EMC and PLC
Training Implementation
Suggestions and Guidelines

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About Us

Welcome to Industrial Text & Video (ITV), the leader in automation and electrical textbooks and video training programs since 1986. With over 150 years of combined program developers' practical, hands-on experience, we provide training solutions in two major areas—*Electrical and Motor Controls* (EMC) and *Programmable Logic Controllers* (PLCs).

While focusing on these two industry-driven areas, we have also taken into consideration the different knowledge levels within each facility. With this in mind, our programs start from basic levels and gradually move to more advanced levels of comprehension. This approach makes our training versatile enough to be used for introductory learning or serve as a refresher to the expert. And through our proprietary training methodology of *View-It-And-Do-It*[SM] you're sure to apply your knowledge right away.

Our Training Design

We have designed our training products to provide solutions to information seekers serious about solving their automation, mechanical and electrical related problems that occur everyday. We welcome you and challenge you to make a difference in your facility with products designed to give you the content, convenience, consistency and cost-effectiveness you need to make your job easier.
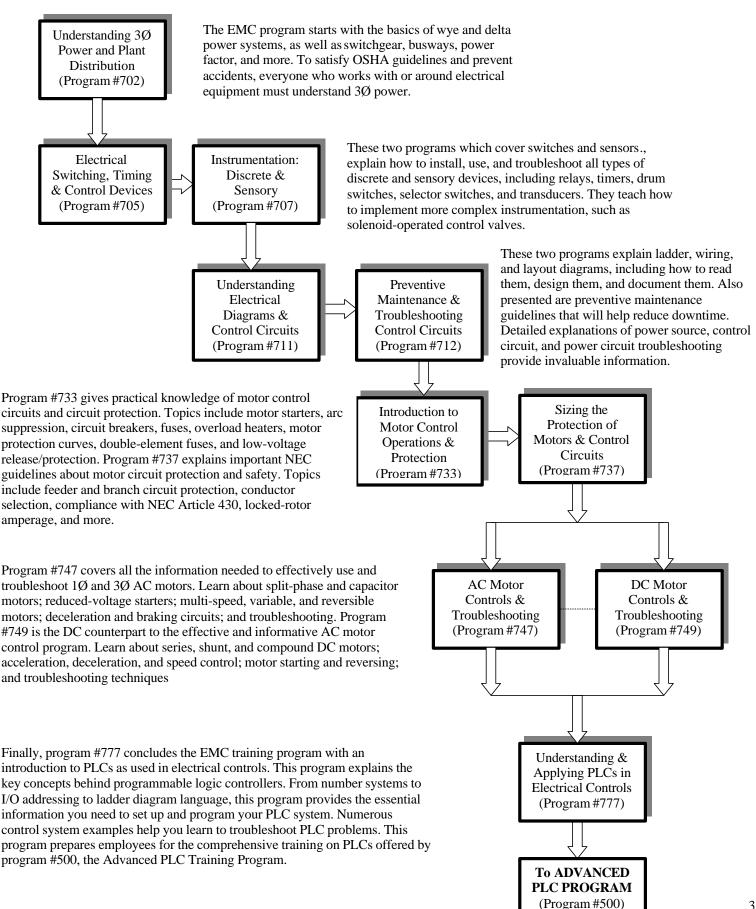
If your facility is equipped with a wide range of PLCs and electrical motors then you are not alone. Like automobiles, all PLCs and motor controls operate the same; they just have different features. This led us to concentrate on the similarities among the different equipment. By adopting and using this "generic" approach, it made our training materials applicable to all makes and models of PLCs and motor controls. So whether it be Siemens, GE Fanuc, PLC Direct, Allen Bradley, or Mitsubishi—no problem! Our PLC and electrical controls training programs offer a solution.

About This Document

This document is provided with the purpose of suggesting possible guidelines for implementing our EMC and PLC training solutions in your manufacturing plant. These two training products, available from Industrial Text and Video (ITV) are designed to help you build and maintain your team of skilled technicians. Our programs cover the most critical and fundamental skills that your maintenance department needs to know in the most important maintenance areas. Each program includes videos, ECS testing software, and one student kit, which includes a video reference handbook and a course completion certificate.

Although the EMC training program may be purchased individually, it is intended to be used as a complete series for training, where each training program progresses from the previous one in content and applicability. Our series on PLCs is a comprehensive training program applicable to all makes and models of PLCs without requiring any prior PLC knowledge. The program starts off with the basics, thoroughly explains the hardware section of the controller, moves on to both basic and advanced programming topics, and wraps up with proper system implementation guidelines.

Typical Electrical and Motor Controls (EMC) Training Program Implementation and Sequence Guide

Understanding 3Ø Power and Plant Distribution (Program #702)

The EMC program starts with the basics of wye and delta power systems, as well as switchgear, busways, power factor, and more. To satisfy OSHA guidelines and prevent accidents, everyone who works with or around electrical equipment must understand 3Ø power.

Electrical Switching, Timing & Control Devices (Program #705)

Instrumentation: Discrete & Sensory (Program #707)

These two programs which cover switches and sensors., explain how to install, use, and troubleshoot all types of discrete and sensory devices, including relays, timers, drum switches, selector switches, and transducers. They teach how to implement more complex instrumentation, such as solenoid-operated control valves.

Understanding Electrical Diagrams & Control Circuits (Program #711)

Preventive Maintenance & Troubleshooting Control Circuits (Program #712)

These two programs explain ladder, wiring, and layout diagrams, including how to read them, design them, and document them. Also presented are preventive maintenance guidelines that will help reduce downtime. Detailed explanations of power source, control circuit, and power circuit troubleshooting provide invaluable information.

Program #733 gives practical knowledge of motor control circuits and circuit protection. Topics include motor starters, arc suppression, circuit breakers, fuses, overload heaters, motor protection curves, double-element fuses, and low-voltage release/protection. Program #737 explains important NEC guidelines about motor circuit protection and safety. Topics include feeder and branch circuit protection, conductor selection, compliance with NEC Article 430, locked-rotor amperage, and more.

Introduction to Motor Control Operations & Protection (Program #733)

Sizing the Protection of Motors & Control Circuits (Program #737)

Program #747 covers all the information needed to effectively use and troubleshoot 1Ø and 3Ø AC motors. Learn about split-phase and capacitor motors; reduced-voltage starters; multi-speed, variable, and reversible motors; deceleration and braking circuits; and troubleshooting. Program #749 is the DC counterpart to the effective and informative AC motor control program. Learn about series, shunt, and compound DC motors; acceleration, deceleration, and speed control; motor starting and reversing; and troubleshooting techniques

AC Motor Controls & Troubleshooting (Program #747)

DC Motor Controls & Troubleshooting (Program #749)

Finally, program #777 concludes the EMC training program with an introduction to PLCs as used in electrical controls. This program explains the key concepts behind programmable logic controllers. From number systems to I/O addressing to ladder diagram language, this program provides the essential information you need to set up and program your PLC system. Numerous control system examples help you learn to troubleshoot PLC problems. This program prepares employees for the comprehensive training on PLCs offered by program #500, the Advanced PLC Training Program.

Understanding & Applying PLCs in Electrical Controls (Program #777)

To ADVANCED PLC PROGRAM (Program #500)

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Typical Programmable Logic Controllers (PLC) Training Program Implementation and Sequence Guide

Section 1: PLC Fundamentals

Module 1: Introduction to Programmable
Controllers
Module 2: Number Systems and Codes—
Their Uses and Application in
Module 3: Logic Functions and Their
Relationship with PLCs

Section 1 includes three modules. The first module provides a basic understanding of PLCs and shows typical PLC applications. The second module explains the different number systems used in PLCs and shows how ASCII and BCD codes are stored in internal registers. The final module of this section thoroughly explains the logic functions and shows how they are used to implement PLC output circuits and sequences. All of the information presented is related to actual applications employees are likely to see in the plant.

Section 2: PLC Operation

Module 4: General CPU Operation, Memory
System and PLC I/O
Module 5: Discrete Input/Output System
Module 6: Analog Input/Output System

Section 2 includes three video modules and explains in detail the hardware section of the controller. The first module describes the CPU, I/O scan, mapping, and sequencing. The second module explains discrete (ON/OFF) I/O and the wiring and programming of these devices. The third module covers, in great detail, analog I/O including signal understanding, data representation and handling, as well as I/O interfacing and connection. Throughout the modules, real-life control examples are presented to prepare you for proper application and troubleshooting.

Section 3: PLC Programming

Module 7: PLC Instructions and Control
Software Programming, Part 1
Module 8: PLC Instructions and Control
Software Programming, Part 2
Module 9: PLC Instructions and Control
Software Programming, Part 3

Section 3 includes three video modules that explain all the aspects of PLC programming. The first module covers the basic instructions as well as ladder format, logic continuity, and scan order evaluation. The next module progresses into how to use and apply the many different types of timers and counters. In addition, instructions that apply to PLC program flow control— GOTO, GOSUB, and MCR—are also explained. Finally, the last module wraps up programming by covering advanced functions, such as how to handle I/O data, block transfers, Boolean Mnemonics, and much more. In order to learn how to program any PLC, the programming instructions throughout this section relate to real-life situations.

Section 4: PLC Implementation

Module 10: PLC Control System
Implementation and
Programming

Section 4 puts all the concepts learned throughout the training series into action. This module explains how to implement a PLC-based system and provides guidelines to ensure a safe installation. We use real-life examples to illustrate both the implementation and programming steps so that you can relate to actual situations seen on the shop floor.

Instructor's Guides and Assessment Tools

Both programs (EMC and PLC) include two optional methods for assessing students. One is utilizing the Electronic Courseware Series (ECS), ITV's easy-to-use software, and the other is using a manual method which uses hard copy test to be given to students. Both methods are provided with instructor's guide and answer key (for manual exams) to aid the instructor in the teaching of the EMC and PLC subjects as presented in the previous program implementation guides.

Tools for Student Practice and Assessment Methods

The table below illustrates the two methods available from ITV to provide assessment to students. Under the two methods (manual and ECS) there are two modes which include Student Practices and Students Exams/Test. If the chosen method for assessing students is utilizing the ECS, it is recommended that the instructor also suggest to the students that they also practice using the manual mode. In this manner, practice on the subject matter is reinforced.

Method	Practice Mode	Exam/Test Mode
Manual (utilizing video handbooks and hard copy tests)	▪ Utilizes the Review Question section of the student's video handbook ▪ Provides relevant questions on the topic covered ▪ Manual interaction with student ▪ How Did You Do? section provides solutions to the Review Questions with explanations of the correct answer	▪ Uses hard copy test to be given to students ▪ Tests the student's expertise on the subjects covered ▪ Answers provided in the Instructor's Guide and Answer Key ▪ Requires manual grading of exam
ECS (utilizing testing software)	▪ Training Units provide questions about each topic covered ▪ Provides feedback that lets student know if answer is right or wrong to enhance the practice experience ▪ ARM–Automatic Reinforcement Mode is a feature that automatically ask the student another question on the same topic if he/she answers the original question incorrectly ▪ Provides practice score	▪ Final Exams provide questions to students from a random pool of questions on the subjects covered ▪ Provides a final score so students can immediately see their test results ▪ Information about the student's score on the exam can be reviewed by the instructor using the Administrator feature of the ECS software

Frequently Asked Questions (FAQs) and Training Methodology

How often should training modules be viewed?

Because the EMC and PLC training programs are comprehensive and detailed, it is recommended that your students view no more than one EMC program or one PLC video training modules per week. This will give them enough time to complete the recommended pre- and post-assignments. Additionally, it is a good idea to allow groups of two or three students to view the programs at the same time. This makes learning about PLCs a team effort. The students may consult each other with questions on the subject and help each other with the review exercises.

What should students do *before* each training video?

Students should read the brief Introduction, Instructional Objectives, and Module Review of each training module before they watch it. Before viewing the module, you might also want to raise some questions dealing with what they are going to be learning in a module. It is encouraged to have students read the actual material on the video handbook since it provides the actual content of what is presented in the video. In this manner students can be reinforced with the video presentation and can better assimilate the subject matter being covered.

What should students do *during* each training video?

While viewing each training module, students should follow along in their video guides/handbooks. The video guides also contain all the graphics shown in the videos, making it easy to follow along. Additionally, spaces are provided in the video guide for taking notes. By taking notes in the video guides, the student's notes will be right next to the subject that they concern. These notes, along with the handbook, can serve as a great on-the-job reference tool.

What should students do *after* viewing each training video?

Practice Session:
> After viewing a module, the students should complete the Practice for that module whether using the manual or ECS method. In the manual method, after they finish the review questions, they should go over the answers to find their results. The answer to the questions are located in the How Did You Do? section of the video guide. Next, allow students to ask any questions and let them work as a team to come up with solutions to problematic questions. In the ECS method, as students answer the questions, any wrong answers are reinforced with a follow-up question, thus ensuring a clear understanding of the subject matter.

Exam Session:
> Upon completion of the review questions and review of the answers, students may take the Module Exam for that part of the program using the manual or ECS method. However, if their performance on the review questions was unsatisfactory, they might want to review some parts of the video module before giving them the exam. If you are using the manual method, grade the exams using the Exam Solutions located in this instructor's guide. Correct the exams and include any additional comments or suggestions concerning the student's performance. We recommend that students get at least 70% of the exam questions correct before continuing on to the next module. If you are using the ECS method you can review the students score using the Administrator tool. A complete hard copy of all the ECS questions and correct answers for the EMC and PLC programs is also available. Please remember that there are over 1200 questions per program.

What can students use as reference after viewing each training video?

The instructor may, at his/her discretion, recommend further reading on the subjects covered in the EMC and PLC training programs. The EMC program provides ten student handbooks that contain the complete content of each video program and provides an excellent reference for the student. More information on the PLC topics in the PLC program can be found in the *Programmable Controllers-Theory and Implementation* textbook which comes with each student kit. Refer to the table of contents to assign extra reading. Studies have shown that, upon successful completion of a training module, the student is at a stage of positive encouragement. This means that, if given the opportunity for further training, the student will want to learn more on the subject. *The Programmable Controllers-Workbook and Study Guide* may also be used as a training aid. A companion to the PLC book, it contains topic summaries and additional study questions that students can review at their own pace.

What about certification?

After watching the EMC and PLC video series, completing all the study questions, and successfully passing the modules exams, students may be awarded their Training Certificates.

Typical Student EMC and PLC Training Flowchart

View
EMC and PLC
Training Program or
Module

Perform
EMC and PLC
Training Program or
Module
Assessment **Practice**

Ready For Exam

Perform
EMC and PLC
Training Program or
Module
Assessment **Exam**

Exam Score
Greater Than
Minimum
Required?

Review
EMC and PLC
Training Program or
Module Again

View Next
EMC and PLC
Training Program or
Module