

# Motor Controls & Starters Low-Voltage

4.5 Days, 3.6 CEUs

The low-voltage motor control center (MCC) plays a vital role in controlling motors and production processes. Now more than ever, out of sequence motor operation, failure of timers, control relays, limit switches and other critical components carry a high cost. Over the years, MCCs have evolved from cabinets that housed basic electromechanical devices such as circuit breakers, contactors, and overload relays to centers of automation that may include variable frequency drives, starters, and programmable logic controllers. This course offers effective MCC maintenance and troubleshooting techniques that enable technicians to ensure correct operation of the control scheme, reduce repair times and identify problems in control circuits from the manufacturer. Class participants learn to design basic ladder diagrams for motor control circuits then wire up the circuits on simulators.

## Who Should Attend

This hands-on course is intended for new or experienced electricians and technicians that install, maintain, repair or troubleshoot MCCs rated 600 volts or less. The participant should have basic knowledge of AC/DC electricity.

## Learning Objectives:

Upon completion of this course and lab practice, the participant will demonstrate by attaining a minimum average of 80% (between lab and final exam), that he/she is able to:

- Describe the application of motor control pilot devices.
- Interpret MCC wiring diagrams and schematics.
- Describe control circuit types and show the application of two-wire control, three-wire control, reversing circuits, sequence control, jogging and inching circuits.
- Describe the methods of deceleration, reduced-voltage controls, speed controls, and operating principles of variable frequency drives.
- Troubleshoot motor control circuits utilizing a multi-meter.
- Design and wire various motor control circuits.

## SCOPE

### Day 1\*

#### I. Safety

- A. Working with Low-Voltage Equipment
- B. More Than One Source of Voltage
- C. Hazards Around Motor-Control Centers
- D. Disconnection of Motors While Troubleshooting

#### II. Description

- A. Components
- B. Interlocks
- C. Relays
- D. Contactors

### Day 2

#### III. Common Control Circuits

- A. Two-Wire Control
- B. Three-Wire Control
- C. Reversing Circuits
- D. Jogging Circuits
- E. Labs (8 Hours)
  - 1. Design and Build
    - 2 Wire Control
    - 3 Wire Control
    - Reversing Circuit
    - Jogging Circuit

#### IV. Practical Exercise

- A. Design Ladder Diagram
- B. Wire Circuits from Design
- C. Test Circuits
- D. Troubleshoot Circuits

#### V. AC Controls for Reduced Voltage Starters

- A. Primary Resistor
- B. Autotransformer
- C. Wye-Delta
- D. Solid-State

#### VI. Methods of Deceleration

- A. Plugging
- B. Dynamic Braking
- C. Electric Braking
- D. Friction Brake

### Day 3

#### VII. Speed Control

- A. Wound-Rotor Motor Control
- B. Two-Speed Motor Control
- C. Consequent Pole Control
- D. Introduction to Variable-Frequency Drives

#### VIII. Motor Overloads

- A. Thermal
- B. Magnetic
- C. Solid-State
- D. Selection

### Day 4

#### IX. Testing

- A. Insulation Resistance
- B. Contact Resistance
- C. Fuses
- D. Contactors

#### X. Troubleshooting

- A. Safety Precautions
- B. Techniques
- C. Using Test Equipment
- D. Common Problems in Starter Circuits

### Day 5

#### XI. Review & Final Exam

\*Class scheduling times may vary based on discussions and size of class

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## STANDARD EQUIPMENT LIST

### MOTOR CONTROLS AND STARTERS LOW-VOLTAGE

REVISED: 02/27/2014

COURSE NO. 307, REV 2

BY: DEAN BARTLETT/JJ

DAYS: 4.5

<b>TEXT (PER 1 STUDENT)</b>	
<b>QUANTITY</b>	<b>ITEM</b>
1	MCSLV STUDENT PACKET
1	<i>ELECTRIC MOTOR CONTROL FOR INTEGRATED SYSTEMS</i> /American Technical Publishers (ATP) 5TH edition
1	<i>ELECTRICAL MOTOR CONTROLS FOR INTEGRATED SYSTEMS-WORKBOOK</i> /American Technical Publishers (ATP) 5TH edition

<b>MATERIALS NEEDED (PER CLASSROOM)</b>	
<b>QUANTITY</b>	<b>ITEM</b>
*1	PROJECTOR OR TV WITH PROJECTION CAPABILITIES
*1	DRY ERASE BOARD WITH MARKERS AND ERASERS
*10	STUDENT TABLES
*10	STUDENT CHAIRS

<b>EQUIPMENT (PER 1 STUDENT)</b>	
<b>QUANTITY</b>	<b>ITEM</b>
1	CALCULATOR (TO BE RETURNED W/ EQUIPMENT)
1	RED PENCIL
1	12" RULER
1 PER 2 Students	CAT III MULTIMETERS WITH TEST LEADS - (GREENLEE OR EXTECH)
1 PER 2 Students	MCC SIMULATORS CONTAINING COMPONENTS & TOOLS

<b>EQUIPMENT (PER CLASS)</b>	
<b>QUANTITY</b>	<b>ITEM</b>
1	ROLL OF 16 GAUGE STRANDED MTW WIRE (BLACK 5LWY1 GRAINGER #)
1	ROLL OF 16 GAUGE STRANDED MTW WIRE (WHITE 5LWY3 GRAINGER #)
1	3-PHASE GRACTIONAL HP MOTOR
1	INSULATION RESISTANCE TESTER (1KV)
1	MOTOR CONTROL TOOL BOX
1	BOX OF MISC MOTOR CONTROL COMPONENTS

FOR VIRTUAL CLASSES:  
 CONTENT MATERIAL WILL BE PROVIDED IN DIGITAL FORMAT

NOTE: All items indicated with an asterisk (\*) must be supplied by the client on On-Site courses