SOFT START OF INDUCTION MOTOR BY USING IGBT

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ABSTRACT: High rating of three phase induction motor beyond than 50 HP takes very high inrush current and low power factor at starting when connected directly to three phase supply. In order to avoid mitigate the adverse effects of starting torque transients and high inrush currents in induction motors, a popular method is to use electronically controlled soft-starting voltages utilizing IGBT's. Normally soft-starters are used for avoiding this problem and to achieve smooth starting of large capacity induction motors. Soft starters use ac voltage controllers to start the induction motor and to adjust its speed. The performance of a voltage-controlled large induction motor soft starter has been improved, resulting in nearly perfect current and torque profiles. Soft starters are used as induction motor controllers in compressors, blowers, fans, pumps, mixers, crushers and grinders, and many other applications. Starting torque pulsations are eliminated by triggering back-to-back-connected IGBT at proper points on the first supply voltage cycle. The soft starter is connected in motor drive during the starting condition only and once the motor get its rated speed then the soft starter is disconnected from the main motor system so that the motor get protected. For analysis of the various waveforms Digital Storage Oscilloscope Textronix TDS2024B is used.

Keywords: IGBT, Comprator, AC voltage regulator, Induction motor, soft starter, microcontroller, optoisolator.

I. INTRODUCTION

Like induction motor (IM) variable speed drives, soft starters are also essential components in every modern IM drives and automation systems. In almost every application the squirrel cage Induction Motor is used. Whenever a squirrel-cage induction motor is started, the electrical system experiences a current surge, and the mechanical system experiences a torque surge. With line voltage applied to the motor, the current can be anywhere between four to ten times the motor full-load current. The magnitude of the torque (or turning force) that the driven equipment will be in excess of 200% of the motor full-load torque. These current and torque surges can be reduced substantially by reducing the voltage supplied to the motor during starting. AC voltage controller-based soft starters offer many advantages over conventional starters such as the following. Smooth acceleration, which reduces stress on the mechanical drive system due to high starting torque hence increases the life and reliability of belts, gear boxes, chain drives, motor bearings, and shafts.Smooth acceleration reduces also stress on the electrical supply due to high starting currents meeting utility requirements for reduced voltage starting and eliminating voltage dip and brown out conditions. It reduces also the shock on the driven load due to high starting torque that can cause a jolt on the conveyor that damages products, or pump cavitations and water hammer in pipes. Thus, a fully adjustable acceleration (ramp time) and starting torque for optimal starting performance, provides enough torque to accelerate the load while minimizing both mechanical and electrical shock to the system. Energy savings at lightly loaded conditions. Energy savings by voltage control is achieved by reducing the applied voltage if the load torque requirement can be met with less than rated flux. This way, core loss and stator copper losses can be reduced . In this work an attempt is made to develop a soft starter for a three phase Induction Motor drive. The soft starter uses two anti parallel connected switches in each phase. The IGBT‟s are used as the switches in this work because of their higher power rating and high efficiency. The Fig. 1 shows the block diagram of the entire system. In the Fig.1 the motor is connected to the soft starter at the starting and once the motor get its rated speed then the soft starter is disconnected and the motor drive system take the control over the motor. By using soft starter the controlled voltage is applied at the motor input so the motor is protected and life of motor increases.

II. METHODOLOGY.

A.OPERATING PRINCIPLE

This project attempts a new speed control technique for single phase AC induction motor. It has low cost, high efficiency drive capable of supplying a single phase induction motor with PWM modulated sinusoidal voltage. The circuit operation control by an 8051 family microcontroller.The device is aimed at substituting commonly used TRIAC phase angle control drives. The circuit is capable of supplying single phase induction motor (inductive or resistive load) with varying AC voltage.

B. BLOCK DIAGRAM

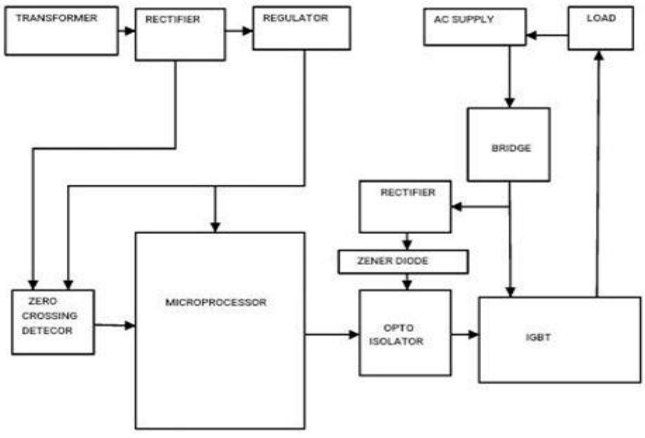

Fig.1 Block diagram of soft start of induction motor by using IGBT

It is same as in TRIAC control, the voltage applied to load can be varied from zero to maximum value. On the other side, a pulse width modulation technique (PWM) is used and it is compared with the phase angle control and used for TRIAC, it produces much lower high order harmonics. Because the circuit is aimed at low-cost, medium-power applications, to produce the output voltage waveform it does not use a conventional converter topology.It modulates the mains AC voltage. As compared with costly converter, it requires minimum number of active and passive power components. The device attempted here takes advantage of both the low cost of the phase angle control and the minimum harmonic content and greater efficiency which get standard converter topology. The drive uses a PWM controlled MOSFET then the load in series with a bridge rectifier. This drive based on this proposed control technique is used in consumer and industrial products like fan, washing machine, dishwashers, ventilators etc. The input terminals of the rectifying bridge are connected in series with load. The output terminals (rectified side) has power transistor (IGBT, MOSFET or bipolar) connected across them. Current cannot flow through the rectifying bridge when the power transistor is off then the load which is in series and remains in an offstate. The bridge output terminals are short-circuited, when the power transistor is on and then current can flow through the rectifying bridge and thus through the load. The power to the load is controlled by changing the duty cycle of PWM pulses. Thus the special care is taken by the circuit such that the PWM pulses are synchronized with the supply phase by zero voltage sensing point.

C.HARDWARE SYSTEM

1.MicrocontrollerAT89S52:

The 89c52 is commonly used microcontroller have 8K byte program The AT89S52 is a low-power, high-performance CMOS 8-bit microcontroller with 8K bytes of in-system programmable Flash memory. The AT89S52 provides the following standard features: 8K bytes of Flash, 256 bytes of RAM, 32 I/O lines, Watchdog timer, two data pointers, three 16-bit timer/counters, a six-vector two-level interrupt architecture, a full duplex serial port, on-chip oscillator, and clock circuitry. In addition, the AT89S52 is designed with static logic for operation down to zero frequency and supports two software selectable power saving modes. The Idle Mode stops the CPU while allowing the RAM, timer/counters, serial port, and interrupt system to continue functioning. The Power-down mode saves the RAM contents but freezes the oscillator, disabling all other chip functions until the next interrupt or hardware reset.

2.Opto-isolator(MOC3021):

In this project we have an opto-coupler MOC3021 an LED diac type combination. Additionally while using this IC with microcontroller and one LED can be connected in series with IC LED to indicate when high is given from micro controller such that we can know that current is flowing in internal LED of the opto-IC.When logic high is given current flows through LED from pin 1 to 2. So in this process LED light falls on DIAC causing 6 & 4 to close. During each half cycle current flows through gate, series resistor and through opto-diac for the main thyristor / triac to trigger for the load to operate. The opto-coupler usually found in switch mode power supply circuit in many electronic equipment. It is connected in between the primary and secondary section of power supplies.

3.IGBT(Insulated Gate Bipolar Transistor):

It is evident that the silicon cross-section of an IGBT is almost identical to that of a vertical Power MOSFET except for the P injecting layer. It shares similar MOS gate structure and P wells with N source regions. The N laye at the top is the source or emitter and the P layer at the bottom is the drain or collector. It is also feasible to make P-channel IGBTs and for which the doping profile in each layer will be reversed. IGBT has a parasitic thyristor comprising the four-layer NPNP structure. Turn-on of this thyristor is undesirable.

Steps:

I] START.

II] Initialize port pin and functions.

III] If INCR button is pressed then it will increase the firing angle of IGBT by 10%.

IV] If DECR button is pressed then it will decrease the firing angle of IGBT by 10%.

V] Stop.

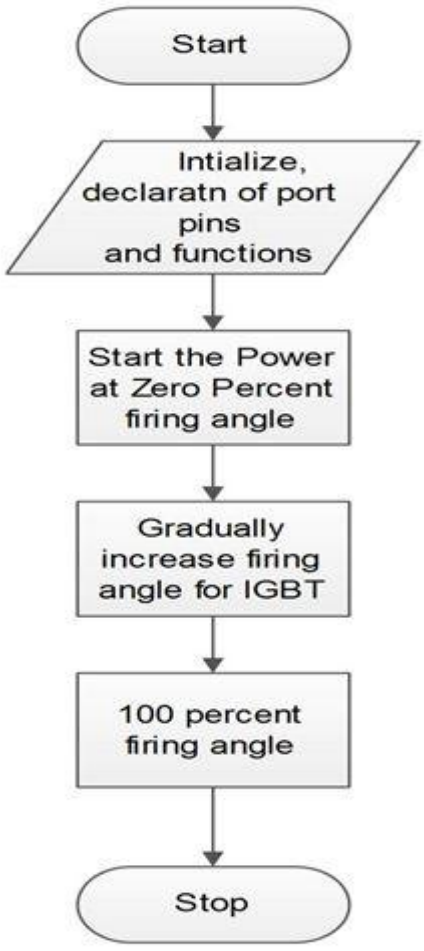

Fig.2 Flowchart of project system

III. CONCLUSION

Microcontroller based system can be efficiently used for soft starting of induction mtor by using IGBT along with pulse width modulation technique.

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