



Install a Motor Control System Using Three-Wire Control

Program: Electrician Technician

Course: EL170 – Motor and Industrial Motor Controls

Objectives: Under the supervision of your instructor, you should be able to do the following:

- Identify contactors and relays, both physically and schematically, and describe their operating principles.
- Interpret motor control wiring, connection, and ladder diagrams.
- Connect motor controllers for specific applications according to *National Electrical Code® (NEC®)* requirements.
- Make all connections for a magnetic motor controller controlled by two pushbutton stations, including the connections for holding the circuit interlock.

Lab Equipment:

- Project board (plywood sheet or equivalent)
- 1 - 120V/24V secondary-fused control transformer
- 1 - 120-volt pigtail with cap (plug) to energize transformer
- 1 - Magnetic starter (any NEMA size) with a 24V coil and a minimum of one set of latching contacts
- 2 - Pushbutton stop-start stations

Required Tools:

- 1 – Flathead Screwdriver
- 1 – Phillips screwdriver
- 1 – Pair of wire cutters
- 1 – Pair of wire strippers
- 1 – Pair of lineman pliers
- 1 – Marker
- 1 – Continuity tester

Materials:

- 25' - Red 14 AWG THHN
- 5' - White 14 AWG THHN
- 1 - Book of wire numbers (tags, labels, etc.)
- 6 - Screw-mount 6- or 8-inch cable ties (Tyraps® or equivalent)
- 6 - Sheet metal or wood screws for mounting stop-start stations, magnetic starter, and securing cable ties

Safety (PPE):

- Goggles or safety glasses with side shields must be worn when cutting and stripping wiring.
- Only 24 volts should be connected downstream from the transformer's secondary fuse block to the stop/start stations and magnetic starter. 120 volts should only supply the primary side of the transformer.
- Designate the fused transformer secondary conductor as L1 conductor.
- Designate the unfused transformer secondary conductor as L2 conductor.
- Run L2 directly from the transformer's secondary side to the L2 terminal on the magnetic starter.
- The only wire terminated within the stop-start stations or latching contacts on the magnetic starter is L1.



- Avoid wild wire strands when terminating conductors to the switches and starter terminals.
- Use screw-mount cable ties and screws to neatly secure completed wiring bundles to the project board

Resources: N/A

Instructor Notes:

- Make sure the secondary side of the transformer is fused with a maximum fuse rating of one ampere.
- Verify that L2 (unfused transformer secondary conductor) is wired directly from the transformer to the L2 termination point on the magnetic starter. This prevents a potential short circuit that may be caused by any miswiring of the stop-start stations.
- Stress neat workmanship in installing and securing the wiring.
- If the stop-start stations do not function as intended during the testing phase, de-energize the circuit and have the trainees troubleshoot their circuit using the drawing provided and a continuity tester.

Time Required: 120 Minutes

Shop Maintenance:

- All work will cease 20 minutes prior to the end of class.
- All work areas must be cleaned.
- Tools and equipment must be cleaned and returned to the designated areas (cage, tool room, cabinets etc.)
- Any broken or missing tools must be reported immediately.
- Tools and equipment are student's responsibility.

Procedures: (Eye protection must always be worn)

This performance project requires the trainee to install two momentary-contact stop-start stations and associated wiring that control the coil of a magnetic starter.

1. Mount the stop-start stations and the magnetic starter to the project board, like the layout shown in Figure 1.
2. Carefully review the schematic drawing in Figure 2.

WARNING!

Verify that the 120-volt supply pigtail to the transformer primary is disconnected from the AC supply.

3. Install a section of white wire from the unfused secondary side of the transformer to the L2 terminal on the magnetic starter. This terminal is usually located on the overload relay assembly.
4. Before wiring the stop-start stations, remove one knockout plug (if applicable) on each station enclosure to allow wire entry.
5. Install three pieces of red wire between Stations A and B, and two pieces from Station B to the magnetic starter.
6. Label each end of each wire between Station A and Station B as 1, 2, or 3, and the two wires from Station B as 2 and 3 on each end.
7. Prepare the wire ends and terminate the wiring in Station A, Station B, and on the magnetic starter latching contact as shown in Figure 2.
8. Neatly secure wiring bundles to the project board using screw-mount cable ties and screws.
9. Have your instructor check your wiring before installing the station covers, then install the covers.
10. Energize the control circuit by plugging in the AC supply pigtail to a 120-volt receptacle.
11. Press the Start button on Station A. The starter coil should energize, and the starter contactor pull in.
12. Press the Stop button on Station A and the starter coil should de-energize.
13. Repeat Steps 10 and 11 for Station B, looking for the same results.
14. If any switches do not respond as intended, unplug the circuit and troubleshoot your installation using a continuity tester and the schematic.

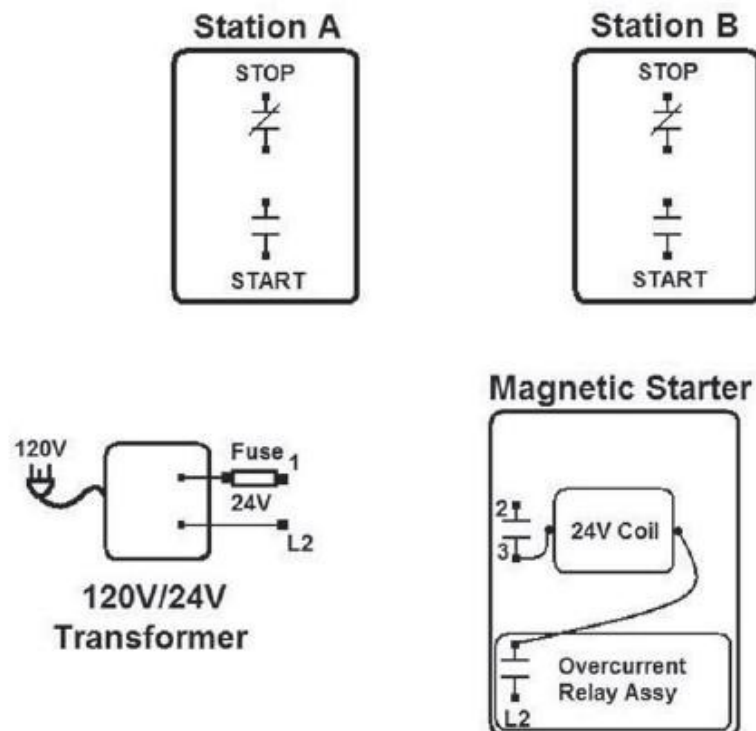


Figure 1 ■ Stop-Start Station and Magnetic Starter Physical Layout

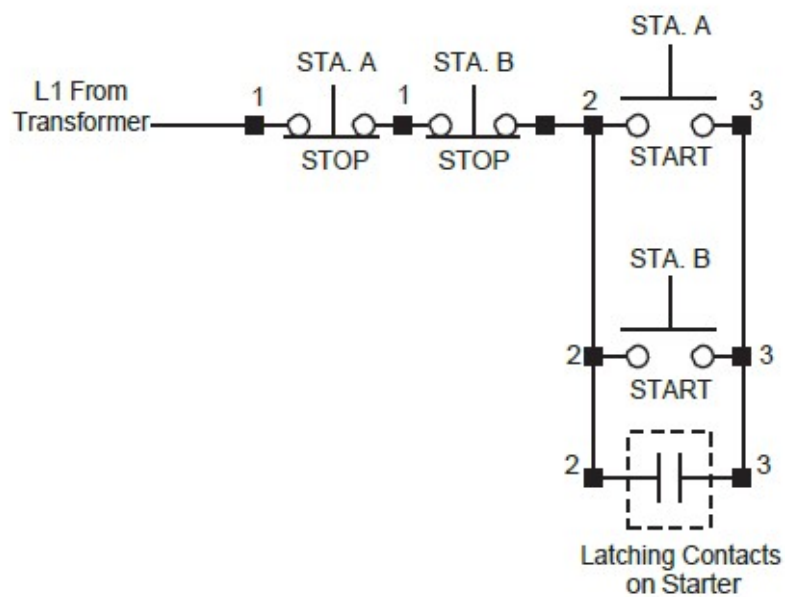


Figure 2 ■ Three-Wire Control Wiring Schematic