

## **BASIC LADDER LOGIC PROGRAM**

### **❖ OVERVIEW**

This course is for users working with Programmable Logic Controllers (PLCs) in general who require familiarity with the basic concepts of PLCs and the unique language they use, Ladder Logic. This course is a must for anyone interested in moving to automation in the production, assembly, or testing of manufactured goods. The introduction of Ladder Logic is designed as an entry level program taking users into the world of PLCs, which are evident in most manufacturing environments today. This course is designed as a primer for advanced levels of interfacing with PLCs and their programming.

### **❖ AUDIENCE**

The course is intended for technicians, electricians, mechanics, maintainers, engineers, and anyone starting to work with programmable logic controllers.

### **❖ PREREQUISITES**

Students should have a basic understanding of electro-mechanical control devices and electrical circuits. Basic electrical knowledge, including the ability to read schematics is desirable. A familiarity with basic computer structure and operation is helpful.

### **❖ OBJECTIVES**

Upon completion of this course, the student is able to:

- Demonstrate a knowledge of the basic operating principles of PLCs.
- Describe typical applications of PLCs in industry.
- Recognize and use the symbols used in ladder logic.
- Understand and convert decimal numbers into binary, binary coded decimal, and hexadecimal numbering systems used in ladder logic control.

Enclosure A

### **❖ OBJECTIVES (Continued)**

- Understand common ladder logic programming terms.
- Utilize ladder logic symbols in basic control programs.
- Experiment with a PLC digital test workstation to troubleshoot mechanical and electronic "bugs".
- Configure I/Os electronically.
- Develop or modify a basic PLC program in ladder logic.
- Run and de-bug a program.
- Compare and evaluate common digital controls to their analog counterpart.

### **Basic Ladder Logic Course**

#### **Unit 1**

Ladder Logic Overview, Historical Background, Relays - Advantages/Disadvantages, Principles of PLC Operation, Typical Areas of Application, Features and Benefits of PLCs.

#### **Unit 2**

Mind-Mapping, Flow Charting, Conventional Electrical Control Symbols, Discrete Inputs, Discrete Outputs.

#### **Unit 3**

Numbering Systems Structure and Uses for Decimal, Binary, Octal, Binary Coded Decimal, Hexadecimal, ASCII Codes, Gray Codes, Boolean Logic Symbols, Number Conversion.

#### **Unit 4**

Ladder Language Basic Symbols, Relay-Type Instructions, Timer and Counter Instructions, Arithmetic Operations, Data Manipulation Operations, Data Transfer Operations, Program Control Operations, other Ladder Instructions.

### **Basic Ladder Logic Course (Continued)**

#### **Unit 5**

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Ladder Logic Processing, Ladder Logic Processing Sequence, Significance of Scan Time, the Watchdog Timer.

### **Unit 6**

Program Functions, Up/Down Counters, Timers, A Real-Time Clock, ADD, SUB, MUL, DIV, Registers, Computer Memory Data Storage, Fahrenheit to Centigrade Calculator.

### **Unit 7**

Program Examples, Motor Start/Stop Circuit, One-Shot Signal Initialization Using an MCR, System Start-Up Horn, Oscillator Circuit, Self-Resetting Timer, Annunciator Flasher Circuit, Push-to-Start/Push-to-Stop Circuit, Pumps Filling a Tank.

## **METHOD**

Each lesson in the PLC Program has been designed for use with groups of 2 to 10 trainees. Objectives are clearly stated at the beginning of each lesson in terms of performance. New concepts are graphically presented and immediately applied in a variety of work-related situations. Software, hardware, work sheets, and training models are combined in the exercise portion of the lesson for maximum effectiveness.

Although practice is stressed above "reading," each trainee receives a set of Fact Sheets with every lesson as well as basic course supplies. When the program is completed each trainee retains a set of permanent reference materials.

Test Materials are designed to measure trainee ability to select and apply appropriate concepts in typical work situations. While not every shop application can be anticipated, each instructor is encouraged to adapt the lessons as he sees fit to suit specific company applications.

Since all trainees do not progress at the same rate of speed, supplementary materials are provided both for instructional use and for the trainees to work with between classes.

Enclosure A

## **SCHEDULING CLASSES**

Each of the seven (7) units of this Basic Ladder Logic Training Program is approximately two to three (2-3) hours. In most cases, the lessons consist of a 90-minute learning period interrupted by a 10-minute "break" followed by a 20-minute test period.

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It will take a total of about twenty (20) hours to complete this program.

Ideally, the program is presented for three-and-one-half to four consecutive full days. If scheduling such a large block of time is not possible, the program can easily be broken down into convenient two hour lessons spread out over twelve to fifteen days.

### **TRAINING MATERIALS AND RESOURCES REQUIRED**

1. A laptop computer.
2. The Electrical Skills Test Device
3. The Digital Interface Panel
4. A scientific calculator capable of converting numbers in binary, decimal or hexadecimal formats.