

MODULE 4

TESTING AND SPEED CONTROL OF INDUCTION MOTOR

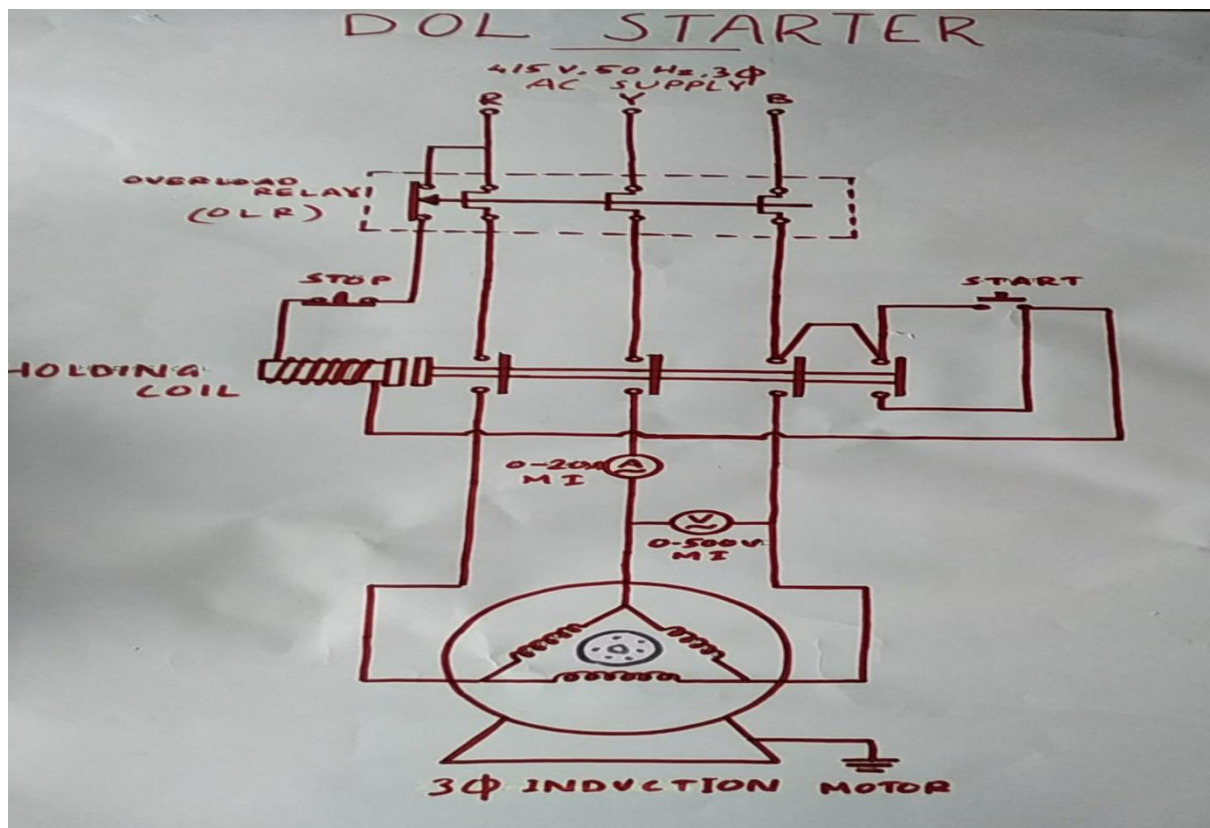
STARTERS USED FOR IM

WHY STARTERS ARE NEEDED: When IM started directly, it takes a huge current. This starting current value is around six to ten times of rated current of IM. If this huge current flows through winding of the motor, the motor burns. large current is taken by the motor for starting also causes voltage dip in the system.it affects the working of other machines connected to that system. Therefore, starting current of the IM must be reduced. To reduce it we use starters.

Starters used for squirrel cage IM starting

1. DOL STARTER (Direct online starter)

It is a simple and inexpensive starter.it is very easy to install and maintain. So, it is very commonly used. In this starter , full line voltage is applied directly across the IM. So, it takes a huge current. This starting current value is around six to ten times of rated current of IM. If this huge current flows through winding of the motor, the motor burns. large current is taken by the motor for starting also causes voltage dip in the system.it affects the working of other machines connected to that system. So the use of DOL starter is used for starting of 3 phase induction motors having capacity less than 5hp. It is a simple and inexpensive starter.it is very easy to install and maintain. So it is very commonly used



It consists of

1. 2 nos of push button switches. one is Start button switch which is normally open and other is Stop button switch, which is normally closed.
2. holding coil used for holding contacts
3. overload relay (OLR) to disconnect motor supply when motor is overloaded.
4. main contact- 3 nos of main contacts are present..
5. Auxiliary contact-it help to keep holding coil energised after ON push button is pressed

Working of DOL Starter

When start button is pressed (which is normally open), the current flows through holding coil. It energises Holding coil. This energised holding coil closes the three main contacts. Now the supply will come across motor winding terminals. The auxiliary contact helps to energize the hold on coil after the start button is released. Therefore motor gets supply even when start button is released.

When stop button (which is normally closed) is pressed, the supply through holding coil will break. So holding coil is de-energised. So main contact will open. So the supply to motor winding terminal is disconnected.

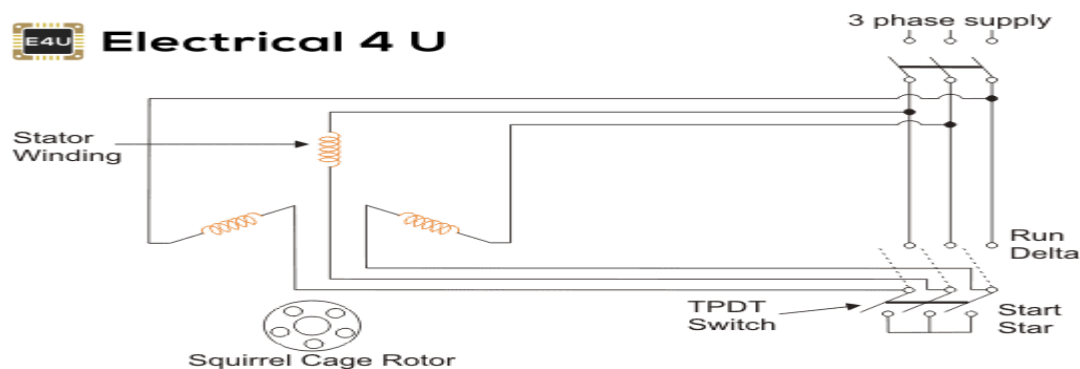
When overload is happened during motor working condition, OLR operates and disconnect the supply through holding coil. This makes main contacts to open. Thus, the supply to motor winding terminal is disconnected.

If supply voltage fails or supply voltage reduces below certain value, the main contacts will open and the motor stops. Therefore it provides under voltage also.

2. STAR-DELTA STARTER

- It is a widely used reduced voltage starter
- This starter is used for squirrel cage IM having delta connected stator winding. . It consist of one TPDT(Triple pole Double throw)switch.

Working principle

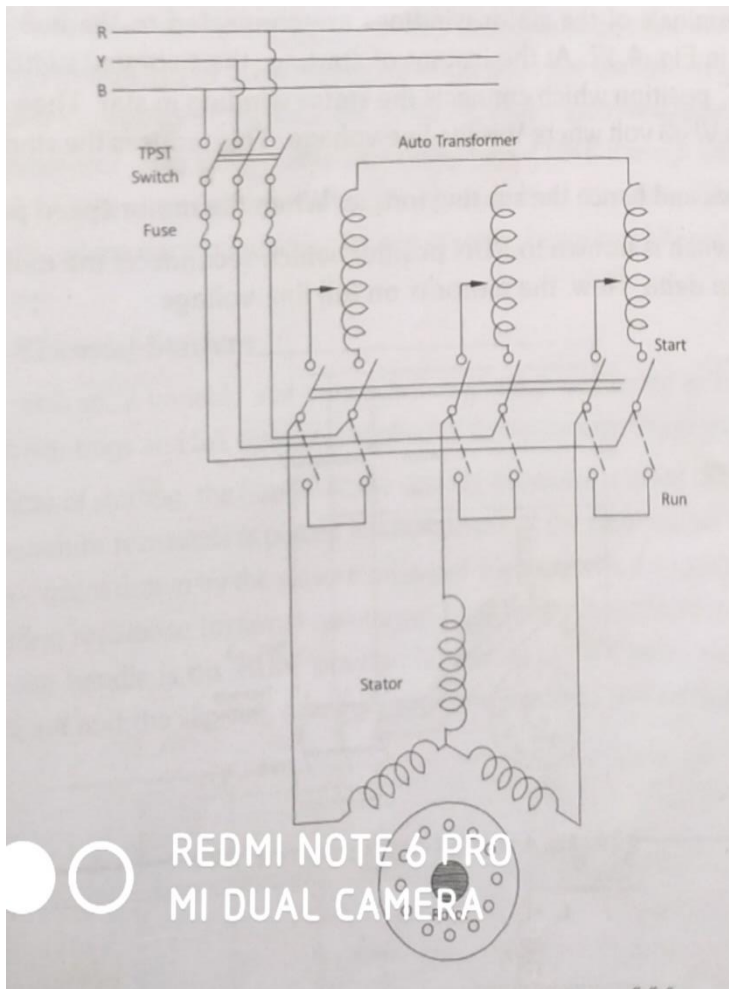


- For starting of IM, star delta starter TPDT switch is placed in the star side. Now the windings will become in star connected. When winding is in star, the voltage across each winding will be $1/\sqrt{3}$ times the line voltage. So the starting current will reduced to $1/3$ times. When motor is attaines a sufficient speed, the TPDT switch will be changed to delta side. Now the winding become delta connected.
- This starter is commonly used for IM having rating between 5hp and 20 hp

3. Auto transformer starter

- It is a widely used reduced voltage starter

- This starter is used for squirrel cage IM having star and delta connected stator winding.



- It consists of auto transformer with suitable tapping points and a TPDT switch.
- During starting, TPDT switch is placed in start side. Now the voltage input to the motor at starting is reduced by x times. So the starting current taken by the motor reduces x^2 times.
- After motor attained sufficient speed, TPDT switch is placed in the run position. Now the auto transformer is cut out of the circuit and full supply voltage comes across the IM

4. Stator resistance starter or Rheostatic starter

- It is a reduced voltage starter
- In this method we add resistor in each phase between the motor terminal and the supply mains as in diagram. Thus, by adding resistor we can control the supply voltage to motor x times the full supply voltage (x is less than 1). so, the starting current taken by the motor reduced by x times.
- After motor attains the sufficient speed, this stator starting resistance is cut out from the circuit.

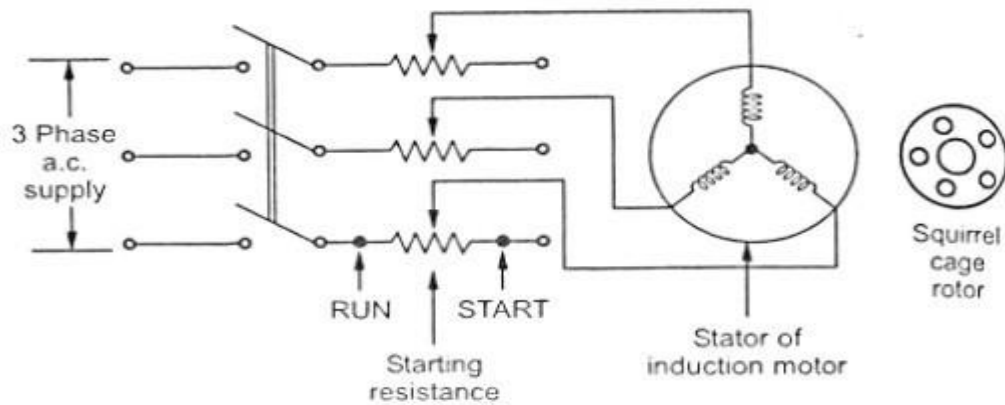
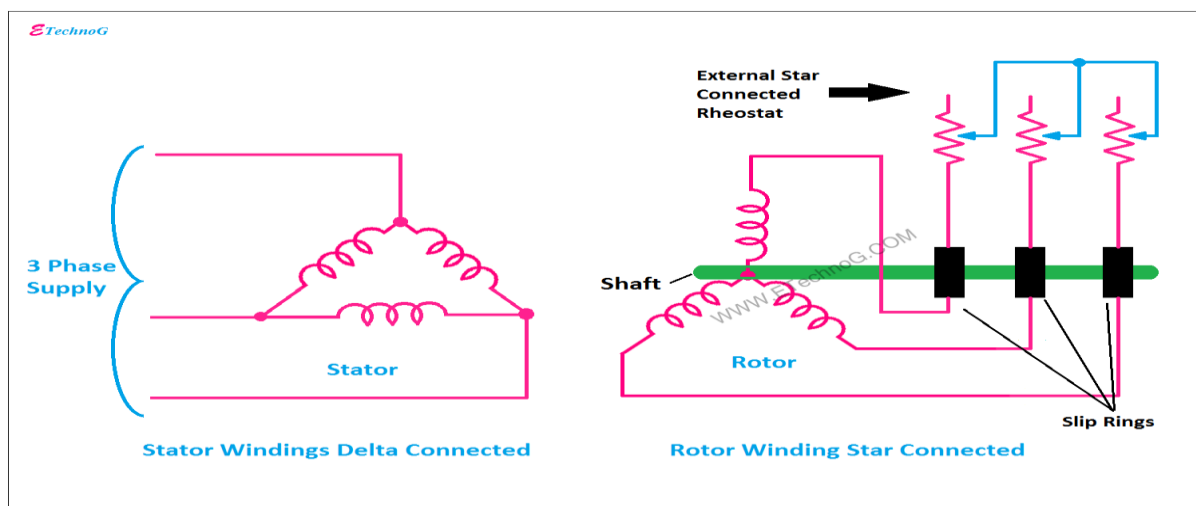


Fig. 7.3.1 Stator resistance starter

- This method is limited for small rated squirrel cage IM

Starters used for Slip Ring IM starting

1. Rotor Rheostatic Starter



- This starter is used for slipring IM starting
- In this starter a variable star connected rheostat is connected to the rotor winding through slipring.
- At the time of starting, the rheostats are placed at maximum resistance position. So the starting current will be less.
- When the motor gains sufficient speed, the rheostat is cut out from the rotor circuit
- This method not only limit the starting current, but also increases the starting torque.

Electrical Breaking

Stopping or reducing the speed of motor by electrical methods is called electrical breaking. There are 3 main types of electrical breaking.

1. Plugging

It is done by interchanging any two phases of IM. This leads to development of torque in opposite to direction of rotation of the IM. This torque acts as breaking torque and using this torque breaking action takes place. After breaking operation is completed, interchanged phases are taken back to old position.

2. Regenerative Breaking

This breaking is achieved by running the IM at a speed higher than synchronous speed of the motor. Now the slip of induction motor becomes negative. So IM acts as induction generator. Now the direction of torque in Induction generator will be opposite to direction of torque in Induction motor. So this opposite torque acts as breaking torque and using this torque breaking action takes place. The main advantage of this breaking is during breaking period electrical power developed by induction generator is fed back to supply source.

The main condition needed for this is rotor speed should be greater than synchronous speed of the motor. It can be achieved either by running rotor at very high speed by external means or by reducing synchronous speed of the motor using variable frequency drives.

This breaking is called regenerative because, during breaking period electrical power developed by induction generator is fed back to supply source.