Journal of Science Engineering Technology and Management Science
Volume 02, Issue 01, January 2025
www.jsetms.com

A Comparative Analysis of a New Approach to Induction Motor Starting

Raja Sekhar Reddy[1] and Niharika[2]
Department of Electrical and Electronics Engineering, PES University, Bangalore
Corresponding Author: rsreddy121@gmail.com

To Cite this Article
Raja Sekhar Reddy and Niharika, "A Comparative Analysis of a New Approach to Induction Motor Starting", Journal of Science Engineering Technology and Management Science, Vol. 02, Issue 01, January 2025, pp:15-19

***Abstract**: A polyphase induction motor's starting current is five to eight times its rated current when it is started from rest with full voltage impressed. Such a motor's huge line current is undesirable since it may cause a sudden reduction in the supply circuit's voltage and have an unfavorable effect on other connected loads or devices. Therefore, it is common practice to use auto transformers, star delta starters, and other devices to start such motors at a lower voltage. This work presents a novel technique for starting polyphase induction motors without the need for a primary voltage compensator, which lowers the inrush of the starting current. The motor's appropriately accelerated rotor is then driven in the designated direction of rotation using a crank-driven system. After that, the motor is tested with its rated voltage applied. Through oscillographic recordings obtained from experiments, where the results are contrasted with the various beginning approaches, this is illustrated with a case study on a three-phase, five-horsepower NGEF motor.*

***Keywords**: Starter, inrush current, voltage drop, induction motor, and novel method*

I. Introduction

Compared to other motor types with the same rated power and speed, three phase induction motors are more durable, require less maintenance, and are also less expensive. As a result, these motors are widely used in all industrial settings, from tiny workshops to major corporations. When the stator's three-phase winding is powered by a balanced three-phase ac supply, a uniformly rotating magnetic field of constant magnitude is created. The spinning field sweeps across the rotor conductors, causing an induced electromagnetic field (emf). The rotor conductors' current-carrying element is comparable to a short-circuited winding. The interplay between the rotor current and the field created by the stator winding results in the torque required to rotate the motor. The starters are usually utilized to start such motors in order to limit the inrush of current that is at least seven to nine times the motor's rated current. It will lessen the negative impact on the associated loads and devices as well as the effect on the system voltage. A substantial starting current drawn by the motor is seen as such because of the huge relative speed between the rotor conductors at stationary and the field rotating at synchronous speed. According to Faraday's law, the rate at which flux linkage changes determines the size of the induced emf. Since the relative speed is at its highest, the rotor-induced emf is likely to be significant, and the current that results around windings with finite resistance will be big and flow, which is the only thing that can stop the current from flowing.

At startup, the rotor induced emf magnitude is rather strong, which causes a high current to flow through the rotor winding. Therefore, when the stator is started in this way, it draws a lot of current at beginning, which causes a substantial loss of copper in the motor and damage to the insulation in the winding, in addition to lowering system voltage and adversely influencing the loads on the same line. The rotor being at a stop and requiring more energy to overcome inertia and start could be another reason for the high beginning current. Therefore, it is standard procedure to use auto transformers, star delta starters, etc. to start these motors at a lower voltage.

II. Induction Motors Starting without a Starter

The equipment utilized for starting is not used in this procedure. Large induced emf results from the spinning field trailing the subpar rotor conductor circuit delivery when electricity is given to the motor while it is at rest. The induced emf in the rotor circuit is decreased when voltage is applied but the relative speed between the two arms is decreased beforehand. Here, the rotor is rotated at the proper speed via mechanical means before to receiving the rated voltage. The crank drives the rotor shaft, which impresses the rated voltage. The rotor's induced emf is caused by the relative speed being significantly reduced as it moves. Therefore, in comparison to the current in the rotor circuit at the moment that the first current is launched, the current delivered to the rotor circuit during that instant is fair.

Fig 1: Induction Motor for experimental purpose

As a result, the motor uses little electricity from the supply when it first starts. Nevertheless, it is important to double-check that the rotor is being driven in the designated rotational direction. It would be disastrous to drive it in the opposite direction from where it is intended. This issue would be resolved by using such a crank, which will liberate the wheel if the shaft is attempted to be rotated in the opposite direction and clutch the shaft when it is spun in the proper way. In this instance, the beginning current is determined by the speed at which the rotor is driven. When the rotor operates at high speeds, the relative speed decreases because the current is also diminished. Accordingly, induction motors make up 80% of industrial drives, with 75% to 95% of them being squirrel cage induction motors. Typically, 70% of these drives are "starting without load." As a result, this motor starting scheme is better suited for starting motors that are operating or have a light load.

III. Case Study

A case study is conducted on a three-phase, NGEF-made induction motor with 5 horsepower (3.7 KW), 415 V, 50Hz, 1440 rpm, and 7.3A. Starting the suggested plan is akin to starting a motor using a star delta starter. The following describes the methodology and findings from the experiments. The motor was started using a star delta starter, and a digital scope was used to record the waveform of the starting current.

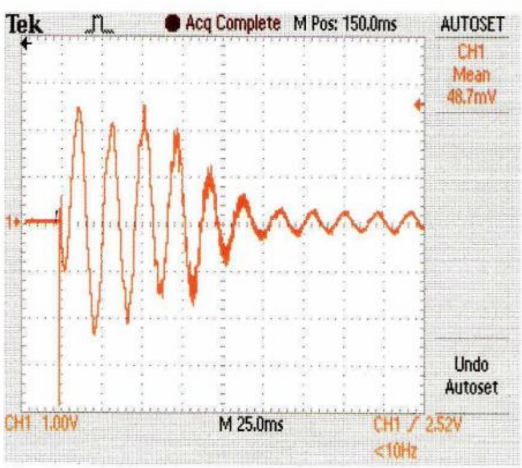

Fig 2: Using a star delta starter to start the current waveform

When repeated for various random switching instants, the resulting waveforms are displayed in Figures 2 and 3. The switching transition in FIG. 4 is also represented by another model. The rotor is driven by a crank driving mechanism at 1320 rpm, after which the stator windings get the rated voltage. The fifth, sixth, and the different current waveforms acquired at random switching instants for the same supply voltage are displayed in Fig. 7, and the suggested beginning approach and switching transients are shown in Figs. 5, 6, and 7.

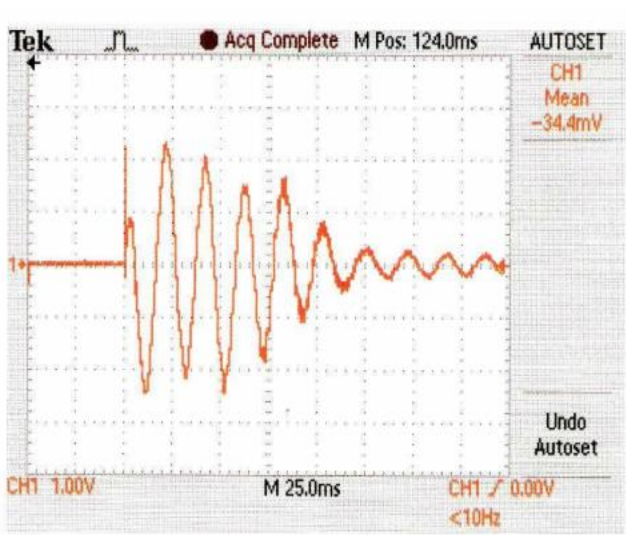

Fig 3: Using a star delta starter to start the present waveform (at some other switching instant)

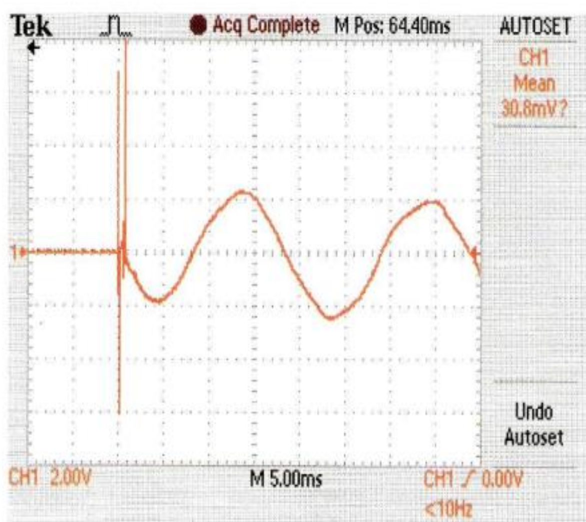

Fig 4: using a star delta starter to switch transients.

IV. Inferences

The following conclusions are made in light of the experimental findings and in compliance with the theory and principle of operation of induction motors.

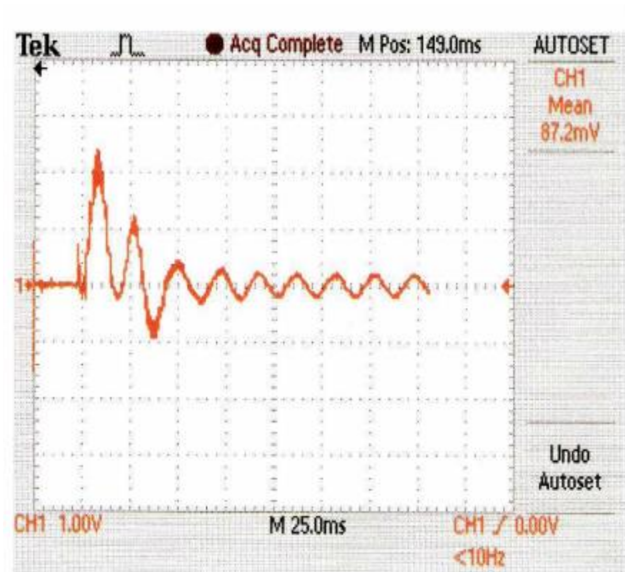

Fig 5: beginning the current waveform using the suggested starting technique. (The initial rotor speed prior to delivering the voltage is 1320 rpm.)

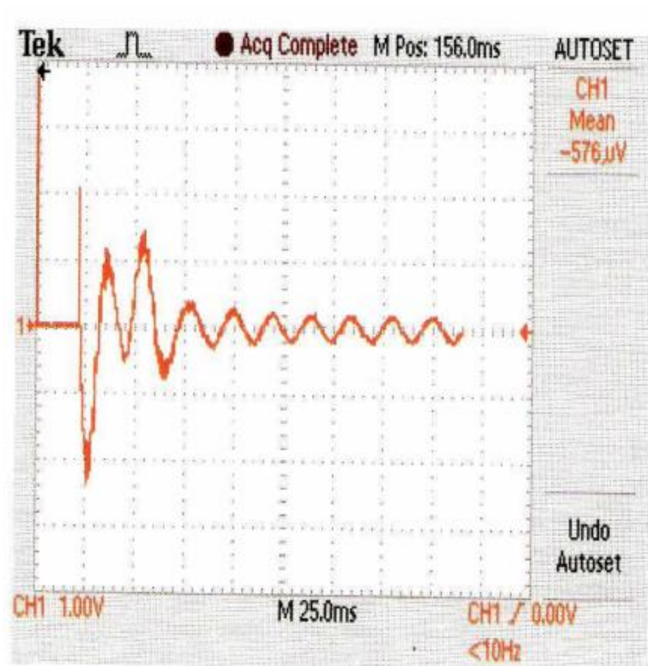

Fig 6: Current waveform using the suggested starting technique.(At some other switching instant before to applying the voltage, the initial rotor speed is 1320 rpm.)

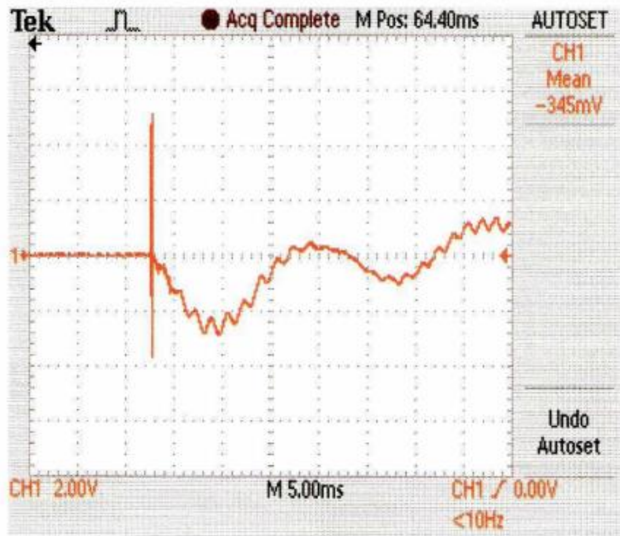

Fig 7: Using the suggested technique to begin switching transients

V. Comparison of Different Starting Techniques

In this instance, the beginning current is 8–9 times the rated current, and the motor is started straight to full supply voltage. Motors under 5kW with starting torque in the range of 0.55 to 4 times the rated torque are used with DOL starters. For a delta connected motor, the motor's phase voltages and phase currents are lowered to 1/ (square root of 3) of its direct-on line. For each line of line current in a delta, the line current value is 4. Star delta starters are used to start the majority of machines with moderate capacities, and their starting torque is generally rather good. The rotor circuit's increased resistance lowers the beginning current and permits starting up to a current level of 2 to 3.5 times the rated current and a torque of 3 to 4.8 times the rated torque. When reactance's and resistances are connected in series, a lower voltage is supplied initially. This lowers the current, but it will keep losing power. Additionally, the motor's starting voltage is reduced, which in turn reduces the beginning current and torque. Its advantage is that by choosing the appropriate tapping on the autotransformer, the torque and current values may be adjusted to match the desired value. It costs extra.

IV. Conclusion

When these induction motors are starting under light load, they can be started using this technique. These enable bringing the beginning current's limit inrush to a secure level. The motor's life will be guaranteed because the decreased heating impact will likewise exist without endangering the insulation. This reduces the system disruption to a higher degree and prevents unwanted effects on linked loads and devices. It is more cost-effective because there are no startup equipment purchases or operating expenses. There is no deviation in the motor performance. Consequently, it is preferable to start an induction motor using this way. The initial current drawn is comparatively modest when using the other starting procedures.

References

[1]. K. Singh Rathod Mehta, M. Rabheek Khan, and P. Raghavendra Mehta 2004, "Power Consumption Routing Technology in Induction Motors." In Proceedings of the 10th Annual IEEE international Conference on Mobile Networking (Delhi, India, January 12-32, 2005).

[2]. B.B.. D. Mehata Singh and A. Naga Lakshmi, "Power Consumption Routing in Adhoc Networks using Induction motors" Wireless Satellite Communications, Springer Volume 02, Issue 02, February. 2010 Page(s):32-43

[3]. S. Rajendra, S. Anand Kumar, M. Tole Sukhe, "Satellite Communication in Wireless Relay Networks" Mc Graw Hill Press 1999, Chapter 12, Page(s): 43-142

[4] N.Rana Singh and J.K. Tony Lee, "Distribution of Wireless Networks using Relays Concepts: Open Discussions in Relay Networks, " Springer Volume 09, Issue 02, January. 2012 Page(s):67-82

[5] M. Lohit Khan, S. Manoj Yadav and E.Rohit Kapoor Sivakumar, "Implementation of Space Time Space Codes in Diversity Relay Networks" Workshop on Wireless Communication, 2010. Proceedings. Conference on 09-11 November. 2008 Page(s):18-26

[6] C.Sohail Khan, P.S.Arbaz Khan and Sk.Islam, "Wireless Relay Networks in MIMO Designing Concepts throughput enhancement in wireless ad hoc networks" Areas in Wireless Communications, IETE Journal on Volume 12, Issue 8, December 2010 Page(s):67 – 92