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A Star-Delta starter is an electromechanical device used to start and control the speed of a three-phase induction motor. This starter employs the star-delta (Y-Δ) method for starting the motor, which involves changing the motor’s winding connection from a Star configuration to a Delta configuration once the motor reaches a certain speed. The Star-Delta starter includes a control circuit that typically consists of a timer, contactors, and overload relays. When the motor is started, it is initially connected in a Star configuration to reduce the starting current, which can be up to 6 times the motor’s full-load current. After the motor reaches a specific speed, the timer switches the winding connection to a Delta configuration to ensure the motor operates efficiently. This starter is widely used in industries where high-power motors are required, such as in oil and gas, mining, and manufacturing. The star/delta starter offers several advantages, including reduced starting current, better control of inrush current, and reduced stress on the motor windings during starting. However, it also has some disadvantages, including increased cost and complexity, longer starting time, and reduced torque during starting. In this tutorial, we will demonstrate the automatic star-delta (Y-Δ) starting method for 3-phase AC induction motors. This will include providing a schematic, power and control, PLC ladder, and wiring diagrams. We will also explain how the star-delta starter works and discuss its applications, as well as its advantages and disadvantages. Working of the Automatic Star / Delta Starter using Timer Automatic Star Delta Starter with Timer For Three Phase Motor On the left-hand side, there is the main contactor with a pneumatic timer. The main contactor is always energized. In the middle, there is the Delta contactor, which is equipped with a thermal overload for motor protection in the event that the motor exceeds the ampere rating set on the thermal overload. On the right-hand side, there is the Star contactor, which is the first contactor to be energized with the main contactor. When the timer reaches its time limit, the Star contactor de-energizes, and the Delta contactor energizes. This allows the motor to run at full load. Related Motor Control & Power Diagrams: Operation & Working of Automatic Y-Δ Starter The phase current flows from L1 to the thermal overload contact through an MCB/MCCB or general fuse, then to the OFF push button, On push button interlocking contact 2, and then to K3. The circuit is thus completed, and both contactor coil C3 and timer coil (T) are energized simultaneously. As a result, the motor winding is connected in Star, and when K3 is energized, its auxiliary open links will close, and the close links will open. Consequently, Contactor K1 is also energized, and the Three Phase Supply reaches the motor. Since the winding is connected in Star, each phase will receive √3 times less than the line voltage, which ensures safe motor starting. The close contact of K3 in the Delta line opens, preventing the activation of contactor 2 (K2). After the push button is released, Timer coil and coil 3 will receive a supply through Timer contact (Ia), Holding contact 3, and the close contact 2 of K2. When Contactor 1 (K1) is energized, the two open contacts in the line of K1 and K2 will close. For a specific time (generally 5-10 seconds), the motor will be connected in Star. After that, the Timer contact (T) will open (which can be adjusted by rotating the timer knob to set the time again), and as a result, Contactor 3 (K3) will turn off, and the open link of K3 (in the line of K2) will close, causing K2 to energize. When K3 is off, the star connection of the winding will also open, and K2 will close, connecting the motor winding in Delta. Contact 2 (which is in the line K3) will also open, preventing the activation of coil 3 (K3). Now that the motor is connected in Delta, each phase will receive full line voltage (415V), and the motor will start to run at full speed. Related Post: Wiring, Power & Control Diagrams of Star Delta Starter Power Diagram Click image to enlarge Power Circuit Diagram of Star Delta Starter Schematic Wiring Diagram Click image to enlarge Control Diagram Click image to enlarge Control Diagram of Star Delta Starter using Timer Control Circuit Diagram of Star Delta Starter with Timer Click image to enlarge Automatic Star-Delta (Y-Δ) Starter with Timer for 3-Phase Induction Motor Wiring Diagram of Y-Δ Starter using PLC Ladder Diagram of Y-Δ Starter using PLC We have published an article that specifically covers the programming of a Star/Delta starter using a Programmable Logic Controller (PLC). The article includes detailed explanations and illustrations of the ladder, power, and control circuit diagrams for the setup. Related Posts: Legends and its Abbreviations: L1 , L2, L3 = Brown, Black, Blue (3 Phase Lines) CB / MCB / MCCB = General Circuit Breaker Main = Main Supply Y = Star Δ = Delta T = Timer K1, K2, K3 = Contactors O/L = Thermal Overload Relay NO = Normally Open NC = Normally Closed K1/NO = Contactor Holding Coil (Normally Open) Advantages & Disadvantages Advantages: Simple design and operation. Comparatively cheaper than other voltage controlling methods. The torque and current performance of the Y-Δ starter is good. It draws two times the starting current of the FLA (Full Load Ampere) of the connected motor. It reduces the starting current to approximately one-third compared to a DOL (Direct ON Line Starter). Related Posts Disadvantages Starting Torque is also reduced to one-third because the starter reduces the starting current to one-third of the rated current [as Line voltage is also reduced to 57% (1/√3)]. It requires six leads or terminals for a Delta-connected motor. For Delta connection, the supply voltage must be the same as the rated motor voltage. At switching time (from Star to Delta), if the motor does not reach at least 90% of its rated speed, then the current peak may be equally high as in a Direct ON Line starter(D.O.L), thus causing harmful effects on the contactor’s contacts, making it unreliable. We should not use a star-delta starter if the required (application or load) torque is more than 50% of the three-phase induction motor’s rated torque. Related Posts: Characteristics & Features of Star-Delta Starter The starting current is 33% of the full load current for a star-delta starter. The peak starting torque is 33% of the full load torque. The peak starting current is 1.3 to 2.6 times the full load current. Star-Delta starters can be used only for low to high power three-phase induction motors. They have reduced starting current and torque. Six connection cables are needed for the motor terminal box. In a star/delta starter, there is a current peak and high transmission on mechanical load during the changeover from star to delta. Applications As we know, the main purpose of a star-delta starter is to start the three-phase induction motor in Star Connection and then switch to Delta Connection during operation. It’s important to keep in mind that a Star-Delta starter can only be used for low to medium voltage and light starting torque induction motors. In the case of direct on-line (D.O.L) start, the current drawn by the motor is about 33% of its rated current, and the starting torque is reduced by about 25-30%. As a result, the Star/Delta Starter is suitable only for light loads during motor starting. Otherwise, a heavy-load motor won’t start due to the low torque available during the acceleration phase while converting to the Delta connection Related Tutorials and Resources used in Power & Control Wiring Diagrams for Motors The power and control circuits of a star-delta starter are discussed in this article with the help of an actual star-delta starter wiring diagram. You can find the instructions to calculate the ratings of contactors for a star-delta starter circuit here: Star-Delta starter design tool. Further operation in detail can be found here: Star-delta starter (Wye-Delta Starters) – Circuit, working.The wiring diagram for a 132kW star-delta starter used for a condenser pump is shown below:Star delta starter wiring diagramThe diagram can be divided into two parts: The power circuit & control circuit.The power circuit of the starter consists of the following components:MCCB (Q1) : Protects the circuit from short circuits.Contractors : Main (1KM1), star (1KM2) and delta (1KM3). For switching.Overload relay. (OLR1) For protection against overloads.Terminals. (TB-X1) For motor connection.The control circuit of the starter consists of the following components:MCB (Q2): For circuit protection.Operation mode selection switch (1S1). For selecting the mode of operation. When turned towards hand mode, the starter is triggered immediately and when turned towards auto, the circuit is triggered only when an external command is received from BMS/PLC/DCS.Coil and auxiliary contacts of Main (1KM1), star (1KM2) and delta (1KM3) contactors.Star delta timer (1T2): Timer that switches the star and delta contactors.Indication lamps (1L1, 1L2): For starter status indications.When the selector switch 1S1 is turned towards hand and the overload relay is not in trip position, the star contactor 1KM3 is turned on instantaneously, The timer IT2 and the main contactor 1KM1 are now turned on through the auxiliary contact of 1KM3. After a time delay, the timer auxiliary contacts 15-16 changes over to 15-18, thereby opening 1KM3 contactor and after a very short delay, the timer auxiliary contacts 25-26 changes over to 25-28, and the delta contactor 1KM2 is closed, thereby completing the star delta transition.When the selector switch is turner towards auto position, the above mentioned sequence will start when start command is received from the BMS between the terminals TB-X1: 1 and TB-X1: 2.On the occurrence on motor overload, OLR-1 contacts 95-96 opens, thereby tripping the entire circuit.The run indication 1L1 turns ON along with main contactor and the trip indication 1L2 turns on when the OLR trips.star delta panel-wiring diagramDownloadStar delta starter circuitDownload The power and control circuits of a star-delta starter are discussed in this article with the help of an actual star-delta starter wiring diagram. 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The alternating current allows the motor to start and stop smoothly without any jerky movements. A timer is then used to control the start and stop of the motor. When the timer reaches the specific time that is set, the motor will start and stop as programmed.The star delta starter wiring diagram with timer pdf includes information about the voltage and current limits, the wiring diagram for the motor, and the timer settings. This diagram also includes information about the safety features that are included with the starter. These include an overload protection switch, a low voltage cut-out relay, and an emergency stop switch. All of these features work together to ensure that the motor is operating safely and efficiently.By following the star delta starter wiring diagram with timer pdf, anyone who is unfamiliar with this type of wiring can easily install and use the system. This makes it easier for those who do not have experience with wiring to install this system correctly. 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