all my friends who helps me to prepare my project. We will always be indebted to them for his valuable support.

8.Reference

1. M.H. Rashid, "Power Electronics: circuits, Device & Applications", Prentice Hall of India Ltd. 3rd Edition 2004.
2. M.D. Singh & K.B. Khanchandani, "Power Electronics" Tata MC Graw Hill, 2005.
3. P.S. Bimbra "Generalized theory of electrical machines" Khanna Publishers.
4. G.K. dubey, "Fundamentals of Electric Drives" , Norasa Publishing House.
5. Bimal K. BOSE, "Modern Power Electronics & AC Drives" Prentice Hall of India Ltd.