



THREE-PHASE ELECTRIC MOTOR CONTROL WITH A MANUAL FORWARD REVERSE CONTROL SYSTEM EQUIPPED WITH A DELAY TIMER

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ABSTRACT

The control of three-phase electric motors with manual forward and reverse control systems equipped with off-timers (TOF) is a production solution with a simple structure and relatively low cost compared to other systems. Three-phase induction motors typically work via electromagnetic induction from the stator winding to the rotor, making them the preferred choice in both large and small industries due to their accommodativity and efficiency. The purpose of this study was to determine and analyze the control of a three-phase electric motor with a manual back and forth control system equipped with a delay timer. The research method used is secondary data analysis from various relevant and valid sources. The results showed that the manual back and forth control system with TOF is very effective in moving production equipment efficiently and reliably. The implications of this study show that with current technological developments, the use of three-phase electric motors with manual back and forth control systems equipped with TOF has become very important in improving operational efficiency and effectiveness in the industrial world.

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INTRODUCTION

Three-phase electric motor control with a manual forward reverse control system equipped with an off-timer (TOF) (Jannati & Idris, 2017). It is a production with a simple structure commonly used because the price is relatively cheap and affordable compared to other productions. The induction commonly used in 3-phase motors usually uses electromagnetic induction from the stator to the rotor windings. We took this research method from existing data, and it can be used to help complete this research. Forward Reverse is a system commonly used because it functions as a driver for a production tool (Wu et al., 2015). This is related to the title we took that controlling a 3-phase electric motor requires Forward Reverse. Three-phase electric motors are widely used in large and small industries because they are accommodating compared to other motors (Rachmat & Ruhama, 2014). With current technological developments, using 3-phase electric motors is very important in the industrial world. Electric motors convert electrical energy into mechanical energy (Amalia et al., 2023).

Electric motors are ubiquitous in various industrial and commercial applications due to their efficiency and versatility (Kristianto & Fat, 2023). Among the different types of electric motors, three-phase motors are widely used for their robustness and reliability (Abdalla, 2022). Controlling the direction of rotation of a three-phase motor is essential for many industrial processes, and one common method is through a manual forward-reverse control system equipped with a delay timer (Jaya, 2016). This system allows operators to switch the motor's direction manually, providing flexibility and

control over machinery operations(Raynonto et al., 2023). In this paper, we explore the design and implementation of such a control system, focusing on its structure, functionality, and practical applications in industrial settings.

The manual forward-reverse control system consists of several key components, including a control panel, contactors, overload relays, and a delay timer (Putra, 2020). The control panel typically features a selector switch or a toggle switch, allowing operators to choose between forward, reverse, or stop modes (Jatmiko, 2015). When the desired direction is selected, the corresponding contactor is energized, connecting the motor windings in the appropriate configuration to achieve the desired rotation. Additionally, overload relays are incorporated into the system to protect the motor from damage in case of overcurrent conditions. The delay timer adds an extra layer of functionality by introducing a time delay between switching directions, preventing sudden changes that could impact machinery and ensuring smooth transitions.

Practical applications of this manual forward-reverse control system are abundant across various industries, including manufacturing, agriculture, and construction (Prastyo, 2023). For instance, in conveyor belt systems, the ability to reverse the motor's direction is crucial for controlling the movement of materials and preventing jams or blockages. Similarly, in irrigation systems, the capability to switch between forward and reverse rotation enables efficient water distribution and prevents clogging in pipes. By implementing this control system, operators can optimize the performance of machinery, improve productivity, and enhance overall operational safety.

METHOD

We took this research from existing data and other references that match our title: Three-phase electric motor control with a manual forward reverse control system equipped with a timer-off delay (TOF). In this study, a system was designed to control a three-phase electric motor using a manual forward-reverse control system equipped with an off-delay timer. Components such as the three-phase electric motor, contactor, manual control switch, and timer were carefully selected based on their compatibility and suitability for the desired application. The wiring configuration of the system was adjusted according to industry standards and manufacturer specifications to ensure proper electrical connections and system safety. Experiments were conducted by mounting the motor, contactor, manual control switch, and timer on a test bench to facilitate testing and evaluation. The testing procedure involved manually operating the control switch to initiate forward and reverse motor rotation, with observations made regarding the system's response and relevant data recorded, such as motor speed and timer delay duration. Data on motor performance, timer delay, and system operation were collected during testing, and statistical analysis was performed to evaluate the system's performance and reliability. In cases where simulations were conducted, the system model was developed using appropriate simulation software. Simulations were performed to validate the design and predict system behaviour under different operating conditions. Experimental results were validated against theoretical calculations and simulation outcomes to ensure the accuracy and reliability of the system design. Parameters such as timer delay settings and control switch positions were adjusted to optimize system performance and efficiency. Throughout the experimental process, ethical considerations were taken into account, including safety precautions and environmental impact, to ensure the well-being of personnel and minimize adverse effects on the surroundings.

RESULTS AND DISCUSSION

It has an essential safety system in the interlock system. In the Time Off Delay (TOF), this circuit is considered very safe because every movement has been considered for safety. The price of electric motors is also relatively low, the power of electric motors is greater, and the efficiency is high (Ilham & Abidin, 2022). This 3-phase forward reverse motor circuit has been widely used in various industries, especially those with multi-storey buildings, for example, applied to elevators (Naim, 2021). This title aims to provide an understanding of motor control—Three-phase electric circuits with a manual forward reverse control system equipped with TIMER OF DILLAY (TOF). In the industrial world, with current technological developments, the use of 3-phase electric motors is essential; electric motors work to convert electrical energy into mechanical energy (Purba, 2022). The working principle of a 3-phase electric motor is to utilize the magnetic field interaction between the rotor, and when the rotor rotates, the magnetic field changes and makes the rotor move. This makes the motor work and produces rotation (Evalina et al., 2018). This research aims to realize and improve a 3-phase motor control system so that we can conclude how the 3-phase motor system with a forward reverse circuit performs. In carrying out this research, we use direct experiments; we do not have a particular method, but directly based on existing data and evidence; we have also tested this circuit based on practical experience with 3-phase motors; we will carry out a control system test so that we will obtain control system test results. Using a 3-phase motor is important because the motor components are very effective. By providing AC electric current, several tools will be used in the forward-reverse circuit of a 3-phase electric motor, namely a +/- screwdriver, combination pliers, and a test pen. The electric motor will work if we press the ON1 push button then electricity will enter the contactor coil so the motor will operate when we press the OFF push button the electric current entering the contactor coil is cut off thereby making the motor stop, when pressing the ON2 push button the motor will rotate opposite direction.

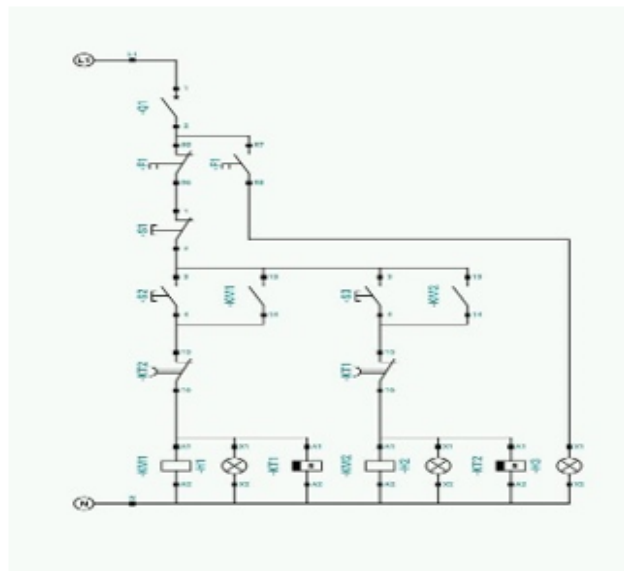


Figure 1. Control Series

In this setup:

- A three-phase electric motor is the primary drive.
- A manual forward-reverse control system allows users to select the rotation direction.
- A contractor manages the power supply to the motor based on the chosen direction.

d) An off-delay timer ensures the motor continues operating for a set time after removing the control signal.

Here is how it works:

- a) The user selects forward or reverse via a manual switch.
- b) The contactor closes, allowing power to the motor.
- c) An off-delay timer activates.
- d) The timer keeps the motor running for a set time after signal removal.
- e) The timer disengages, cutting power to the motor.
- f) The system awaits new user input.

This system offers manual control over a three-phase motor's direction, with a delay ensuring operation for a specified time after signal loss. It is helpful in tasks requiring completion before shutdown. Such a system finds extensive use in industrial settings due to its versatility and reliability. Let us delve deeper into its components and operation:

Components:

- a) Motor: The heart of the system, typically a robust three-phase electric motor capable of handling various loads.
- b) Manual Control System: This system offers tactile control to operators, allowing them to switch between forward and reverse modes effortlessly.
- c) Contactor: Acting as the gateway for power, the contactor manages the flow of electricity to the motor based on the chosen direction.
- d) Off-Delay Timer: This is critical as it ensures the motor continues running for a specific duration after the control signal ceases, offering additional flexibility in operations.
- e) Operation:
- f) User Input: Operators select the desired direction (forward or reverse) through the manual control system.
- g) Contactor Activation: Upon receiving the input, the contactor corresponding to the chosen direction closes its contacts, enabling the power flow to the motor.
- h) Timer Activation: Simultaneously, the off-delay timer is triggered, initiating its timing cycle.
- i) Continued Operation: The timer keeps the motor running throughout the delay period, even if the control signal is removed. This feature is particularly advantageous in scenarios where additional time is needed for processes to complete.
- j) Timer Completion: Once the preset delay period elapses, the off-delay timer disengages, interrupting the power supply to the motor.
- k) System Reset: The system returns to a standby state, awaiting further input from the user for subsequent operations.

Applications:

- a) Conveyor Systems: Controlling the direction of conveyor belts for material handling operations.
- b) Machine Tools: Regulating the rotation of tools and spindles in machining processes.
- c) Winches and Hoists: Managing crane and hoist systems' lifting and lowering actions.
- d) Pumps and Fans: Adjusting the flow direction in pumping and ventilation systems.

Advantages:

- a) Flexibility: Operators can easily switch between forward and reverse modes as needed.
- b) Process Optimization: The off-delay timer ensures processes can be completed before the motor shuts down, enhancing efficiency.

- c) Reliability: By incorporating manual controls and simple electromechanical components, the system boasts high reliability and durability in industrial environments

CONCLUSION

The forward reverse circuit control system is a circuit where when we press the on button, the motor will spin forward, or if we previously pressed on two, the motor will spin in the opposite direction; in this circuit, there is a safety system where we use the Thermal Overload Relay (TOR) component.) namely the safety of an electric motor that works when there is an overload; this TOR works by cutting off the electric current to the contactor coil so that the motor stops working and is marked with a red indicator light; apart from that this circuit has the most core safety system, namely the interlock which works by using two timers off delay, the working principle is that when the motor is rotating, we cannot reverse the direction of rotation before the motor turns off, and after we turn the motor off, we cannot immediately start the motor because the timer is counting down after the countdown is finished then we can restart the electric motor. We can find this circuit in our daily lives, such as elevators and escalators.

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