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Micro-Controller Based Soft Start for three Phase Induction Motor

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***Abstract*—** This project attempts a new speed control technique for the A.C three-phase induction motor. It uses optimized soft-start to start induction motor. At the time of starting Induction motor draws high amount of current (Starting Current) which is 6 times of full load current, to prevent this starter is needed. Here we are using PIC18F4550 to control the soft-start. Input control signal to PIC, which gives Digital output to DAC (Digital to analog converter). DAC converts digital input of PIC to analog output. This analog output is given to Op-Amp, for maintain reference output, which in turn is gives supply to opto-coupler for protection of Control Circuit. It presents a design of a low-cost; high-efficiency drive capable of supplying a three-phase induction motor.

***Keywords*—** Soft-start, Induction Motor, Micro-controller, Proteus, Digital to Analog Converter.

I. INTRODUCTION

An induction motor is similar to a poly-phase transformer whose secondary is short circuited. Thus, at normal supply voltage, like in transformers, the initial current taken by the primary is very large for a short while. If an induction motor is directly switched on from the supply, it takes 5 to 7 times its full load current and develops a torque which is only 1.5 to 2.5 times the full load torque. This large starting current produces a large voltage drops in the line, which may affect the operation of other devices connected to the same line. Hence, it is not advisable to start induction motors of higher ratings (generally above 25kW) directly from the mains supply.

Various starting methods of induction motors are described below: -

1. Direct-on-line (DOL) starters:

Small three 3 phase induction motor can be started direct-on-line, which means that the rated supply is directly applied to the motor. But, as mentioned above, here, the starting current would be very large, usually 5 to 7 times the rated current. The starting torque is likely to be 1.5 to 2.5 times the full load torque. Induction motors can be started directly on-line using a DOL starter which generally consists of a contactor and a motor protection equipment such as a circuit breaker. In order to avoid excessive voltage, drop in the supply line due to large starting current, a DOL starter is generally used for motors that are rated below 5kW.

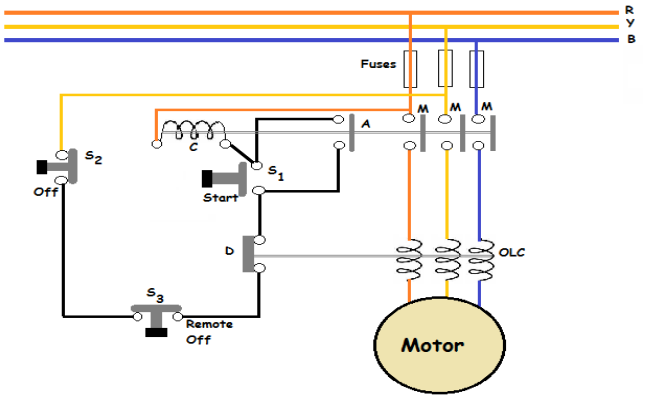

Fig 1: - DOL starter

2. Auto-transformer Starter:

Auto-transformer starter is also known as auto-starters. They can be used for both star connected and delta connected squirrel-cage induction motor. It is basically a three phase step down transformer with different taps provided that permit the user to start the motor at, say, 50%, 65% or 80% of line voltage. With auto-transformer starting, the current drawn from supply line is always less than the motor current by an amount equal to the transformer ratio.

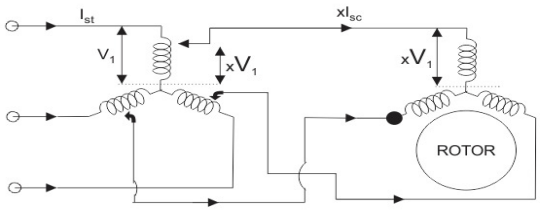

Fig 2: - Auto Transformer starter

3. Star-delta starter:

This method is used in the motors, which are designed to run on delta connected stator. A two-way switch is used to connect the stator winding in star while starting and in delta while running at normal speed. When the stator winding is star connected, voltage over each phase in motor will be reduced by a factor 1/(sqrt. 3) of that would be for delta connected winding. The starting torque will 1/3 times that it will be for delta connected winding. Hence a star-delta starter is equivalent to an auto-transformer of ratio 1/(sqrt. 3) or 58% reduced voltage.

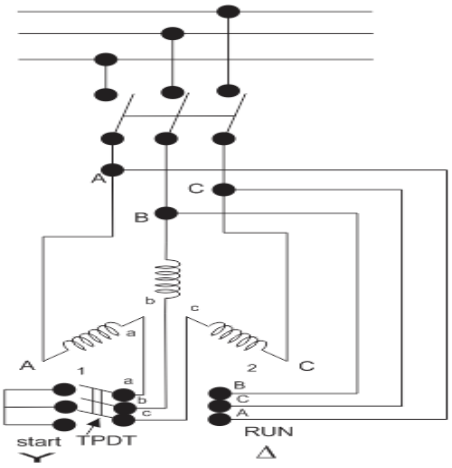

Fig 3: - Star-Delta starter

4. External Resistance Staring:

Slip-ring motors are started with full line voltage; as external resistance can be easily added in the rotor circuit with the help of slip-rings. A star connected rheostat is connected in series with the rotor via slip-rings as shown in the fig. Introducing resistance in rotor current will decrease the starting current in rotor (and, hence, in stator). Also, it improves power factor and the torque is increased. The connected rheostat may be hand-operated or automatic.

As, introduction of additional resistance in rotor improves the starting torque, slip-ring motors can be started on load.

The external resistance introduced is only for starting purposes, and is gradually cut out as the motor gathers the speed.

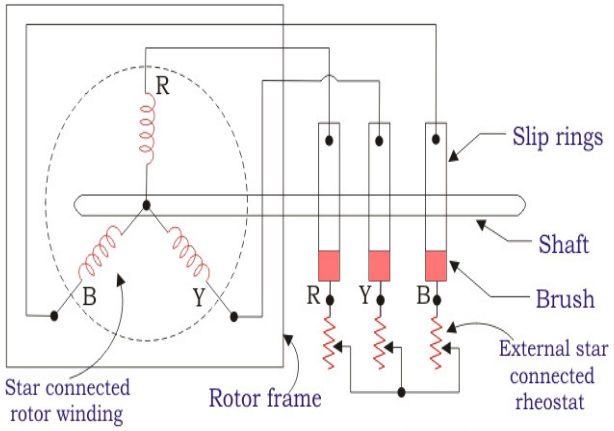

Fig 4: - Ext. Resistance starter

II. SOFT START & PROPOSAL MODEL

A. Soft Starter Introduction

An induction motor connected directly to the power supply draws a constant magnetizing current at full speed, no matter what the load is. At anything less than full load, power factor of the induction motor is less than its rated power factor because the torque producing current decreases as the load decreases, but the magnetizing current does not change. The lighter the load, worse the power factor.

Motors selected from a standard range are almost always chosen with a rated power in excess of maximum load demand, with the result that in any installation the motors seldom operate at their full rated load. Consequently, they can never achieve their rated power factor even at a maximum load demand. Moreover, if the load is variable. Maintaining the Integrity of the Specifications:

B. Soft Starter Introduction

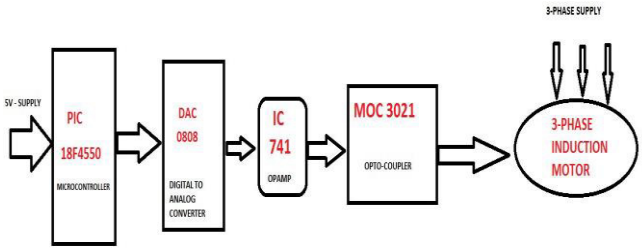

Fig 5: - Proposed system

Fig 5 suggest, giving supply to PIC microcontroller, which gives controlled output to DAC (Digital to Analog Converter). DAC converts digital input of PIC to analog output. This analog output is given to Op-Amp which in turn gives supply to opto-coupler for protection of control circuit

form high voltage supply. It presents a design of a low-cost; high-efficiency drive capable of supplying a three-phase a.c. induction motor. Finally, complete content and organizational editing before formatting. Please take note of the following items when proofreading spelling and grammar:

III. SIMULATION AND EXPERIMENTAL SETUP

Table 1: - Ratting of Experimental Induction motor

K.W(H.P)	.75(1)
VOLTS	415±6%
FREQUENCY	50 Hz
FRAME	80
PHASE	3
R.P.M	1450
AMPS	2.1
RATING	CONT
INSULATION- AMBIENT TEMPERATURE	B-40c
CONNECTION	STAR

IV. MODEL VALIDATION

The software stimulation has been done in proteus. The pic programming has been first made in C Language then has been made into hex code. In proteus the 3 phase induction motor is not available. So in the place of 3 Phase IM we have used three Bulbs. Each bulb represents each phase of Induction motor.

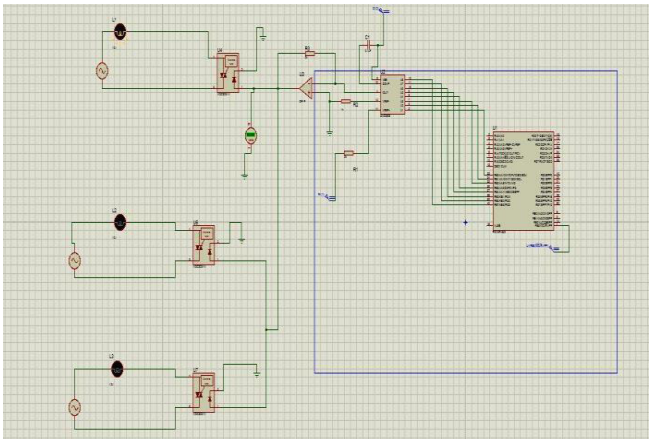

Fig 6: - Proposed simulated system

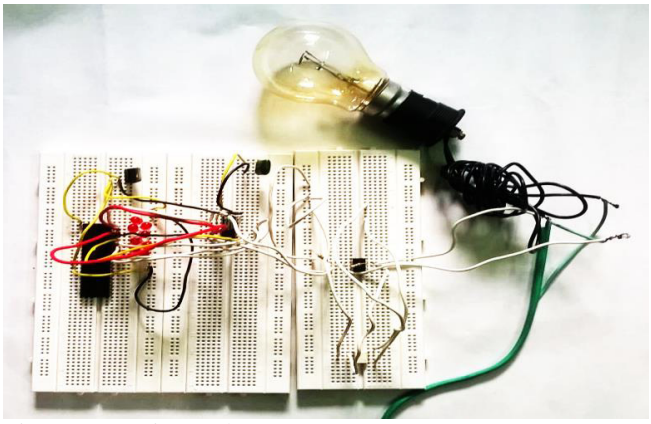

Fig 7: - Experimental setup 1

The model for this soft-start has been made successfully. The induction motor has been replaced with the bulb and a prototype has been made. The prototype has been run on PROTEUS successfully. In experimental setup 2 (Fig 8) full hardware circuit and setup will be given

Fig 8: - Complete hardware circuit

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V. RESULTS AND DISCUSSION

Some of the values from entire 256 bits are given in Table 2. Starting current and speed of the motor is gradually increase to its final values of current and speed (in no load condition). In auto transformer of Star delta peak of starting current is 6Amps (1 hp motor) but in this model reduce that peak current. Fig 8 shows the characteristics of different starting current of using different starting topology.

Table 2: - Experimental table

BINARY BITS FROM MCU	VOLTAGE ACROSS DAC (V)	VOLTAGE ACROSS OP-AMP (V)	VOLTAGE ACROSS LOAD (SINGLE PHASE) (V)	STARTING CURRENT (A)	SPEED OF MOTOR (RPM)
00000000	0	0	0	0	0
00001111	0.003	0.56	25	0.02	90
11110000	0.047	207.06	414	1.7	1364
11111111	0.05	220	440	2.1	1450

Characteristics of DAC are not linear some some noise is happened in time of experiments.

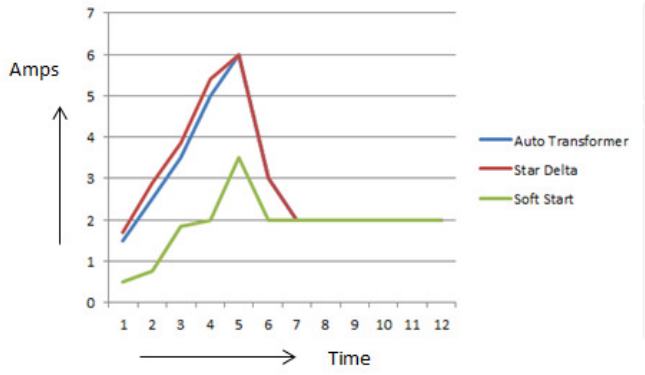

Fig 9: - Comparison chart

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REFERENCES

[1] J. A. Kay, R. H. Paes, G. Seggewiss, and R. G. Ellis, "Methods for the Control of Large Medium-Voltage Motors: Application Considerations & Guidelines," IEEE Trans. Industry Applications, Vol. 36, No. 6, pp. 1688-1696, November/ December 2000.

[2] A. K. Mukhopadhyay, "Matrix Analysis of Electrical Machines", New Age International Limited Publishers, 2003, ch. 7, pp.77-104.

[3] I. F. Akyildiz, X. Wang, and W. Wang, "Wireless Mesh Networks: A Survey", Computer Networks and ISDN Systems, Vol.47, Issue-2, **2005**, pp.**445-487**.

[4] Blaabjerg, F., Pedersen, lK., Rise, S., Hansen, H.-H. and Trzynadlowski ,A. M. (Sept.-Oct. 1997). Can Soft Starter Help Save Energy. IEEE Industry Applications Magazine, Vol. 3, pp. 56 - 66.

[5] Lukitsch, W,J (4-6 May 1999). Soft Starter Vs AC Drivers Understand the Differences. IEEE Textile, Fiber and Film Industry Technical Corfe rence, p. 5.

[6] Sastry, V.V., Prasad, M.R. and Sivakumar, T.V (Nov. 1997). Optimal soft starting of voltage-controller-fed 1M drive based on voltage across thyristors. IEEE Transactions on Power Electronics, Vol. 12, pp. 1041 - 1051.

